

Clinical Practice in Interventional Radiology

Volume I

Patient Care
Risk Factor Management
PAD
Carotid Stenting
TACE in HCC and NET
UFE
Vertebroplasty

Version 0.1

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From the CIRSE Task Force on Clinical Practice in IR

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Foreword



Interventional Radiologists have done pioneering work in the development of image guided minimal invasive therapeutic procedures such as angioplasty and embolization, biliary and urinary stenting and fluid drainage. In focusing on doing procedures IRs have been slow to become involved in the clinical care of their patients. Often, IRs still act upon referrals with patient interaction prior to the procedure reduced to the bare minimum and little control over the overall treatment plan for the patient. However, to act as a real doctor and not only as a technician IRs have to take care of the patient before and after the procedure. In more complex cases this may occur in an interdisciplinary way. Direct patient care in the postprocedure period and longitudinal follow-up of the patient is mandatory.

This manual is intended to help IRs promote themselves directly to referring physicians as specialists in assessing and treating organ systems or diseases. It makes a strong case for greater clinical involvement of IRs and offers practical guidance on what to look out for when setting up a hospital-based clinic or, as the case may be, a private office. Following on from the opening chapter on principles of clinical care, a chapter each is dedicated to the resources required in each of these two basic scenarios. A further chapter deals with marketing. Enlarging one's patient base is one of the obvious immediate challenges faced by anyone intent on promoting a new business service. There is, moreover, a general need to increase awareness amongst the public, patients and referring doctors of the wide range of minimal-invasive treatment options offered by interventional radiologists today.

The greater part of the manual offers clinical guidance on the medical conditions, indications and treatment options the interventional radiologist needs to be aware of in order to provide informed counsel to patients. For the sake of readability the information provided has been reduced to a minimum. It goes without saying that the information offered presents the bare bones only, with much of the meat to be found in the dedicated literature.

A chapter on cardio-vascular risk factors serves as an introduction to common conditions such as the metabolic syndrome, hypertension, diabetes and cardiovascular disease. This is expanded upon in a chapter dedicated to peripheral vascular disease which many interventional radiologists dedicate most of their time to. This chapter as well as all the following chapters that deal with specific conditions and their interventional treatment focus on the indications for imaging and intervention, diagnosis, treatment, medication and aftercare. In turn carotid stenting, hemodialysis fistulas, hepatocellular carcinoma, neuro-endocrine tumours, uterine fibroid embolization and vertebroplasty are discussed. Sample medical history, physical, and vascular examination forms can be found in the annex.

We hope that some of the ideas and methods which have been born out of long-standing practice and experience and are now shared through this manual will encourage you to seek greater involvement in clinical practice for your own benefit and that of the discipline.

Change is never easy and will feel daunting at first. Yet, with a bit of preparation and taking one step at a time, greater clinical involvement is certainly within easy reach of most of us.

In a second part we will prepare a manual for the management of emergency and complicated situations in the cathlab or during the postprocedure period.

Johannes Lammer
Chair, CIRSE Clinical Practice Taskforce

Principles of Clinical Care

(Partially adapted from the SIR Manual: Setting up & Running an Office-Based Clinical Practice, SIR 2005)

An Interventional Radiologist (IR) should act as the patient's primary doctor for treating a disease process – rather than merely performing a procedure.

BENCHMARKS OF CLINICAL PRACTICE

Accept referrals from hospital clinicians and primary care physicians for treating disease processes as the sole or primary consultant for the disease process.

- Perform and bill for consultations and referrals for patients before and after planned or elective interventions.
- Routinely inform patients referred for diagnostic services of the spectrum of therapeutic options that might benefit them and provide interventional treatment if they desire.
- Routinely establish treatment plans and implement them without requiring the participation of another specialist. Other medical or surgical specialists would be consulted if the situation requires.
- Admit patients to the interventional service and provide inpatient care before and after therapeutic interventions.
- Clinical IRs should have admitting privileges at a hospital and routinely admit patients who require interventional treatment to their service. However, admission for unanticipated medical problems, such as congestive heart failure, or poorly controlled diabetes, patients can be handled by another service as appropriate.
- Provide longitudinal patient care. This requires interventionalists to see patients in an outpatient setting in the pre-procedure period for assessment and discussion of the potential outcomes, clinical benefit, and complications of the procedure. In addition, IRs should follow patients long-term to assess outcomes, recurrence, or development of new problems.

Incorporating these features into an IR practice requires changing not only the way IRs practice, but also the way they relate to other specialties and hospitals. This can be challenging, but it is what our patients deserve.

Interventional Radiologists as clinical practitioners

There are essentially two options for interventional radiologists in the future:

- Hospital-based interventional radiologists continue to accept referrals for “procedures”. Their schedules will be filled passively with services that no other specialty wants to provide.
- Interventional radiologists run their own practice from either within or outside the hospital accepting referrals, organising the patient's treatment, and performing the procedures themselves.

The future of IR, as we see it, lies with the second option. IR should be a cognitive, office-based, competitive specialty capable of competing in an environment where cardiologists and surgeons offer similar services. Those who cling to the technical or procedure model, who rely on their exclusive contracts and hospital franchise, will eventually lose to other competing clinical specialties.

THE NEED FOR AN OFFICE

The clinical office-based practice is essential to be able to compete with any of the other specialists who have long-established clinical programs and referral networks. The office is the centre for

- **Coordinating and performing pre- and post-procedure evaluations** and for communicating back to referring physicians – and most importantly, their patients. Like other clinicians, clinical IRs will take the patient's history, perform the physical examination and the imaging studies prior to any intervention.
- **Imaging studies** typically ordered by primary care physicians may allow clinical IRs the advantage of access to patients before their competitors.
- **Informed consent** should be obtained before the procedure and the best setting for this is during a preprocedural assessment in an outpatient clinic. Informed consent is the legal embodiment of the concept that each individual has the right to make decisions affecting his or her well-being. Details of the proposed treatment, common and serious side effects and the probability of success should be discussed with the patient. The patient should be made aware of alternative treatment options available. The patient should receive appropriate information through verbal, written and other educational aids to enable them to make an informed decision.
- **Follow-up:** Clinical IRs should evaluate and see their patients for routine follow-up. This might also involve Doppler ultrasound examinations. Clinical IRs should have a defined protocol and tracking programme that will enable them to follow their patients indefinitely.
- **Post-procedure reports** and letters should be sent not only to all referring clinicians, but should be given to the patient for their own follow-up records (as well as post-procedure instructions and a follow-up plan). Copies of these letters should be sent to all doctors important in the care of the patient, not just the referring doctor. Such letters should have a letterhead that reflects the practice's interventional focus. The letters should not resemble X-ray reports.

CLINICAL IR: THE COMPETITIVE ADVANTAGE

- Interventional radiologists offer **services with low morbidity and mortality** compared with surgical alternatives. Many internal medicine specialists often consider it a failure of their treatment to send the patient for surgery. Medical specialties in general consider invasive procedures, including surgery, to be extremely risky, and traditionally have focused more on the risk than on the benefit. Similarly, patients are very concerned about morbidity and mortality, and many are sophisticated enough to often seek out interventional radiologists for consultation for their disease process.
- Interventional radiologists can also present themselves as ideal **gatekeepers** for invasive therapy. A natural paradigm for referral would be medical treatment first, followed by minimally invasive therapy if medical treatment fails, followed by open surgical procedure if interventional therapy fails. Surgeons in general are poor gatekeepers for interventional procedures. Often, patients with suitable lesions for minimally invasive intervention undergo more invasive, riskier, open surgical procedures if surgeons are consulted first.
- Interventional radiologists have a **"high-tech" image**, with access to the latest treatments and technologies, as well as expertise in complex imaging services such as CTA and MRA. They are potentially viewed as offering more modern therapy than competing specialists. Interventional radiologists can present themselves to the referring community as a minimally invasive, non-surgical specialty.

In the past many interventional radiologists believed that they were not capable of managing patients. This is ironic because interventional radiologists routinely show ingenuity in their daily work and have mastered many complex surgical procedures such as portosystemic shunts, endografts for aneurysms, arterial stenting, etc.

Additionally, current IR training includes a clinical internship, four to six months of interventional radiology during residency, and one year of interventional radiology. The total clinical experience of an interventional radiologist is often 2.5 years or more. This is similar to clinical training in internal medicine or paediatrics. IRs undergo substantial clinical training that compares favourably with medical or surgical training.

Managing patient care is well within the capability of most interventional radiologists. Indeed, the bar is not high if one examines the performance of other “clinical” specialties. Compliance by generalists or specialists with published guidelines for management of hypertension, hyperlipidemia, diabetes, and numerous other conditions has been shown consistently to fall far short of the mark. Interventional radiologists are capable of clinical care at least as good as that described for other clinical specialties.

There may be concern among non-interventional radiologist partners about setting up a clinical office. It is worth taking the time to present the reasons for adopting a clinical practice. Clinically, it is better for the patient. Financially, it adds well-reimbursed, complex interventional procedures and sophisticated ancillary imaging work to the group case load. Marketwise, it positions the group for growth in the area of minimally invasive procedures, which is increasing substantially in volume.

ORGAN SYSTEM AND DISEASE FOCUS VS TECHNIQUE FOCUS

Interventional radiologists must promote themselves directly to referring physicians as specialists in assessing and treating organ systems or diseases.

Adopting this approach to promoting their clinical practice will help to position clinical IRs as a clinical expert in the areas where they want to focus their practice – rather than as a “jack of all trades” technician not involved with clinical assessment. The result will be an increase in direct referrals for clinical evaluation and treatment.

The classic technical model of IR no longer suits the needs of referring doctors, patients or IRs because of the breadth and depth of available therapies. Primary doctors want and expect to send patients for evaluation, work-up and management. Patients also expect this service, and once they have met and been seen by a physician, they develop a trust and expectation that the same physician will continue to take care of them. Vascular surgeons who offer endovascular techniques are well positioned to capture that market regardless of their skill level. IRs must offer the same breadth of patient care not only to compete, but also to give patients the benefit of their knowledge and skill in minimally invasive treatments.

To compete with other clinical services, clinical IRs must offer comparable clinical care. Otherwise, therapeutic interventions are diverted from IR, leaving the less desirable work.

What's in a Name?

What you call yourself is important. Interventionalists should popularize the use of the preferred term, “vascular specialist” with primary physicians. Emphasizing the fact that you provide clinical care will dispel the notion that interventionalists “do not treat the whole patient.”

Setting up an outpatient office

In order to become a clinical specialty, clinical IRs should establish a clinic to see patients before and after IR procedures. These clinics will usually be located within the hospital where the interventional radiologists have their practice, although they may be outside the hospital.

Setting up a Hospital Based Outpatient Clinic

An outpatient clinic achieves several objectives:

- **Declaration of clinical interest:** It shows hospital-based clinical specialists and primary care physicians outside the hospital that you are a practising clinician in your own right.
- **Problem-solving:** Rather than being the recipient of request forms "ordering" you to perform a procedure. You can be regarded as a problem solver i.e. patients should be referred to you with a clinical problem and the choice should be left up to you to decide on the course of imaging investigations required to achieve a diagnosis and the choice of procedure needed to effect treatment rapidly.
- **Pre-procedural assessment:** Patients can be assessed in the setting of a well-run clinic, very different to the suboptimal method of preprocedural assessment outside (or even inside) the interventional room immediately before the procedure. An accurate history of the patients' symptoms can be taken and a targeted clinical examination can be undertaken at relative leisure. This enables the Interventionalist to have a full understanding of the patient's clinical history and their clinical signs. As a result, the Interventionalist can decide on an appropriate course of action with regard to diagnostic tests and interventional procedures. Appropriate haematological examinations (e.g. full blood count, blood chemistry, coagulation) can be arranged at this time. This means that the Interventionalist is in full possession of the relevant information when the time comes to perform an interventional procedure.

Patients benefit from pre-procedural assessment because they gain a full understanding of the procedure and if there are options of treatment available, the patient is given time to consider the different options without being rushed into a decision.

- **Informed consent:** Consent can be obtained during the preprocedural assessment visit and patients can be provided with relevant patient information sheets or booklets.
- **Patient comfort:** There is little doubt that patients are much happier if they see doctors who perform operations on them in a different setting and at a time removed from the actual procedure itself. During the preprocedural visit, patients feel that they are allowed to fully express themselves in conveying the full story of their problem to the doctor. They leave the consultation content in the knowledge that the doctor who is to operate on them has all the information necessary to enable them to make the right decisions. They also have a chance to meet the Interventionalist and form a relationship which will make it easier to undergo any future invasive procedures when they patient and the IR next meet.

- **Follow-up:** Patients can be followed up after their procedure by the physician who has performed the procedure. This benefits the IR and the patient. The IR is informed whether the procedure has been successful or not, and can make a decision as to whether further procedures or imaging investigations are required, or if the patient can be discharged back to the referring clinician or to the community. At the end of this visit, the majority of patients will be discharged back to their referring physicians. The IR should undertake to write a comprehensive letter detailing the results of the patients imaging investigations, the interventional procedure performed and the outcomes with suggestions for any future investigations or procedures likely to be needed.

RESOURCES

You will usually need to approach their hospital managers to ask for the necessary resources required to run an outpatient clinic. These should include a consultation room, personnel and an allocated regular time in the week for these resources.

- **Room:** The optimal arrangement is to have two rooms - a room for consultation and an examination room where patients can undress and dress in privacy. Although ideal, this is not essential and the consultation and examination may take place in the same room if space is not available for two rooms. Whether one or two rooms are available, there should be adequate space for a desk for the consultation, and an examination table. For the consultation, there should be enough room for one IR doctor and one assistant, and space for 2-3 people on the other side of the desk - a patient and 2 relatives; with a computer terminal for accessing blood results and preferably PACS, and a transcription device. For the examination, there should be an examination couch with blankets, a hand held Doppler, stethoscope, sphygmomanometer, access to phlebotomy, and possibly an ECG machine. A diagnostic quality portable US machine is desirable.
- **Personnel:** The personnel required to run an IR Clinic are:
 - The interventional radiologist, a clinical assistant if available, or an experienced clerical officer,
 - A nurse - preferably IR trained,
 - A receptionist or a scheduler.
- **Time:** The most critical aspect of any successful IR clinic is the ability to manage time. Under no circumstances should you schedule a procedure - no matter how short - at the same time as the clinic. Patients do not appreciate being kept waiting unnecessarily. It is better to schedule fewer patients initially, than too many. It is sensible to allow 30-45 minutes for new patients and 15-30 minutes for follow-up consultations. Informed consent should be obtained at the initial clinic visit. There should be time allocated between consultations to allow time to write a detailed note into the patient's record and to dictate a letter to the referring clinician.
- **Planning:** The key to running a successful interventional radiology clinic is planning. The first impression you will make on setting up the clinic will generally be a lasting impression. Try to make sure that if referring doctors are tempted to refer patients to you with the promise of state-of-the-art clinical care that you can deliver this for their patients. You could easily alienate early clinical referrers by failing to provide an adequate service, making it that more difficult to win future referrals. You should make sure that your office support systems, including phones, business and clinical staff are all in place before you start to seek referrals. It will make a substantial difference to the service you will be able to provide if these have not been organised before you receive your first patients.

HOW TO ATTRACT REFERRALS TO YOUR CLINIC

The first thing that can be done is to divert patients who would usually be booked for a procedure to your outpatient clinics. This can be done in two ways:

- **Selective:** The person who answers the telephone in the hospital interventional radiology department, or who receives the request forms, would refrain from immediately booking patients for procedures. Instead, they would schedule some patients for consultation in your outpatient clinic. A protocol could be developed for guidance, which would state which patients should be directed to the outpatient clinic, and which should be booked directly for a procedure. The protocol could also be sent to your clinical referrers. This protocol would be expected to be changed from time to time, with increasing experience.
- **Inclusive:** All referrals to the IR department would be seen initially in the outpatient clinic before any procedures are scheduled. In other words, the practice of a clinician calling the IR department to schedule a patient for a procedure would be stopped altogether. Instead, all referrals would be provided with a clinic appointment prior to the intervention. Although, attractive in theory, the main drawback of this system would be the potential large volume of patients involved. It may not be possible to see all of the patients in the clinic if the resources for the clinic are finite.

Whichever system is adopted will likely depend on local preferences and the availability of resources.

Setting up a Private Office

The secret to success of interventional radiology are patients.

In many countries, interventional radiologists work in state-supported hospitals and supplement their income by working in private diagnostic radiology practice. The clinical reasons for having an office are similar to the previous section. However, an additional factor to consider in the case of a private outpatient office is that the aim of the office is also to attract work for private income.

As a true clinician the modern interventional radiologist sees patients before and after performing a procedure. Many IR practices have established a clinic within the hospital to review the indication and to discuss the procedure with the patient. They are ingrained with the hospital-based model and might be concerned about failing in a competitive, office-based environment. However, outpatient private offices are better suited to meet patients because of a relaxed atmosphere and the generally easy accessibility compared to a hospital.

To become a true clinical specialty, setting up an outpatient practice or office seems to be a logical step and necessity for interventional radiologists. "If you don't have an office, you aren't a doctor". At least as far as the rest of medicine is concerned. By creating a private practice with patient follow-up, interventional radiologists are no longer a "hired-gun" simply performing the procedure requested of them by referring physicians. They are able to document, learn from, and teach the clinical aspects of patient care relevant to their expertise and the effects of any procedure they subsequently perform.

There are several reasons to set up a private IR office in addition to those described in previous chapters:

- to meet patients outside the hospital, because radiological departments are usually designed for procedures rather than consultations
- to provide a relaxed atmosphere of the office compared to the generally more difficult accessibility of a hospital
- no interruption by emergencies

- no need to navigate hospital politics to set up the facilities you need to offer as a clinician
- to potentially build referrals by showing your referring community that you are serious about clinical practice
- to change the attitude of other competing specialists about a subordinate role that interventional radiologists have in patient care, and be willing to form equitable collaborative agreements
- dependent on the national health care system, insurance companies may try to move smaller procedures away from the hospital to outpatient offices by giving financial incentives
- to establish admitting privileges under your name and thus become an important referral source to the hospital. Thus, interventional radiologists may potentially provide increased leverage in negotiations over hospital credentials. You are no longer a contract worker, but become a good customer.

RESOURCES

The keys to successfully opening an IR office are careful planning, a good location, an optimized schedule, a motivated team and marketing. Figuring out how to provide the seemingly humble medical office in your specific market is considered the key component of continued success for IR. Although setting up a medical office may be a common need, interventional radiologists can achieve it in several ways. Usually subleasing from another practice seems to be practical and cost effective. You may spend one to two half days per week seeing patients. The primary tenant or owner handles the logistics of stocking the exam rooms, allowing the tenant to just show up and go to work. Plus, subleasing also allows the interventional radiologist to pay only for the time he actually uses the facility. In general, this seems to be a better option than initially committing to leasing space on a full-time basis. It might be difficult to find sufficient, appropriate space to set up traditional examination rooms in an imaging centre setting.

Office staff

The office staff is another key for success. Your team must be dedicated to patient care. A full-time patient coordinator might be employed to handle scheduling, authorization, and other insurance issues, and manage charts. Friendly and competent ancillary personnel at the front desk and in the examination room will help to create a positive impression on the patients and will also create familiarity upon repeat visits. The coordinator may work from the radiology group's business office and should be accessible by phone for patients' routine questions or forward more serious questions to the interventional radiologist.

Optimized schedule

It's always better to schedule patient visits and procedures during separate blocks of time outside the hospital so they don't interfere with each other. Logistically, it can be done immediately by directing a person who answers the telephone in the hospital IR department to refrain from immediately booking patients who require consultation for procedures. Instead, they should schedule them for a consult in your private office.

An algorithm may be developed that will help patient schedulers determine which cases are diagnostic (these can be immediately scheduled) and which cases involve treatment of diseases requiring a consult. The algorithm should be posted next to the phone.

Ideally the patient would come to the clinic with some understanding of what the procedure is about. After the patient is seen in the office and a procedure is warranted, the interventional radiologist would call the scheduling secretary in the hospital IR department and schedule the procedure. The interventional radiologist would also have the option to schedule patients without a consult in the rare cases where the situation warrants it.

The primary task of a private practice is to see patients before and after IR procedures which are performed in a nearby hospital. However, with the increasing number and possibilities of minimal invasive procedures in IR, an outpatient practice can also serve as a location for small procedures. Possible procedures are the treatment of varicose veins with laser, ambulatory phlebectomy or sclerotherapy; dialysis access management including placement of tunnelled catheter, angiography and interventions on malfunctioning AV fistulas and grafts or vertebral augmentation procedures. It is obvious that the practice setup has to be adjusted to the level of procedure performed. It is helpful to have a close affiliation to a nearby hospital in case a sudden hospitalization is required.

One of the biggest risks for an IR practice is getting overloaded with referrals from primary care doctors that are not appropriate for the IR's expertise.

The solution is for the interventionalist to have a highly triaged patient population sent to their office, just as other specialists do.

The goal of triage is to ensure that the majority of patients evaluated are referred for procedures. This will prevent the IR from focusing too much practice time on managing cases that do not require specific IR interventions.

To establish yourself as a disease treatment specialist, you may find it necessary to offer more in-office diagnostic and management services that is ideal to produce the highest revenue. Interventional radiologists have to be considered as well-rounded vascular specialists, including managing wound care issues for patients with chronic venous insufficiency. If you don't provide these services for patients you are seeing, you may lose referrals from some primary care physicians.

CT and MR angiography and spine imaging have become increasingly important and interventionalists should be familiar with how to use these in their practice. However, be careful to keep it from becoming the focus of the IR practice.

Marketing

Marketing your services, while important in all settings, is very important if a private office is going to be successful. The subject of marketing is dealt with comprehensively in a separate chapter (please, see the relevant chapter in this manual).

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Resources required for a Hospital Clinical Service

BEDS

To have beds means that the department provides a full service and assumes responsibility from the admission to the discharge of the patient. Beds of the department are necessary as a reference for colleagues and patients, as well as to give the possibility of clinical support to patients from other hospitals.

The number of beds will depend on the size of the hospital, the number of patients treated by the department and the case mix. Many patients may be treated with day case procedures, some may stay for 2 - 3 days only and only a few will require a prolonged hospital stay.

The following points are to be considered to determine the number of beds:

- Total number of beds in the hospital
- Number of interventional treatments that require hospitalization
- Level of complexity of the procedures
- **Origin of referral**

Only from inside the hospital:

- For in hospital patients, we will use the beds pertaining to the department that has referred the patient to our IR department/required our service.
- A small number of IR beds (2-4) for those patients who come referred from other hospital departments after being discharged for additional treatment, or through outpatient hospital consultations.

From outside the hospital:

- We will use a higher number of beds (> 10) for our own schedule and patient organisation.
- We will also use hospital beds.

From our outpatient clinic

- In this case we can use either of the systems mentioned above.

The advantage of having own beds is to be able to manage the scheduling and organisation of patients, depending on the availability of beds in other departments. Another advantage is to be able to admit patients with pathologies that are not exclusively represented in the hospital by any one department.

The advantages to have patients in the wing of specific specialities, is to have the support of the colleagues of those specialities, as well as from the nursery.

It would always be convenient to have own beds. Although, if we are unsure about how many patients we'll have daily, it would maybe be better to have a minimum number of beds, and the rest depending on hospital availability.

Nonetheless it's convenient that some pathologies would be admitted in the areas related to each of them; i.e. if a patient enters the hospital for a TIPSS, he should stay in a bed of the surgery or digestive disease department.

Classification of Beds

- Day-case beds
- IR department beds
- Hospital beds

	Advantage	Disadvantage
IR beds	<ul style="list-style-type: none"> - Own scheduling - Freedom to set admission criteria 	More administration and staff required
Hospital beds	Hospital is in charge of the whole administration	No control of the 'when' and 'where' of the patients admission

	Invasive diagnostic	Interventional procedure	Complications after procedures	Emergencies	Complex cases
IR beds	X	X	X	X	X
Beds in other departments			X		X
Day care beds	X	X			

Use of beds depending on the type of intervention**STAFF**

The IR department will need staff as follows:

Physicians

Physicians are required for the following services:

- Angio-lab: 1 staff and 1 fellow/resident physician per procedure
- Outpatient office: this can be done daily for some hours or once the week
- Consultation service: this doctor can be responsible to manage emergency cases and can be called by other departments in case a consultation service is required
- Make sure you comply with the European Working Time Directive when organising night and weekend shifts.

Physicians' duties regarding hospitalized patients:

Day-case bed

- Admission
- Request consultations, labs, etc.
- Evaluation pre treatment + informed consent
- Post treatment same day
- Discharge

IR department bed

- Admission
- Request consultations, labs, etc.
- Evaluation pre treatment + informed consent
- Post treatment same day
- Minimum visits twice a day, during hospital stay: morning and afternoon
- Discharge

Bed in other departments

- Evaluation pre treatment + informed consent
- Post treatment same day
- Minimum visits twice a day, during hospital stay: morning and afternoon

Nursery

Areas to be covered by nursery:

- **Angio lab room:** It is highly advantageous to have trained nursery staff, for both cardiac and non cardiac interventional procedures, which will save time and money in terms of time spent on training. If they are generally trained in minimally invasive surgery they can also work for other specialities.
At least one nurse should assist the operating MD during the intervention and another one control:
 - Monitor cardiovascular stability
 - Maintain adequate ventilation
 - Maintain fluid balance
 - Provide physical and emotional comfort
 - Report any changes in patient status to the MDs
- **Outpatient clinic:** There should be at least one trained nurse, to collaborate in ankle-brachial index (ABI), wound management and catheter drainage patency, tube care, etc.
- **Inpatient beds:** It is important to have trained nurses who are familiar with IR procedures and the aftercare which is required after each of the procedures. For the own IR department beds and for the care of patients in other departments a training nurse or at least a special training course is recommendable. This is especially important regarding specific controls such as (in situ) fibrinolysis and specific pre and post IR treatment.

Technicians

Areas covered by supervised technicians:

- Some diagnostic non invasive proceedings, such as AAI, US.
- Preparation of the angiosuite room.
- Handling and providing the material for the operation.

If the department collaborates with an animal lab, a person in charge of investigation and experimental work should be considered.

Marketing in IR

The range of minimal-invasive treatment options offered by interventional radiologists has increased considerably over the last 25 years. However, knowledge about these therapies is scarce among the public, patients and referring doctors. This is a basic problem that interventional radiologists (IR) face and it is imperative that we take a more proactive role in the future. Marketing is an important tool to overcome this problem.

"Marketing is an organizational function and a set of processes for creating, communicating, and delivering value to customers and for managing customer relationships in ways that benefit the organization and its stakeholders."

Definition of the American Marketing Association, 2004

The principles of marketing outlined above can also be applied in Interventional Radiology. However, this is not a business book; the intention of this chapter is to share ideas which permit us to continue to progress in our work, developing our practice including diagnostic methods as well as minimal invasive therapies, maintaining our relationship with patients and referring physicians.

BRAND IDENTITY

Interventional Radiology is a difficult "brand". IR offers many different techniques for different diseases. As opposed to Gynecology, Surgery or Gastroenterology, IRs offer a broad range of treatment alternatives across traditional speciality borders. For marketing purposes this presents a big challenge since our product/service cannot be promoted under one unique name. Therefore it may be necessary to create a name which can be clearly identified by patients and referring doctors. The name may focus on a single disease or a clearly identifiable area of expertise.

Here are some examples

- The Fibroid Centre
- The Artery & Vein Centre
- Cardiovascular Institute
- Department of Medical Imaging and Minimal Invasive Therapy

To allow the reader to translate common business theory into his or her own medical practice we have selected three different areas (UFE, Vertebroplasty and PAD) where - beyond traditional pathways - knowledge of marketing principles is the key for success. These subchapters may be used as a "toolbox" for establishing these techniques within a given environment.

Marketing UFE

Traditionally IR has used in-house education of physicians to obtain referrals for their procedures. Although excellent cooperation with the gynaecology department is an essential prerequisite to offering UFE, it does not in our experience lead to increased awareness among patients and office-based gynaecologists and therefore to higher numbers of referrals. These groups need to be targeted directly through information events organized by IR and cooperating gynaecological departments which cover the spectrum of treatment options offered to patients with fibroids at their hospital. IR also need to position themselves as clinical partners with longstanding expertise in minimal-invasive image-guided techniques, something which is not known to many physicians in practice. Information events can easily be put on with a minimum of resources (standard power point presentations about UFE are available from CIRSE) and may be supported by clinic management as a good opportunity to promote the clinic in the local community. Do not forget to target general practitioners. They are often the trusted partners of women with symptomatic fibroids and have a deep understanding of quality of life issues. Lastly consider putting on an information event for women and opinion leaders from women's organizations.

An advanced integrated communication approach will include internet & e-mail, patient information leaflets and media activities as important marketing tools.

WEBSITE

A website offers a unique opportunity to reach patients with information about UFE directly. There is no loss of information through a third party, it saves time since patients can get information about the procedure and answers to some of their questions, it offers the possibility to present an image of your department and staff, it allows the patient to get in direct contact with you. The array of information that can be offered includes

- **Background information on the procedure:** History, safety & efficacy, comparison to other alternatives. Patients can download consensus papers for example to show their health care providers and referring physicians that UFE has been proven safe and effective.
- **The procedure in depth:** "Doc, what will happen to me during treatment?"
- **Question & Answers:** The most frequently asked questions can be answered.
- **Images & Movies:** As interventional radiology procedures are not "bloody", we can easily explain what we do via images and film clips without causing anxiety to the patient.
- **How to get in contact:** Be sure to allow patients to contact you via phone, fax or even e-mail. This can be time consuming but is essential. There is no such thing as an "easy referral" in UFE. Friendly, approachable office staff who can take calls and sort out which further steps need to be taken by the patient and whether additional direct contact is necessary can take some of the pressure off you. Reserve time for patient consultation.

Patient information leaflets

This is a simple way to offer comprehensive written information to women. Leaflets may be sent by email or by post on request and give the patient the opportunity to discuss the facts about UFE with their gynaecologists. It also allows you to give precise instructions about which kind of diagnostic and laboratory tests should be performed prior to UAE and which additional information is needed prior to hospital admission. This will save you time and compensate for the time expended on some of the extra activities described in this chapter.

Tip !

If the idea of creating an internet site seems difficult, start with the minimum - perhaps one page presenting your department with links to other sites containing more detailed information. The media studies department of a local further education college /university might be able to help you put one together for free as a student project.

MEDIA WORK

Media work is a challenging but also low cost and very effective communication tool. It is not about "selling" the procedure UFE, it is about educating the public and building confidence in interventional radiologists. The majority of IR practice is in a hospital which is embedded in the local community. Targeting patients from distant cities via national media may be worthwhile for large tertiary care or university hospitals ("the big names") but it is a strategy that is not appropriate for most IR, in any case most patients prefer to be treated nearer home. That is why it is essential to define your goals before approaching the media. You need to know, who you want to reach, what kind of information you want to give and identify what kind of press echo you expect. Media reports are a good way of drawing attention to and increasing traffic on your website.

How do you get in touch with the media?

- Write a press release. It is acceptable today to contact journalists by email. It is not difficult to write a good press release. There are rules to follow but they are simple. Here are some internet addresses with useful tips. Your press release should not be more than a page long (sample press release available from CIRSE).

http://www.ehow.com/how_8793_write-press-release.html

http://www.press-release-writing.com/10_essential_tips.html

- Put together a distribution list, i.e. email addresses of the editors of the newspapers, radio and TV stations which are read/listened to by the people you wish to reach. Local newspapers, radio and TV are very interested in local news. You can normally get a list of local newspapers/radio & TV by contacting the local chamber of commerce, town hall or local press club or journalists association. Newspapers/media are generally looking for personal stories. They need to be short but attractive to their audience. Therefore "big science" or "high tech" is generally not the key ingredient to deliver your message. Uterine fibroids are not a life-threatening disease such as cancer but an underestimated health problem with a tremendous impact on a woman's quality of life. That is the area to make a point. You are offering nonsurgical minimal-invasive treatment, which is highly effective and safe. Ideally, a patient story will transport the information you want to deliver. If you already treat patients by UFE, one of your former patients may be willing to explain how she experienced the procedure and the benefits to her personally, while you cover background and technical aspects. It is best not to criticize gynaecologists for not informing patients about UFE, since they are the primary caregivers and also your best friend in difficult cases. It is a good strategy to have one of your cooperating gynaecologists make a positive statement.

Patient groups and forums

Patient organizations and self-help groups are an established element of the health care system in many countries. A further development is the patient internet forum. It provides an easy way for women to get in contact with other fibroid sufferers and give each other psychological and emotional support. This can be useful as it may take a few months before the benefits of the treatment are felt by the patient. The moderator of a good forum will censure any attempts by members to give each other medical advice or influence choices, but will encourage women to research their options and to take a proactive role in their own health care, for example by actively seeking out a gynecologist who will give them a referral to your department. Two examples, one U.S. and one German forum, are presented below. If there is no patient forum in your language to which you can refer patients, you might encourage one of your patients to start one. Many of the women choosing UFE today are highly educated, professional women who will have the necessary skills to start and moderate a forum.

<http://de.groups.yahoo.com/group/myome/>

<http://health.groups.yahoo.com/group/uterinefibroids/>

Marketing Vertebroplasty

The majority of patients with back pain seek a way to avoid surgery. Minimal-invasive techniques may accomplish the same results as with open surgery and have quicker recovery and no or less hospitalization. Interventional radiologists (IR) are uniquely suited to treat back pain because they have an excellent knowledge of imaging technology and can perform image-guided procedures that target the source of the pain. In the management of spinal compression fractures secondary to osteoporosis, trauma, hemangioma, myeloma, and osteolytic metastasis, image-guided percutaneous vertebroplasty (PV) or kyphoplasty (PK) yield analgesic effects and augment mechanical stability by fortifying weakened segments of the vertebral column. PV and PK evoke images of competitive procedures and groups of entrenched physicians locked in turf battle. These procedures have grown exponentially in the past several years. The potential reasons for this phenomenon include aggressive marketing campaigns, the enfranchisement of neurosurgeons, orthopedic surgeons, and other nonradiologist practitioners and the pervasive trend toward minimal-invasive therapeutic procedures.

One big challenge of IR is getting word to colleagues and patients that radiologists are the right specialists to perform PV or PK. Medical marketing results from increased competition among healthcare providers, the advent of specialties and sub-specialties, and a growing number of health-savvy consumers.

Like vascular centres, pain centres may build on existing relationships participating physicians have established in their community. Pain centres may enjoy a built-in referral base, and may copy the various modes of marketing practiced by vascular centres.

THE WEB-DRIVEN PITCH

Many marketing plans are incorporating new technology, most specifically the use of websites. Prior to careful creation of these websites, however, pain centres need to decide whether that will be an entry point for appointments, a place to find information, or both.

There is currently a lack of reliable information on the Internet, and what is there is not peer-reviewed.

The webpage should include a list of frequently asked questions (FAQ).

- What is a Vertebroplasty?
- Why did my doctor recommend this procedure?
- How is vertebroplasty performed?
- Will I need other tests?
- What should I do to prepare?
- What can I expect after the procedure?
- Why have my procedures at our department?

Person-To-Person

While the Internet allows centres to reach a bigger audience, the biggest marketing impact may not be from a high-tech source, but from a very old-fashioned method: personal contact. IRs should return all their own calls, much to the appreciation of physicians and patients. IRs also may let physicians and radiologists in the community spend time in the pain centre, developing friendships and watching procedures.

Outright advertising

Successful marketing of IR requires a distinct strategy: one that takes into account not only the particulars of IR but also the attitude of the local medical community.

Because the majority of IR departments are part of a hospital, the hospital might assign it a budget and a marketing manager responsible for promoting and advertising the department. The manager places special interest stories and information on PV and PK and research on television news programs and in newspapers.

Advertisements for the department also are placed in local and national journals, newspapers, and magazines, and on radio. A campaign focused on information about PV or PK in the form of a brochure is another option.

In general, IRs should adhere to a three-step marketing timeline. (1) The IR wait until they have a handle on PV or PK procedures before marketing to referral physicians. (2) Next, the procedure is usually marketed to the referring physicians. For any practice this internal marketing job is critical. It should be referral intensive, and it can be the difference between success and failure. Developing and maintaining relationships with referral physicians is the single most important piece of external marketing. (3) Finally, consumers form the final leg of the marketing strategy, and IRs play a role in the consumer marketing effort.

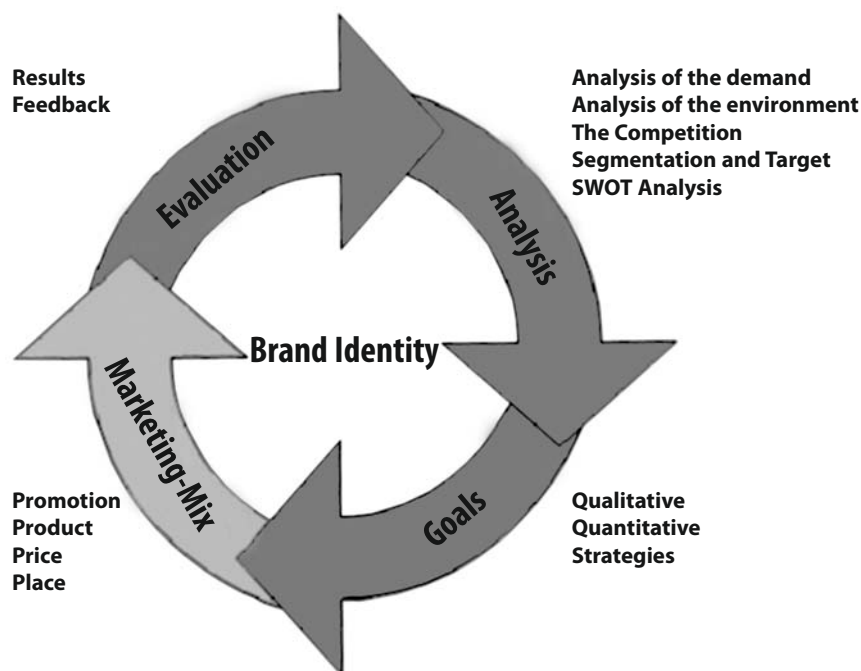
Medical marketing for PV and PK remains tricky. There is a fine line between providing information and creating demand for a procedure that may or not be suitable for a given population of patients. For IRs, marketing becomes more complex, because they truly depend on referring physicians for patients. Furthermore, IR represents a competition to surgeons and other specialties that perform the procedures as well.

There are some questions you may want to ask yourself and some guidelines for a strategic marketing plan for newer or smaller practices.

- Who has decision-making power before spending a lot of money on public promotions?
- Before promoting PV or PK, make sure you have the ability to serve your target market well.
- Do not ignore the referral base. What type of attitude does your referral base have about radiologists communicating with the public? Talk to physicians and educate them before trying to create a demand among their patients.
- Promote services people can understand and identify with. Procedures like PV and PK need to be explained well to both physicians and the public.
- Make appearances at women's groups and civic organizations to mark specialized months such as National Osteoporosis Month. It allows a practice to educate and create a relationship with potential patients.
- Write educational articles for the local newspaper.
- Do a cost-benefit analysis on how much should be spent on marketing and what type of benefits or return the investment might bring.

Marketing in PAD

A marketing plan is a written document that details the actions necessary to achieve one or more of these objectives. In developing such a plan, it is useful to go through the various steps of below chart.



ASSESSING DEMAND

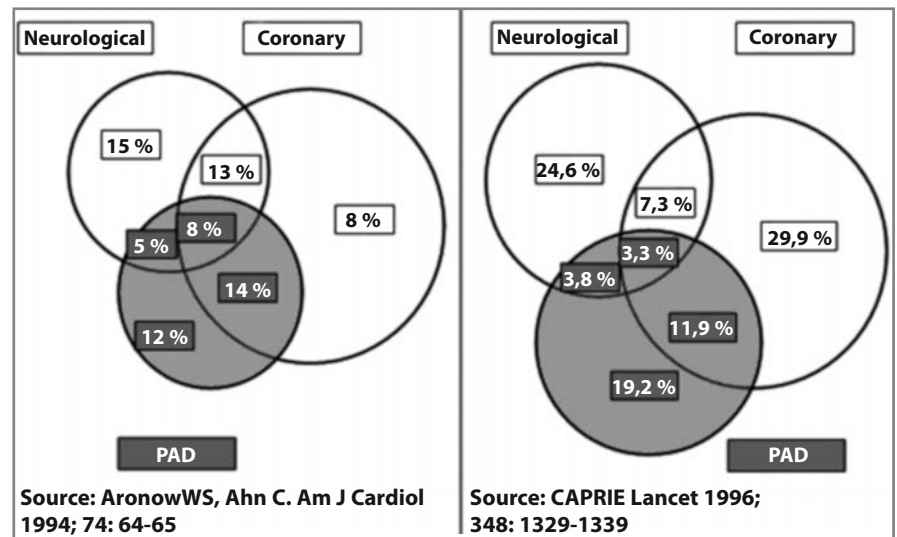
Vascular pathology is a systemic disease. It affects everyone, although it might not have a clinical manifestation. **Prevention must be part of our marketing strategy.** Peripheral Arterial Disease, or PAD affects 8-12 million Americans. It becomes more common as one gets older, and by age 70, about 20 percent of the population has it.

The following shows an estimation of prevalence in Europe

Condition		Prevalence	Patients in Europe (approc.)
Asymptomatic		5% adult population	20 millions
Symptomatic	Claudication	3% - 6% population > 60 years	10 millions
	Critical Limbs Isquemia	500-1,000 presons * per million (adult population)/ year	200,000 / year

*Source: J Vasc Surg. 2000 Jan;31(1 Pt 2):S1-S296 (TASC)

Co-morbidities between PAD with coronary and neurological diseases



The natural course of PAD

Intermittent claudication

- 1/3 of the patients will suffer a progression of the symptoms
- 15-20% will develop rest pain and gangrene
- 1-5% will suffer risk of amputation after 5 years of apparition of symptoms

Critical limb ischemia

- 25% of the patients will get an amputation after 6 months
- 25% of patients will have mortality after 6 months

Environment

It is essential to know the environment related to the services we offer for vascular pathologies in the geographic area of our hospital.

- Demographic environment: how old is the population in the area?
- Economic environment: who are the health care providers in the area?
- Politic environment: How is health managed in the area?
- Cultural environment: Are new technologies known, is prevention an issue, what type of communication is generally used to promote new treatments?

All these factors have an effect on competition and demand.

Competition

We must not forget that there are also other doctors who carry out treatments for PAD. For this reason it is mandatory to know **who they are and what they do**.

For example vascular surgeons and interventional cardiologists have access to patients and referring doctors and knowledge to apply the minimal invasive techniques in PAD. For this reason we must know their area of market and depending on their location and facilities, identify their strengths and weaknesses.

- **Direct Competition:** Not only produced by vascular surgeons and cardiologist, but as well by our own colleagues of speciality and from the radiology department

- **Possible /New Competition:** Those who can start the techniques which we carry out when they detect the patients needs and the possibility of increasing their number
- **Substitutive Product:** It is not only competition through the specialist doctor who carries out our techniques, but the technological development, this means new alternative techniques which can substitute the ones we use now.

Competition based on cost will depend on our relation with the insurance companies and the way of managing the costs of the hospital. In general they will look for the cheapest price, we must insist on quality and full service.

The best alternative to competition is to create a team and to work together.

Segmentation and Targeting

Marketing instruments for PAD must be tailored (segmented) to serve the two main sources of costumers: The patient and referring physicians.

Primary targets

- Patients
- General practitioners

Secondary targets

- Clinical specialists who need hospital support
- Surgical specialists who need technical support
- Minimally Invasive Specialists who need technical solutions they don't have

SWOT

A SWOT analysis (**S**trengths, **W**eaknesses, **O**pportunities and **T**hreats) is helpful to develop a marketing strategy. This will allow us to see what our actual situation is and to stay focused and motivated by monitoring our progress. The following points reflect a possible SWOT analysis focussed on an interventional radiology department dealing with vascular pathologies.

SWOT Analysis

Threats	Strenghts
Specialists in vascular pathology need and want to incorporate endovascular techniques within their daily work.	Global education on interventional technologies
Other disciplines are increasingly using endovascular techniques	Skills in Endovascular Therapy Years of experience in this "new" therapeutics alternatives
	Access to different Imaging Modalities
Opportunities	Weaknesses
A large PAD patient population, are potential costumers	No specific vascular training programme compared to specialities with vascular residency qualification such us angiology, vascular surgery
Current lack of information about PAD and endovascular treatment alternatives among doctors and patients	No clear brand identity
Our guidance can be important for specialists not integrated into hospital groups	No outpatient clinic experience

Objectives (Goals)

First of all do not be afraid to use marketing in medicine. The correct way to offer the best medical service to the community is through information. The main objective in marketing is attracting and retaining a growing base of satisfied customers through a clearly defined brand identity and product/service. Our targets have to be defined and marketing has to be specifically designed to serve the following goals:

For Patients:

Easy and fast access to:

- Information about our department
- Information about the different therapeutic alternatives.
- Information about our position in the disease track:

For Professionals:

- The referring doctor (RD) must be confident about our behaviour as a "helper" at any time
- The RD is always involved in decisions about his patient.
- The RD needs to feel that his/her patient is in the best professional hands.

Marketing Mix

This is a term which is used to describe all the activities which go into marketing (this includes goods and services)

The 4 P's: Place, Price, Product and Promotion

Place - Defining the areas from where PAD patients may be directed to our service

- In the first place we must look inside our hospital where we have our department or in its area of influence (in-patient pathways)
- We must also attract patients of other hospitals to our hospital (alliances)
- Attract patients from the geographic territory where our hospital is located
- Attract patients to the outpatient office

Price - Studying market rates

- Prices and costs of competitors in our geographical territory
- How insurance companies reimburse procedures and how they deal with new technologies
- The budget of the associates and/or hospital and what type of costs we need to assume ourselves

Product - Adding value

- Providing targeted information to patients, referring physicians and health care providers, including insurance companies
- Outlining the quality of the service

Promotion

Specific products and offers

- Ulcer out patient clinic with alternative methods such as ozone
- Outpatient clinic with vascular Lab
- Screening programs in peripheral vascular in association with others specialist: cardiology, renal hypertension, carotid, Aortic disease, Intestinal ischemia
- Non invasive diagnostic methods as MRA, CTA, Doppler US
- "Home follow up" nurses team to visit the patient at home.
- Create a patient field vascular evolution: "PAD Track" where we can gather the history of the patient in the vascular pathology and his/her evolution to evaluate numbers of procedures, cost, time and patient perception until amputation if this is so. Information should be gathered from the start of the symptoms and treatment, even if this was carried out before arriving to our department or out patient clinic.
- Grand Rounds programs for patient societies, PCP, specialist, medical director of medical insurance companies
- Teaching programs: The academic programs as we have mentioned are one the most beneficial projects in hospitality groups.

Others

- Relationships with local media: TV, radio, news paper
- Conference for referring doctors
- Regular meetings with insurance companies and hospital board
- Patient education seminars
- Call centre and video call centre
- Q&As
- Stickers or media advertisement for the website
- Video conference between hotels and hospital

Evaluation

It is vital in marketing to continually evaluate whether we are achieving the objectives we set for ourselves

Feedback

Feedback from both patients and referring doctors is best obtained through questionnaires.

Results

In order to evaluate the results of our marketing, we should regularly investigate:

- How do patients learn about the services we offer?
- What is the most frequent pathology we treated?
- Why they come to us?
- What do they expect from us?
- From what geographical area do they come?
- How do they cover the costs?
- Are services asked for as the result of an emergency or by appointment?
- How many of the services of the hospital have they used?

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Metabolic Syndrome

DIAGNOSIS

According to the International Diabetes Federation (IDF) consensus 2005, the diagnostic criteria of MBS are:

- Central obesity, defined as waist circumference of >94 cm for Caucasian men and >80 cm for women
- And at least two of the following factors:
 - Raised serum triglyceride level: fasting value >1.70 mmol/L (>150 mg/dl), or specific treatment for this lipid abnormality
 - Reduced serum high-density lipoprotein (HDL)-cholesterol: fasting value <1.3 mmol/L in males (<40 mg/dl) and <1.3 mmol/L in females (<50 mg/dl), or specific treatment for this lipid abnormality
 - Raised blood pressure (BP): systolic BP >130 mmHg or diastolic BP >85 mmHg, or treatment of previously diagnosed hypertension
 - Raised fasting plasma glucose: >5.6 mmol/L (>100 mg/dl), or previously diagnosed type 2 diabetes. If the value is above 5.6 mmol/L, oral glucose tolerance test is strongly recommended but is not necessary to define the presence of the syndrome.

Alzheimer's disease, depression, and sleep apnoea may also be associated with MBS.

PREVALENCE

Depending on the different definitions of MBS, its prevalence in a middle-aged population varies between 17% and 30% for men and between 8% and 20% in women (Alexander et al., 2003)

Among subjects with central obesity (having both BMI >30 kg/m² and waist circumference >100 cm in men and >90 cm in women), the prevalence of MBS is about 55% in men and 40% in women. In the non-obese subjects without central adiposity the prevalence of MBS is 2 to 4%.

TREATMENT

The treatment is principally non-pharmacological and based on lifestyle changes. This approach has been shown to have an excellent effect, for example in the prevention of diabetes (DPS Study).

Lifestyle changes are the only treatment form which have an effect on all the components of MBS, and not employing this treatment should be considered ethically wrong.

Non-Pharmacological Treatment

- Increasing physical activity (30 min 3-5 times per week)
- Weight reduction (BMI <25 kg/m²)
- Dietary changes: increased intake of fibre and decreased intake of fat (particularly saturated fat) and rapidly metabolized carbohydrates (highly refined)
- Cessation of smoking
- Limit alcohol intake to a moderate level

Drug Treatment

Drug treatment encompassing the entire MBS does not exist, and treatment should therefore consist of the management of the individual components of the syndrome.

- **Hypertension:** The treatment of hypertension in a patient with MBS should not contain drugs that worsen insulin resistance, such as non-selective beta-blockers and high-dose diuretics, unless other reasons (secondary prevention of myocardial infarction) warrant their use. The first-line drugs for the treatment of hypertension are:
 - Angiotensin-converting enzyme (ACE) inhibitors
 - Angiotensin-II receptor antagonists (losartan, valsartan, eprosartan, candesartan)
 - Alpha1 receptor blockers
 - Calcium-channel blockers
 - Highly selective beta-blockers

- Dyslipidaemia in a patient with MBS should principally be treated with statins bearing in mind that the patient has a high risk of coronary artery disease.
- Hypertriglyceridaemia should be treated with fibrates if, in spite of non-pharmacological treatment, the triglyceride values are persistently >5.0 mmol/L (450 mg/dl).

Hypertriglyceridaemia in a patient with MBS should be treated medically (statin or fibrate) if the level of triglycerides is >2.30 mmol/L (200 mg/dl) and total-cholesterol/HDL-cholesterol ratio is higher than 5 or if HDL-cholesterol is lower than 0.9 mmol/L (35 mg/dl).

- Diabetes: Dysglycaemia in a patient with MBS should be treated with metformin or thiazolidine derivatives (pioglitazone or rosiglitazone) since these will not only improve the dysglycaemia but will also have an effect on the other components of the MBS. Insulin may also be used for the treatment of dysglycaemia in a MBS patient to achieve good diabetic control. Biguanides, acarbose, and guar gum may correct insulin resistance and are thus feasible as a first-line drug for an obese patient with type 2 diabetes.
- Orlistat may be indicated in MBS if the BMI is >30 kg/m². Orlistat is an anti-obesity drug and it reduces the amount of visceral fat, in particular. Sibutramine may be used as an alternative. However, the new endocannabinoid-receptor blockers are likely to be of most benefit. Rimonabant is an example of these yet to be marketed anti-obesity drugs, and it has a positive effect on almost all the components of MBS.

FOLLOW-UP

Motivation and monitoring of lifestyle changes is of the utmost importance.

The monitoring of a patient who requires drug treatment is the responsibility of a doctor. Regular appointments may often act as an important motivator.

The monitoring of a patient who does not require drug treatment may be carried out by a practice nurse. The following should be included in the follow-up: motivation of lifestyle changes, weight and waist circumference measurements, blood pressure readings, and checking of blood lipids and fasting blood glucose. A doctor should be consulted if:

- Blood pressure repeatedly >140 mmHg and/or >90 mmHg
- Total cholesterol: HDL-cholesterol ratio >5
- Triglyceride values repeatedly >2.30 mmol/L (200mg/dl)
- Plasma glucose is >7.8 mmol/L (140 mg/dl)
(fasting plasma glucose is >6.7 mmol/L 120 mg/dl)
- The patient develops symptoms of another illness (gout, etc.)

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http://www.idf.org/webdata/docs/IDF_Metasyndrome_definition.pdf

Hypertension

Hypertension is the most important modifiable risk factor for coronary heart disease, stroke, congestive heart failure, end-stage renal disease, and peripheral vascular disease. This is why high blood pressure is often called the "silent killer." However, less than 25% of patients with hypertension have sufficient control of their disease.

Many of the following statements are from E-medicine
(www.emedicine.com/med/topic1106.htm)

DEFINITION

Based on recommendations of the Seventh Report of the Joint National Committee of Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VII), the

Classification of blood pressure

(Expressed in mm Hg) for adults aged 18 years or older is as follows*:

- Normal - Systolic lower than 120, diastolic lower than 80
- Prehypertension - Systolic 120-139, diastolic 80-99
- Stage 1 - Systolic 140-159 or diastolic 90-99
- Stage 2 - Systolic equal to or more than 160 or diastolic equal to or more than 100

*Based on the average of 2 or more readings taken at each of 2 or more visits after initial screening

The accepted target value is 140/90 mm Hg.

For special patient groups (diabetics, with chronic renal disease) even lower target values are recommended: < **130/80 mm Hg**.

Hypertension may be either essential or secondary. Essential hypertension is diagnosed in most cases, while secondary hypertension accounts for fewer than 5% of the cases.

- **Cardiac involvement** in hypertension manifests as
 - left ventricular hypertrophy (LVH),
 - left atrial enlargement,
 - aortic root dilatation,
 - atrial and ventricular arrhythmias,
 - systolic and diastolic heart failure, and
 - ischemic heart disease. Increased coronary arteriolar resistance leads to reduced blood flow to the hypertrophied myocardium, resulting in angina despite clean coronary arteries.
 - In the Framingham Heart Study, the age-adjusted risk of congestive heart failure was 2.3 times higher in men and 3 times higher in women when highest blood pressure was compared to the lowest. Multiple Risk Factor Intervention Trial (MRFIT) data showed that the relative risk for coronary heart disease mortality varied from 2.3-6.9 times higher for persons with mild-to-severe hypertension compared to persons with normal blood pressure.
- **The central nervous system:** Long-standing hypertension may manifest as hemorrhagic and atheroembolic stroke or encephalopathy.
 - The relative risk for stroke ranged from 3.6-19.2. The population-attributable risk percentage for coronary artery disease varied from 2.3-25.6%, whereas the population-attributable risk for stroke ranged from 6.8-40%.
- **Renal disease:** Nephrosclerosis is one of the possible complications of long-standing hypertension. Angiotensin II acts at both the afferent and the efferent arterioles, but more on the efferent arteriole, which leads to an increase of the intraglomerular pressure. The result is glomerular hyperfiltration, microalbuminuria and glomerulosclerosis.

- **Age:** A progressive rise in blood pressure with increasing age is observed. The incidence of hypertension appeared to increase approximately 5% for each 10-year interval of age.

LABORATORY STUDIES

The following **routine laboratory studies** should be performed:

- Full blood count, serum electrolytes, serum creatinine, serum glucose, uric acid, and urinalysis, liver enzymes
- Lipid profile (total cholesterol, low-density lipoprotein [LDL] and high-density lipoprotein [HDL], and triglycerides)

Additional tests described below are indicated when specific clinical situations warrant further investigation:

- Microalbuminuria is an early indication of hypertensive nephrosclerosis.
- Plasma renin activity (PRA) confirm the diagnosis of primary hyperaldosteronism.

IMAGING STUDIES

- Echocardiography
- Imaging studies for renovascular stenosis: If the history suggests renal artery stenosis (e.g. manifest PAD) and if a corrective procedure is considered, further radiologic investigations are performed.

INDICATIONS FOR THERAPY

Medical therapy is indicated in patients with

- very high blood pressure values (> 180/110 mm Hg) and/or
- manifest cardiovascular diseases (cerebral insult/TIA/Bleeding; CHD/heart insufficiency).
- presence of three or more cardiovascular risk factors (age: men >55 yrs, women >65 yrs, smoking, dyslipidemia, positive family history, abdominal obesity, CRP > 1mg/dl),
- endorgan disease (left hypertrophy, micro albuminuria, creatinine increase) or
- diabetes mellitus.

LIFESTYLE MODIFICATIONS

As the cardiovascular disease risk factors are assessed in individuals with hypertension, pay attention to the lifestyle that favourably affects blood pressure levels and reduce overall cardiovascular disease risk. A relatively small reduction in blood pressure may affect the incidence of cardiovascular disease on a population basis. A decrease in blood pressure of 2 mm Hg reduces the risk of stroke by 15% and the risk of coronary artery disease by 6% in a given population.

JNC VII recommendations to lower blood pressure and decrease cardiovascular disease risk include the following:

- Lose weight (Body Mass Index 18,5-24,9 kg/m)
- Limit alcohol intake
- Increase aerobic activity (30-45 min most days of the week)
- Reduce sodium intake
- Stop smoking

http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/how_make_dash.html

DRUG TREATMENT

Multiple clinical trials suggest that most antihypertensive drugs provide the same degree of cardiovascular protection for the same level of blood pressure control. Well-designed prospective randomized trials, such as the Swedish Trial in Old Patients with Hypertension (STOP-2), the Nordic Diltiazem (NORDIL) trial, and the Intervention as a Goal in Hypertension Treatment (INSIGHT) trial, have shown a similar outcome with older drugs (eg, diuretics, beta-blockers) compared to the newer antihypertensive agents (eg, ACE inhibitors, calcium channel blockers).

No consensus exists regarding optimal drug therapy for treatment of hypertension; most clinicians recommend initiating therapy with a single agent and advancing to the low-dose combination therapy.

The JNC VII report recommends either a thiazide diuretic or a beta-blocker as the initial therapy of uncomplicated hypertension.

- A low dose of thiazide diuretic (12.5-25 mg hydrochlorothiazide) is a low-cost therapy with fewer complications, and it provides equivalent cardiovascular protection.
- Patients unresponsive to low-dose thiazide therapy should try an ACE inhibitor, beta-blocker, or calcium channel blocker, sequentially. Dosing of β -blockers has to be done carefully ("start low - go slow"). One or two weeks after beginning of therapy the dose can be increased if required and if no side effects are observed. In case of adverse effects or insufficient therapeutic outcome diuretics and /or ACE inhibitors should be increased before reduction of β -blockers.

JNC recommendations for management of hypertension "in certain situations"

- An ACE inhibitor should be the initial treatment in situations in which hypertension is associated with congestive heart failure, diabetes mellitus with proteinuria, and postmyocardial infarction with systolic left ventricular dysfunction.
- In patients who develop persistent cough while on ACE inhibitor therapy, an angiotensin II receptor antagonist may be substituted, but these agents' efficacy in lowering cardiovascular mortality rates has not yet been proven.
- A beta-blocker should be prescribed following an acute myocardial infarction.
- A diuretic or a long-acting calcium channel blocker may be more effective in elderly patients with isolated systolic hypertension.
- In complex situation medical advice is recommended.

Synopsis of Considerations in the Use of Antihypertensive Drug Classes*(modified from <http://www.emedicine.com/med/topic1106.htm>)

Diuretics	Primary Indication	Contraindication
Thiazides	Uncomplicated hypertension (preferred therapy)	Gout
	systolic hypertension in elderly people (preferred therapy),	
	for older diabetic patients without nephropathy	
Loop diuretics	Renal insufficiency (additional therapy)	Gout
Potassium-sparing	Primary hyperaldosteronism	Renal insufficiency
	additional therapy in combination with thiazide diuretics	
Antihypertensives		
ACE inhibitors	Diabetes, post-myocardial infarction, heart failure,	Bilateral renovascular disease
	renal disease, uncomplicated hypertension (preferred therapy)	
Beta-blockers	Post-myocardial infarction, uncomplicated hypertension	Asthma
	diabetes (without nephropathy)	severe PVD
Angiotensin II antagonists	uncomplicated hypertension (preferred therapy)	Bilateral renovascular disease
	heart failure (alternative therapy),	
	Diabetes (alternative therapy),	
Calcium channel blockers		Heart block, heart failure
Dihydropyridines	Uncomplicated hypertension, systolic hypertension	Heart block, heart failure
Nondihydropyridines	Uncomplicated hypertension (alternative therapy)	

Considerations in the Individualization of Antihypertensive Therapy

(modified from <http://www.emedicine.com/med/topic1106.htm>)

Risk Factor / Disease	Preferred Therapy	Alternative Therapy
Uncomplicated hypertension (<60 y)	Low-dose thiazidelike diuretics beta-blockers, ACE inhibitors	Combinations of drugs
Uncomplicated hypertension (>60 y)	Low-dose thiazidelike diuretics ACE inhibitors dihydropyridine calcium channel blockers	Combinations of drugs
Diabetes mellitus without nephropathy	ACE inhibitors or beta-blockers	
Diabetes mellitus with nephropathy	ACE inhibitors	Angiotensin II receptor blockers
Diabetes mellitus without nephropathy	Low-dose thiazidelike diuretics	
Diabetes mellitus with systolic hypertension	Dihydropyridine calcium channel blockers	
Angina or prior myocardial infarction	Beta-blockers, ACE inhibitors	
Peripheral arterial disease	As for uncomplicated hypertension	

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http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/how_make_dash.html
<http://www.emedicine.com/med/topic1106.htm>

Diabetes

EPIDEMIOLOGY

The prevalence of type 2 diabetes mellitus has soared and is at the forefront of current public and community health intervention in Western countries. Type 2 diabetes is prevalent in around 5-7 percent of the total population, and affecting around 20 percent of the over 60 years old. This is relevant because two thirds of diabetic patients are likely to suffer a heart attack or stroke.

Almost always classic diabetes mellitus type 2 cases suffer from metabolic syndrome.

DIAGNOSIS

According to definition, one speaks of

- **manifest diabetes** mellitus if the
 - fasting value of blood sugar measured in venous plasma is equal or greater than 126 mg/dl or if a
 - blood sugar value of 200mg/dl is reached two hours after an oral glucose tolerance test (75 grams glucose). This test is also suitable for diagnosis of impaired glucose tolerance defined as a blood sugar value between 140 and 199 mg/dl after two hours.
- **impaired fasting glucose** at fasting blood sugar levels between 110 and 125 mg/dl. In principle, any venous blood sugar value above 100mg/dl requires further examination and testing.

Glycated Hemoglobin A1c (HbA1c) measurements are not useful for the diagnosis of diabetes mellitus because they are not standardized internationally and are insensitive for detecting milder forms of glucose intolerance. However, these measurements are the criterion standard for monitoring long-term glycemic control.

Urine microalbumin measurements is recommended yearly in all patients with diabetes. Microalbuminuria is defined as 30-300 mg/d (20-200 mcg/min). Microalbuminuria is a common finding in type 2 diabetes mellitus and is a risk factor for macrovascular (especially coronary heart) disease. It is a weaker predictor for future kidney disease in type 2 diabetes mellitus.

THERAPY

Primary attention should be given to insulin resistance. Changes to lifestyle and, failing that, medication with insulin sensitizing effects are imperative.

LIFESTYLE CHANGE

Diet

Patients suffering from diabetes mellitus type 2 are mostly overweight or adipose and feature an atherogenic lipids pattern (low HDL cholesterol, increased triglycerides, small and dense LDL particles). The aim of the therapy would be to attain weight normalisation (BMI lower than 25kg/m²). Therapy should always consist of nutritional intervention and greater physical activity. A calories reduced (e.g. 1.600 kcal/day), carbon-hydrates modified (more slowly absorbable carbon-hydrates, lower glycaemic index) and fat reduced (simple or multiple unsaturated fat rather than saturated animal fat) diet is recommended. In order to cast this in simple terms, one can speak of "Mediterranean" diet.

"Mediterranean" diet

- High consumption of breads, pasta, rice, couscous, polenta, bulgur and potatoes
- High consumption of fruits (3-4 pieces a day), legumes and vegetables (5 different varieties)
- Moderate amounts of grilled and steamed fish
- Moderate amounts of olive oil - consumed with fresh vegetables and on salads
- Alcohol in small amounts
- High intake of antioxidants
- Regular exercise is believed to be such an important part of Mediterranean health that it is part of the Mediterranean pyramid
- Increased physical activity is an important aspect of risk factor reduction. Fitness training after prior medical examination and under professional guidance is highly recommended and serves the purpose of retaining or building muscle mass as an important determinant of glucose intake. Physical activity can also lead to weight reduction and improves the atherogenic lipid profile. Nordic walking is an ideal sport as it can be practiced anytime and everywhere. Physical activity should be at least for 30 minutes per day 3-5 times per week.

However, should the aimed for HbA1c value of 6,6% or 7% not be reached under the effect of such measures, oral anti-diabetic drugs have to come into play.

ORAL ANTI-DIABETIC THERAPY

- **Metformin** is the first line standard of medical therapy for type 2 diabetics featuring a BMI greater than 26 kg/m². Metformin reduces hepatic glucose production and increases insulin sensitivity. Should Metformin alone prove insufficient for effective adjustment, it should be combined with glitazone or a sulfonylurea. Lactatacidosis is the most significant side effect of metformin and occurs mostly in kidney insufficiency patients. A normal creatinine serum is therefore essential for Metformin adjustment. Metformin should be discontinued the day before and for two days after exams or interventions with contrast media.
- **Glitazones** are also known as insulin-sensitizers because by way of the PPAR-γ-receptor they increase insulin sensitivity. Glitazones (except in the case of primary Metformin incompatibility) should only be used in combination with other oral anti-diabetics. Glitazones should not be used in patients with heart insufficiency.
- **Sulfonylureas** have been used for many years now and continue to play a role in the therapy of type 2 diabetes. They stimulate insulin production.
- **Insulin** is used in type 2 diabetics when the HbA1C cannot be kept at a level lower than 7.0 percent with oral anti-diabetic drugs. Long term damages such as micro-angiopathy, retinopathy and nephropathy are also criteria that call for an early insulisation, as do non-controllable postprandial blood sugar peaks.

THERAPIES ACCORDING TO THE STEP-BY-STEP PLAN

- Therapeutic intervention is required at a value of HbA1C of 7.0 percent.
- Basic diabetic therapy that is valid for every diabetic patient needs to be initiated:
 - balanced nutrition,
 - weight reduction,
 - awareness and
 - exercise.
- If the HbA1C level remains above or equal to 7.0 percent after three months, further measures to be taken depend mostly on the BMI.
 - At a BMI greater than $>26\text{kg/m}^2$ metformin monotherapy applies. If there are counter indications against metformin, then glitazone monotherapy or a sulfonylurea may be used.
 - Is the BMI smaller than $<26\text{kg/m}^2$, one should begin primarily with a sulfonylurea monotherapy.
 - If HbA1C is still equal or higher than 7.0 percent after three further months, one should try to primarily add a second anti-diabetic drug.
 - Should the HbA1C remain outside the target area after further three months, a switch to insulin is the usual response.
- It goes without saying that blood pressure (target: 130/85 mm Hg) and lipids (target: LDL cholesterol below 100 mg/dl, HDL cholesterol in men over 40 mg/dl, in women over 50 mg/dl) need to be treated consistently. Therapy with thrombocytic aggregation inhibitors (100 mg acetylsalicylic acid or in case of counter indications or incompatibility clopidogrel) is standard in patients with vascular complications.

Diabetes and cardiovascular diseases (CVD)

HYPERTENSION (HTN)/BLOOD PRESSURE CONTROL

Screening and Diagnosis

Blood pressure should be measured at every routine diabetes visit. Patients found to have systolic blood pressure >130 mmHg or diastolic blood pressure >80 mmHg should have blood pressure confirmed on a separate day.

Goals

- Patients with diabetes should be treated to a systolic blood pressure <130 mmHg.
- Patients with diabetes should be treated to a diastolic blood pressure <80 mmHg.

Treatment

- Patients with a systolic blood pressure of 130 to 139 mmHg or a diastolic blood pressure of 80 to 89 mmHg should be given lifestyle and behavioral therapy alone for a maximum of 3 months and then, if targets are not achieved, in addition, be treated with pharmacological agents that block the renin-angiotensin system.
- Initial drug therapy for those with a blood pressure >140/90 mmHg should be with a drug class demonstrated to reduce CVD events in patients with diabetes (angiotensin-converting enzyme [ACE] inhibitors, angiotensin receptor blockers [ARBs], beta-blockers, diuretics, and calcium channel blockers).
- All patients with diabetes and hypertension should be treated with a regimen that includes either an ACE inhibitor or an ARB. If one class is not tolerated, the other should be substituted. If needed to achieve blood pressure targets, a thiazide diuretic should be added.
- Patients not achieving target blood pressure despite multiple drug therapy should be referred to a physician experienced in the care of patients with hypertension.

DYSLIPIDEMIA/LIPID MANAGEMENT

Screening

In adult patients with diabetes, test for lipid disorders at least annually and more often if needed to achieve goals. In adults with low-risk lipid values (low-density lipoprotein [LDL] <100 mg/dL, high-density lipoprotein [HDL] >50 mg/dL, and triglycerides <150 mg/dL), lipid assessments may be repeated every 2 years.

Treatment Recommendations and Goals

- Lifestyle modification focusing on the reduction of saturated fat and cholesterol intake, weight loss (if indicated), and increased physical activity has been shown to improve the lipid profile in patients with diabetes.
- In individuals without overt CVD
 - The primary goal is an LDL <100 mg/dL (2.6 mmol/L).
 - For those over the age of 40 years, statin therapy to achieve an LDL reduction of 30 to 40% regardless of baseline LDL levels is recommended.
- In individuals with overt CVD
 - All patients should be treated with a statin to achieve an LDL reduction of 30 to 40%.
 - A lower LDL cholesterol goal of <70 mg/dL (1.8 mmol/L), using a high dose of a statin, is an option.
- " Lower triglycerides to <150 mg/dL (1.7 mmol/L) and raise HDL cholesterol to >40 mg/dL (1.15 mmol/L). In women, an HDL goal 10 mg/dL higher (>50 mg/dL) should be considered.
- " Lowering triglycerides and increasing HDL cholesterol with a fibrate is associated with a reduction in cardiovascular events in patients with clinical CVD, low HDL, and near-normal levels of LDL.

ANTI-PLATELET AGENTS

- Use aspirin therapy (75 to 162 mg/day) as a secondary prevention strategy in those with diabetes with a history of CVD.
- Use aspirin therapy (75 to 162 mg/day) as a primary prevention strategy in those with:
 - Type 2 diabetes at increased cardiovascular risk, including those who are >40 years of age or who have additional risk factors (family history of CVD, hypertension, smoking, dyslipidemia, or albuminuria)
 - Type 1 diabetes at increased cardiovascular risk, including those who are >40 years of age or who have additional risk factors (family history of CVD, hypertension, smoking, dyslipidemia, or albuminuria)
- Combination therapy using other antiplatelet agents such as clopidogrel in addition to aspirin should be used in patients with severe and progressive CVD.
- Other antiplatelet agents (such as Phosphodiesterase Inhibitors or thienopyridines) may be a reasonable alternative for high-risk patients with aspirin allergy, bleeding tendency, receiving anticoagulant therapy, recent gastrointestinal bleeding, and clinically active hepatic disease who are not candidates for aspirin therapy.

SMOKING CESSATION

- Advise all patients not to smoke.
- Include smoking cessation counseling and other forms of treatment as a routine component of diabetes care.

CORONARY HEART DISEASE (CHD) IN DIABETICS**Screening and Treatment**

- In patients >55 years of age, with or without hypertension but with another cardiovascular risk factor (history of CVD, dyslipidemia, microalbuminuria, or smoking), an ACE inhibitor (if not contraindicated) should be considered to reduce the risk of cardiovascular events.
- In patients with a prior myocardial infarction or in patients undergoing major surgery, beta-blockers, in addition, should be considered to reduce mortality.

NEPHROPATHY IN DIABETICS**General Recommendations**

To reduce the risk and/or slow the progression of nephropathy, optimize glucose and blood pressure control.

Screening

Perform an annual test for the presence of microalbuminuria in type 1 diabetic patients with diabetes duration of >5 years and in all type 2 diabetic patients.

Serum creatinine should be measured at least annually for the estimation of glomerular filtration rate (GFR) in all adults with diabetes regardless of the degree of urine albumin excretion. The serum creatinine alone should not be used as a measure of kidney function but instead used to estimate glomerular filtration rate and stage the level of chronic kidney disease.

Treatment

- In the treatment of both micro- and macroalbuminuria, either ACE inhibitors or ARBs should be used.
- With presence of nephropathy, initiate protein restriction to <0.8 g/kg body wt/day (approximately 10% of daily calories), the current adult recommended dietary allowance for protein.
- If ACE inhibitors, ARBs, or diuretics are used, monitor serum potassium levels for the development of hyperkalemia.
- Continued surveillance of microalbuminuria/proteinuria to assess both response to therapy and progression of disease is recommended.
- Consider referral to a physician experienced in the care of diabetic renal disease when the estimated glomerular filtration rate has fallen to <60 mL/min 1.73 m² or if difficulties occur in the management of hypertension or hyperkalemia.

All patients should be screened for distal symmetric polyneuropathy (DPN) at diagnosis and at least annually thereafter, using simple clinical tests.

Education of patients about self-care of the feet and referral for special shoes/inserts are vital components of patient management.

FOOT CARE

Perform a comprehensive foot examination and provide foot self care education annually for patients with diabetes to identify risk factors predictive of ulcers and amputations. Proper foot care, including use of appropriate footwear, chiropody/podiatric medicine, daily foot inspection, skin cleansing, and use of topical moisturizing creams, should be encouraged and skin lesions and ulcerations should be addressed urgently in all diabetic patients with lower extremity PAD.

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Hyperlipidemia

DEFINITION

Hyperlipidaemia is the term used to denote raised serum levels of one or more of total cholesterol, low-density lipoprotein cholesterol, triglycerides, or both total cholesterol and triglyceride (combined hyperlipidaemia). Dyslipidaemia is a wider term that also includes low levels of high-density lipoprotein cholesterol¹. Many types of hyperlipidaemia carry an increased risk of cardiovascular disease. High-density-lipoprotein (HDL) cholesterol however confers protection. Generally the risk of CHD rises as the ratio of total cholesterol to HDL-cholesterol (TC: HDL-C) rises.

The management of hyperlipidaemia is directed at the identification of those at high risk of cardiovascular disease and the primary prevention and secondary prevention of cardiovascular disease by the management of all risk factors, including smoking, hypertension, diabetes and obesity.

Adult Treatment Panel III (ATP III) -

Report of the National Cholesterol Education Programme

Elevated LDL-C blood levels are the main cause for CVD. Evaluation of risk status is required.

ATP III recommends that a

- lipid profile including
 - global cholesterol,
 - LDL-C,
 - HDL-C, and
 - triglycerides be done.

In addition to the lipid values,

- risk determinants to be taken into account include the existence of
 - CVD or other clinical manifestations of arteriosclerosis,
 - diabetes mellitus,
 - smoking,
 - hypertension (blood pressure >140/90mm Hg or anti-hypertensive therapy),
 - family history of premature CVD (first-grade male relative with CVD prior to 55 years, first-grade female relative with CVD prior to 65 years),
 - age (men >45 years, women >55 years) and
 - low HDL-C levels <40mg/dl.

At an HDL-C level >60mg/dl one risk factor is deducted. A cholesterol reduction of 30 mg/dl lowers the relative risk of CVD by roughly 30%.

Presentation

- In most patients a high cholesterol concentration is discovered on screening. Although, clinically asymptomatic, patients with hyperlipidaemia usually present with established vascular disease.
- A very small proportion of patients will have clinical signs of abnormal lipid levels:
 - Xanthelasma
 - Tendon xanthomas (usually in familial hypercholesterolaemia)
 - Premature corneal arcus (this is far more often an incidental finding).

Differential Diagnosis

Secondary causes of hyperlipidaemia include:

- High cholesterol: hypothyroidism, nephrotic syndrome.
- High triglycerides: hepatitis, hepatobiliary disease, alcohol abuse, diabetes mellitus, drugs (e.g. isotretinoin, oestrogens), pregnancy, obesity, renal failure.

Laboratory - Studies

- Total cholesterol: non-fasting samples can be used. A mild or moderate elevation in LDL-cholesterol with a concomitant reduction in HDL-cholesterol can result in a normal total cholesterol level, which can be misleading.
- LDL Cholesterol: a fasting sample is required for an accurate result. This is not a standardised test. (LDL can be directly measured or calculated according to Frederikson)
- HDL Cholesterol: the measurement is not standardised and there are generally only small differences between normal and abnormal levels. However the ratio of total serum cholesterol to HDL cholesterol is used in the coronary risk prediction charts.
- Triglycerides: plasma triglycerides rise dramatically after a meal so a fasting sample is required.

Target level

- | | |
|--|--------------------------|
| • Total cholesterol (TC) | <5.0 mmol/l (<190 mg/dl) |
| • Low density lipoprotein cholesterol (LDL-C) | <3.0 mmol/l (<115 mg/dl) |
| • High density lipoprotein cholesterol (HDL-C) | >1.1 mmol/l (>40 mg/dl) |
| • Triglyceride | <1.2 mmol/l (<150 mg/dl) |

Complications

- About 46% of deaths due to coronary heart disease (CHD) may be attributable to raised serum cholesterol¹.
- People with familial combined hyperlipidaemia also have an increased risk of CHD, but CHD usually only presents after the age of 60 years.
- Raised serum triglyceride is an independent risk factor for CHD.
- Very severe hypertriglyceridaemia (more than 10 mmol/l) is a risk factor for pancreatitis.
- Decreased levels of serum HDL cholesterol (HDL-C) are also an independent risk factor for CHD.

Definition of treatment groups and goals

Until recently in preventive care a distinction was drawn between two categories of patients with cardiovascular disease: patients having suffered myocardial infarction (**secondary prevention**) and patients with risk factors but without yet having undergone a cardiovascular event (**primary prevention**).

Today a new distinction is drawn between **high risk** CVD patients (formerly secondary prevention) and **low risk** CVD patients (formerly primary prevention).

High risk patients for CVD

Today not only patients having suffered myocardial infarction but all patients with a cardiovascular equivalent (see table) are grouped in the secondary prevention category. In addition, other patients are also included in the high risk group if the 10 year risk of developing coronary heart disease is higher than 20% and the 10 year risk of cardiovascular death is considered to be higher than 5 percent.

Definition of High Risk Patients (previously secondary prevention)

- Established Coronary Heart Disease
- Peripheral Arterial Occlusion Disease
- Carotid Stenosis or condition after ischemic insult
- Abdominal aorta aneurysm
- Diabetes mellitus
- Patients with a calculated 10 year CVD mortality rate > 5%
- Family history of hypercholesterolemia
- Nephropathy

Recommendations given here reflect both the European Society of Cardiology Guidelines and those of the U.S. National Cholesterol Educational Treatment Program (NCEP/III).

The LDL-C target for patients in this risk category is defined as <100mg/dl. The Heart Protection Study demonstrated that patients with CAD and diabetes run an exorbitantly high risk of suffering a cardiovascular event and stand to benefit most from a statin therapy.

High risk patient therapy should always be a combination of lifestyle modifications and medical treatment with lipid inhibitors (statins). If the set target values are not reached, a combination with ezetimib, a cholesterol uptake inhibitor with no known side effects, is recommended.

"Very-high" risk patients for CVD.

Very high risk patients are those with CAD and:

- multiple cardiovascular risk factors (esp. Diabetes mellitus),
- badly controlled risk factors (esp. continued smoking habit)
- metabolic syndrome (esp. high triglycerides >200mg/dl) and low HDL-C <40mg/dl and
- acute coronary syndrome.

New recommendations added on to the NCEP/III guidelines (2004) recommend LDL target values lower than 70mg/dl

Low and moderate risk patients for CVD

In this group treatment first focuses on lifestyle modifications. Only once such measures prove ineffective (over the course of 3 - 6 months) additional medical therapy is initiated. According to the ESC recommendations lifestyle modification measures are to be initiated at a global risk threshold of < 5% 10 years risk (see table) and to aim at reaching the European target values (total cholesterol < 190 mg/dl and LDL-C < 115mg/dl).

- Low risk CVD patients (no. of risk points 0 or 1). These patients should aim for a LDL-C target < 160 mg/dl. If this is not achieved through lifestyle modifications, medical (statins) therapy should set in at a 190 mg/dl threshold value.
- Moderate risk CVD patients (no. of risk points 2 or more). Intermediate CVD risk patients are those with two or more risk factors and feature a 10 year risk of 20% (Framingham Risk Index). The LDL-C target for patients in this risk category is defined as <130mg/dl. ATP-III recommended not to pursue medical LDL-C reduc-

tion in patients with intermediate risk (10 years <10-20%) and LDL-C<130mg/dl. Statin therapy is however recommended in patient of advanced age, >2 risk factors, grave risk factors (continued nicotine abuse, manifest family history of premature CVD, high triglycerides (>200mg/dl) plus high non-HDL-C(>160mg/dl), metabolic syndrome, CRP>3mg/dl or also coronary calcium above the 75. age and gender specific percentile

ATP III regards triglyceride values <150mg/dl as normal, values of <150-199mg/dl as borderline, <200-499mg/dl as high, and >500mg/dl as very high. In borderline or high value patients ATPIII recommends to focus first and foremost on reaching the LDL-C targets. Triglyceride reducing drugs such as fibrates or nicotinic acid may be combined. In addition, physical exercise and weight reduction are crucial for such patients.

Practical Guide to Individual Risk Measurement

- Step 1: Risk tables and known clinical diagnosis.
- Step 2: Determination of risk factors
- Step 3: Count together all risk factors from tables as well as the risk points (HDL >60 = -1) to differentiate between moderate and low risk patients.

A patient with a final score of 2 or more risk points is a moderate risk patient; one with a score of 0 or 1 risk point is a low risk patient.

For calculation of the Framingham Risk score you can use the web-based Framingham calculator: <http://www.gp-training.net/utills/fram/fram.htm>

Target values for high risk CVD patients (formerly secondary prevention) in mg/dl

		NCEP 2001	ESC 2003
Global C		<200	< 175
LDL-C		< 100	<100
HDL-C	Men	> 40	>40
	Women	> 50	>46
Triglycerides		< 150	< 150

Target values for low and moderate risk CVD patients (formerly primary prevention) in mg/dl

		NCEP 2001	ESC 2003
Global C		<200	< 190
LDL-C	Moderate Risk	<130 (160*)	<115**
	Low Risk	<160(190)*	<115**
HDL-C	Men	>40	>40
	Women	>50	>50
Triglycerides		<150	<150

*) Begin of medical therapy where lifestyle modifications unsuccessful

**) Lifestyle modifications and regular risk assessment (<5years), medical therapy if global risk >5% and target not reached

MANAGEMENT

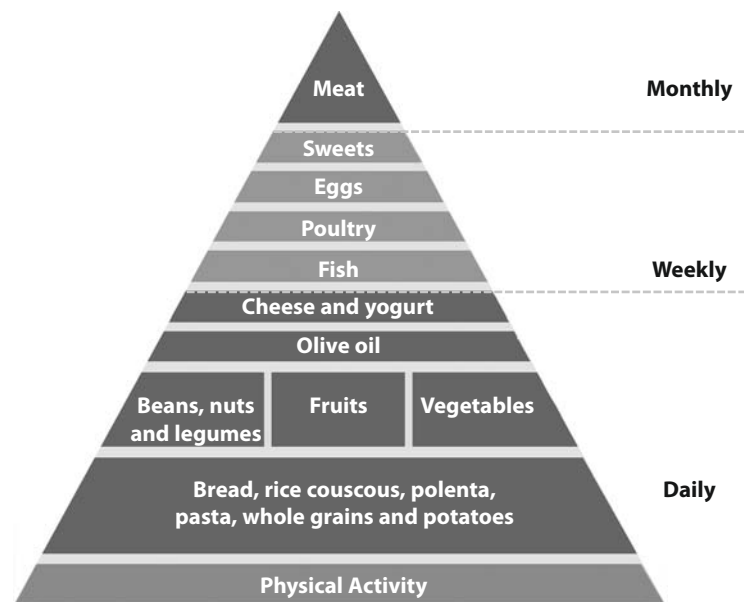
Non-Drug

- Diet, weight reduction, regular physical exercise and, when appropriate, additional measures to reduce cardiovascular risk such as smoking cessation and blood pressure and blood glucose control.

"Mediterranean" diet

- High consumption of breads, pasta, rice, couscous, polenta, bulgur and potatoes
- High consumption of fruits (3-4 pieces a day), legumes and vegetables (5 different varieties)
- Moderate amounts of grilled and steamed fish
- Moderate amounts of olive oil - consumed with fresh vegetables and on salads
- Alcohol in small amounts
- High intake of antioxidants
- Regular exercise is believed to be such an important part of Mediterranean health that it is part of the Mediterranean pyramid

MEDITERRANEAN DIET PYRAMIDE



Drugs

- Statins (atorvastatin, fluvastatin, pravastatin, rosuvastatin, and simvastatin):
 - Are more effective than other classes of drugs in lowering LDL-cholesterol but less effective than the fibrates in reducing triglycerides.
- Fibrates: bezafibrate, ciprofibrate, fenofibrate and gemfibrozil.
 - Mainly decrease serum triglycerides, with variable effects on LDL-cholesterol.
 - All can cause a myositis-like syndrome, especially in patients with impaired renal function. There is an increased risk of rhabdomyolysis when used in combination with a statin (www.bnf.org/bnf).
- Ezetimibe:
 - Inhibits the intestinal absorption of cholesterol.
- Severe hyperlipidaemia often requires a combination of lipid-regulating drugs such as a statin with ezetimibe or with a fibrate. Such treatment should generally be under specialist supervision.

- Combinations of a statin with nicotinic acid or a fibrate carry an increased risk of side-effects (including rhabdomyolysis) and should be used with caution. Gemfibrozil and statins should not be used together.
- Correction of hypothyroidism itself may resolve the lipid abnormality. Untreated hypothyroidism increases the risk of myositis with lipid-regulating drugs.

Studies have shown that dosages of 10 mg atorvastatin and 20 mg simvastatin are limited to achieving <40% LDL-C reduction. Options to reduce LDL-C further include higher statin dosages and the combination of statins with drugs that use a different mechanism to lower LDL-C, such as resorption of cholesterol. A three-step dose titration starting from 10 mg, increasing to 40 mg and finally to 80 mg is likely to lead to an additional LDL-C reduction of only <18%. Studies show that combined therapy using a selective cholesterol resorption inhibitor and a statin (e.g. ezetimib and simvastatin) manage to get up to 83% of patients under the LDL-C target of 100mg/dl.

Therapeutic considerations for the use of statins

Cautions

- History of liver disease or with a high alcohol intake (use should be avoided in active liver disease).
- Liver-function tests should be carried out before and within 1 - 3 months of starting treatment and thereafter at intervals of 6 months for 1 year, unless indicated sooner by symptoms or signs suggestive of hepatotoxicity.
- Treatment should be discontinued if serum transaminase concentration rises to, and persists at, 3 times the upper limit of the reference range.
- Patients should be advised to report unexplained muscle pain.

Side-effects

- Reversible myositis
- Headache
- Altered liver-function tests
- Gastro-intestinal effects including abdominal pain, nausea and vomiting.

Muscle-effects

- Myalgia, myositis and myopathy have been reported with the statins; if the creatine kinase concentration is markedly elevated (> 10 times upper limit of normal), and myopathy is suspected or diagnosed, treatment should be discontinued. There is an increased incidence of myopathy if the statins are given with
 - a fibrate
 - lipid-lowering doses of nicotinic acid
 - immunosuppressants such as cyclosporin;
- Close monitoring of liver function and, if symptomatic, of creatine kinase is required in patients receiving these drugs.
- Rhabdomyolysis with acute renal impairment secondary to myoglobinuria has also been reported.

Investigations

- Liver-function tests should be carried out before and within 1 - 3 months of starting treatment and thereafter at intervals of 6 months for 1 year, unless indicated sooner by symptoms or signs suggestive of hepatotoxicity.
- Closer monitoring of patients taking
 - a fibrate
 - lipid-lowering doses of nicotinic acid
 - immunosuppressants such as cyclosporin.

Summary of guidance in lipid management

Testing lipids

How often should cholesterol or lipids be tested when assessing a patient's coronary risk?

- Before starting lipid lowering drug treatment: At least two measurements taken 1-12 weeks before starting drug treatment

How often should patients' lipids be tested after starting lipid lowering treatment?

- 8 (\pm 4) weeks after starting drug treatment
- 8 (\pm 4) weekly after adjustments to treatment until within the target range

How often should cholesterol or lipids be tested once a patient has reached target or optimal cholesterol?

- Annually (unless there is a specific reason for more frequent reviews)

Liver enzymes and statins

How often should liver enzymes be routinely measured in patients taking statins?

- Before treatment with a statin
- 8 weeks after starting a statin or after any dose increase
- Annually thereafter if liver enzymes are < 3x upper limit of normal

What if liver enzymes become raised in a person taking a statin?

- If \leq 3x upper limit: Continue statin, recheck liver enzymes in 4-6 weeks
- If \geq 3x upper normal: Stop statin or reduce dose, recheck liver enzymes within 4-6 weeks

How often should creatine kinase be measured in patients taking statins?

- Before starting treatment with a statin
- If baseline creatine kinase level > 5 times ULN, do not start statin

What if creatine kinase becomes raised in a person taking a statin?

- If \leq 5x upper limit of normal:
 - Stop treatment, check renal function and monitor creatine kinase fortnightly
 - Consider secondary causes of myopathy if creatine kinase remains elevated
- If \leq 5x upper limit of normal
 - If no muscle symptoms, continue statin (patients should be alerted to report symptoms; consider further checks of creatine kinase)
 - If muscle symptoms, monitor symptoms and creatine kinase regularly if creatine kinase continues to rise

Important Lipid Studies since ATP III

"4S" Study

The Scandinavian Simvastatin Survival Study (4S) trial was the first single trial to show that cholesterol reduction in post AMI patients will reduce morbidity and mortality (including total mortality).

- Males and females, 35 - 70 years (average 60 years) 80% had previous AMI and the other 20% angina.
- Initial total cholesterol >5.5 mmol/L, randomised to simvastatin 20 mg od po, or placebo.

- After a follow up of 5.4 years, total cholesterol was reduced by 25% and total mortality reduced by 30%.
- In addition, major coronary events (defined as coronary death or any non-fatal AMI or resuscitation from cardiac arrest) were reduced by 34%.
- The risk of developing unstable angina, need for revascularisation, having a TIA or CVA were also reduced by about 30%.
- There were no increases in deaths from suicide, cancer or accidents. 6% withdrew from therapy in both treatment and placebo groups (presumed side effects).

"Care" Trial

The CARE study progressed understanding by addressing the issue of secondary prevention as it applies to the majority of patients with average (not high) cholesterol values.

- Survivors of acute MI with total cholesterol, 6.2 (and LDL 3.0-4.5).
- Pravastatin 40mg od po versus placebo.
- 4159 males and females whose cholesterol levels were similar to the general population (the high and low cholesterol patients were removed from the study).
- A 20% reduction in total cholesterol occurred.
- A significant reduction ($p=0.002$) in CAD fatality and non-fatal MI were observed over five years.
- There was also a significant reduction in PTCA and CABG rates in treated group, and a significant reduction in CVA.

"Aspire" study

- The objective was to measure the potential for secondary prevention in CAD in the UK (which was found to be considerable).
- 2583 CAD patients surveyed. Found very poor rates of success in secondary prevention. For example >75% had cholesterol >5.2 at follow-up, up to 27% still smoked, 75% remained overweight, up to 25% remained hypertensive, only 30% were on a beta blocker, and up to 20% were not on aspirin.

Arbiter 2 study

ARBITER 2 - Arterial Biology for the Investigation of the Treatment Effects of Reducing cholesterol) compared combination (simvastatin and niaspan) therapy with statin (simvastatin) therapy alone. Initial dose of Niaspan was 500mg, with a measured increase to 1000mg per day. 69% of patients showed flush symptoms. However, most developed tolerance over time. Compared with statin monotherapy, combined therapy achieved a 20% increase in the HDL-C value over 12 months. ARBITER-3 reached an increase in the HDL-C value of 23.7% after 24 months. A significant regression of atherosclerosis was also noted. 9.6% of monotherapy patients suffered an acute coronary syndrome or infarction but only 3.8% of combined therapy patients suffered such a cardiovascular event.

Heart Protection Study

High risk patients (CVD, other occlusive atherosclerotic diseases or diabetes) were randomised into 40mg simvastatin or placebo therapy. With simvastatin mortality was reduced by 13%, serious vascular events by 24%, coronary deaths by 18%, serious coronary events (deaths or myocardial infarctions) by 27%, strokes by 25%, and revascularisations by 24%. Also in patients with LDL-C <116mg/dl and even with LDL-C <100mg/dl statin therapy achieved a significant reduction of cardiovascular risk.

Reversal study

In this study therapy with atorvastatin 80mg led to a reduction of LDL-C to 79mg/dl (vs. 110mg/dl under standard therapy with 40mg pravastatin) and to a progression standstill of atherosclerotic plaque, whilst plaque volume increased in patients treated with 40mg pravastatin.

Coronary Disease Risk Prediction Score Sheet for **Men** based on LDL Cholesterol Level

Step 1

Age	
Years	Points
30-34	-1
35-39	0
40-44	1
45-49	2
50-54	3
55-59	4
60-64	5
65-69	6
70-74	7

Step 2

LDL - Cholesterol			
(mg / dl)	(mmol / L)	Points	Risk
< 100	≤ 2.59	-3	Very low
100-129	2.60-3.36	0	Low
130-159	3.37-4.14	0	Moderate
160-189	3.37-4.14	1	High
≥ 190	≥ 4.92	2	Very High

Step 3

HDL - Cholesterol		
(mg / dl)	(mmol / L)	Points
< 35	≤ 0.90	2
35-44	0.91-1.16	1
45-49	1.17-1.29	0
50-59	1.30-1.55	0
≥ 60	≥ 1.56	-1

Step 4

Blood Pressure					
Systolic (mmHG)	Diastolic (mmHG)				
	< 80	80-84	85-89	90-99	≥ 100
< 120	0	0 pts	1	2	3 pts
120-129					
130-139					
140-159					
≥ 160					

Note: When systolic and diastolic pressures provide different estimates for point scores, use the higher number

Step 5

Diabetes	
	Points
No	0
Yes	2

Step 6

Smoker	
	Points
No	0
Yes	2

Risk estimates were derived from the experience of the NHLBI's Framingham Heart Study, a predominantly Caucasian population in Massachusetts, USA

Step 7 (sum from steps 1-6)**Adding up the points**

Age	.....
LDL Cholesterol	.....
HLD Cholesterol	.....
Blood Pressure	.....
Diabetes	.....
Smoker	.....
Point Total	

Step 8

(determine CHD risk from point total)

CHD Risk

Point Total	10 Yr CHD Risk
≤ -3	1 %
-2	2 %
-1	2 %
0	3 %
1	4 %
2	4 %
3	6 %
4	7 %
5	9 %
6	11 %
7	14 %
8	18 %
9	22 %
10	27 %
11	33 %
12	40 %
13	47 %
≥ 14	≥ 56 %

Step 9 (compare to men of the same age)**Comparative Risk**

Age (years)	Average 10 Yr CHD	Low* 10 Yr CHD
30-34	3 %	2 %
35-39	5 %	3 %
40-44	7 %	4 %
45-49	11 %	4 %
50-54	14 %	6 %
55-59	16 %	7 %
60-64	21 %	9 %
65-69	25 %	11 %
70-74	30 %	14 %

* Low risk was calculated for a man the same age, normal blood pressure, LDL cholesterol 100/129 mg/dL, HDL cholesterol 45 mg/dL, non/smoker, no diabetes.

Coronary Disease Risk Prediction Score Sheet for **Women** based on LDL Cholesterol Level

Step 1

Age	
Years	Points
30-34	-1
35-39	0
40-44	1
45-49	2
50-54	3
55-59	4
60-64	5
65-69	6
70-74	7

Step 2

LDL - Cholesterol			
(mg / dl)	(mmol / L)	Points	Risk
< 100	≤ 2.59	-3	Very low
100-129	2.60-3.36	0	Low
130-159	3.37-4.14	0	Moderate
160-189	3.37-4.14	1	High
≥ 190	≥ 4.92	2	Very High

Step 3

HDL - Cholesterol		
(mg / dl)	(mmol / L)	Points
< 35	≤ 0.90	2
35-44	0.91-1.16	1
45-49	1.17-1.29	0
50-59	1.30-1.55	0
≥ 60	≥ 1.56	-1

Step 4

Blood Pressure					
Systolic (mmHG)	Diastolic (mmHG)				
	< 80	80-84	85-89	90-99	≥ 100
< 120	0	0 pts	1	2	3 pts
120-129					
130-139					
140-159					
≥ 160					

Note: When systolic and diastolic pressures provide different estimates for point scores, use the higher number

Step 5

Diabetes	
	Points
No	0
Yes	2

Step 6

Smoker	
	Points
No	0
Yes	2

Risk estimates were derived from the experience of the NHLBI's Framingham Heart Study, a predominantly Caucasian population in Massachusetts, USA

Step 7 (sum from steps 1-6)**Adding up the points**

Age	.....
LDL Cholesterol	.....
HLD Cholesterol	.....
Blood Pressure	.....
Diabetes	.....
Smoker	.....
Point Total	

Step 8

(determine CHD risk from point total)

CHD Risk

Point Total	10 Yr CHD Risk
≤ -3	1 %
-2	2 %
-1	2 %
0	3 %
1	4 %
2	4 %
3	6 %
4	7 %
5	9 %
6	11 %
7	14 %
8	18 %
9	22 %
10	27 %
11	33 %
12	40 %
13	47 %
≥ 14	≥ 56 %

Step 9 (compare to women of the same age)**Comparative Risk**

Age (years)	Average 10 Yr CHD	Low* 10 Yr CHD
30-34	3 %	2 %
35-39	5 %	3 %
40-44	7 %	4 %
45-49	11 %	4 %
50-54	14 %	6 %
55-59	16 %	7 %
60-64	21 %	9 %
65-69	25 %	11 %
70-74	30 %	14 %

* Low risk was calculated for a woman the same age, normal blood pressure, LDL cholesterol 100/129 mg/dL, HDL cholesterol 55 mg/dL, non/smoker, no diabetes.

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Peripheral Arterial Disease

INTRODUCTION

Peripheral arterial disease (PAD) contributes a large component to the workload of most interventional radiologists. This section describes the indications for imaging and intervention, the laboratory tests required for these patients and the role of imaging. Most patients present with chronic symptoms i.e. intermittent claudication (IC) or critical limb ischemia (CLI) and the majority of the chapter is devoted to these patients. Some patients present with acute limb ischemia (ALI) and the management of patients with this condition is also described briefly.

Medical therapy and follow-up for peripheral arterial disease (PAD)

Patients with peripheral arterial disease are at increased risk for major adverse cardiovascular events (MACE) and cardiovascular death (Criqui et al) Best medical treatment including antithrombotic, antihypertensive and lipid lowering therapy has been shown to reduce the relative risk by 25 % each. Therefore, best medical treatment is considered the main therapeutic pillar in patients with PAD. However, medication for treatment of peripheral vascular disease should only be used in combination with aggressive life style modification to reduce underlying lifestyle risk factors (e.g., atherogenic diet, overweight/obesity, physical inactivity) to control risk factors such as diabetes, hypertension, and hyperlipidemia. Many of these factors will be relevant to both peripheral vascular and coronary artery disease.

Individuals at Risk for Lower Extremity Peripheral Arterial Disease

- Age less than 50 years, with diabetes and one other atherosclerosis risk factor (smoking, dyslipidemia, hypertension, or hyperhomocysteinemia)
- Age 50 to 69 years and history of smoking or diabetes
- Age 70 years and older
- Leg symptoms with exertion (suggestive of claudication) or ischemic rest pain
- Abnormal lower extremity pulse examination
- Known atherosclerotic coronary, carotid, or renal artery disease

Clinical Presentation of PAD

Asymptomatic

- Individuals with asymptomatic lower extremity PAD should be identified by examination and/or measurement of the ankle-brachial index (ABI) so that therapeutic interventions known to diminish their increased risk of myocardial infarction (MI), stroke, and death may be offered.
- Smoking cessation, lipid lowering, and diabetes and hypertension treatment according to current national treatment guidelines are recommended for individuals with asymptomatic lower extremity PAD.
- Antiplatelet therapy is indicated for individuals with asymptomatic lower extremity PAD to reduce the risk of adverse cardiovascular ischemic events.
- Angiotensin-converting enzyme (ACE) inhibition may be considered for individuals with asymptomatic lower extremity PAD for cardiovascular risk reduction.
- Statins as lipid lowering drugs are indicated in patients with asymptomatic PAD if lifestyle modification and low fat diet did not lead to LDL levels recommended by the NCEP-ATPIII.

Claudication

- Patients with symptoms of intermittent claudication should undergo a vascular physical examination, including measurement of the ABI.
- In patients with symptoms of intermittent claudication, the ABI should be measured after exercise if the resting index is normal.
- Patients with intermittent claudication should have significant functional impairment with a reasonable likelihood of symptomatic improvement and absence of other disease that would comparably limit exercise even if the claudication was improved (e.g., angina, heart failure, chronic respiratory disease, or orthopedic limitations) before undergoing an evaluation for revascularization.
- Individuals with intermittent claudication who are offered the option of endovascular or surgical therapies should: (a) be provided information regarding supervised claudication exercise therapy and pharmacotherapy; (b) receive comprehensive risk factor modification and antiplatelet therapy; (c) have a significant disability, either being unable to perform normal work or having serious impairment of other activities important to the patient; and (d) have lower extremity PAD lesion anatomy such that the revascularization procedure would have low risk and a high probability of initial and long-term success.

Critical Limb Ischemia

- Patients with clinical limb ischemia (CLI) should undergo expedited evaluation and treatment of factors that are known to increase the risk of amputation (see table below)
- Patients with CLI should undergo assessment of cardiovascular risk.
- Patients with a prior history of CLI or who have undergone successful treatment for CLI should have follow-up to assess successful clinical outcome.
- The feet should be examined directly, with shoes and socks removed, at regular intervals after successful treatment of CLI.
- Patients with CLI and features to suggest atheroembolization should be evaluated for aneurysmal disease (e.g., abdominal aortic, popliteal, or common femoral aneurysms).
- Systemic antibiotics should be initiated promptly in patients with CLI, skin ulcerations, and evidence of limb infection.
- Patients with CLI and skin breakdown should be referred to healthcare providers with specialized expertise in wound care.
- Patients at risk for or who have been treated for CLI should receive verbal and written instructions regarding self-surveillance for potential recurrence.

Factors That Increase Risk of Limb Loss in Patients With Critical Limb Ischemia

Factors that reduce blood flow to the microvascular bed:

- Diabetes
- Severe renal failure
- Severely decreased cardiac output (severe heart failure or shock)
- Vasospastic diseases or concomitant conditions (e.g., Raynaud's phenomenon, prolonged cold exposure)
- Smoking and tobacco use

Factors that increase demand for blood flow to the microvascular bed:

- Infection (e.g., cellulitis, osteomyelitis)
- Skin breakdown or traumatic injury

Long-term patency of endovascular sites may be evaluated in a surveillance programme, which may include conducting exercise ABIs and other arterial imaging studies at regular intervals.

TREATMENT

Cardiovascular Risk Reduction

Antiplatelet and Antithrombotic Drugs

- Aspirin: Platelet aggregability has been shown to be 30% higher in patients with peripheral vascular disease even if they are asymptomatic. The risk reduction for antiplatelet therapy versus placebo in the claudicant population was 46% for non fatal stroke, 32% for non fatal myocardial infarction, and 20% for death from a vascular cause. A recent review of 14 randomised clinical trials set out to determine if any drug was more effective than another in preventing re-narrowing of the artery. Aspirin (75 to 325 mg), with or without dipyridamol, reduced the incidence of re-occlusion at six to 12 months when compared with no therapy or vitamin K antagonists.
- Clopidogrel: A randomized, blinded trial of clopidogrel versus aspirin in patients at risk of ischemic events (CAPRIE) had a large subgroup of patients with peripheral vascular disease. Clopidogrel was shown to bring about a small, but substantially greater reduction in vascular morbidity and mortality than aspirin, with a relatively greater effect in PAD patients than other vascular disease subgroups.
- Anticoagulation with warfarin is not indicated as primary prevention treatment of PAD. However, oral anticoagulation may be indicated in patients with embolic risk such as popliteal aneurysmal disease.

Lipid-lowering drugs, antihypertensive drugs and diabetes therapies please consult the risk factor management chapter, pp....

Smoking Cessation

- Individuals who smoke cigarettes or use other forms of tobacco should be advised to stop smoking and should be offered comprehensive smoking cessation interventions, including behavior modification therapy, nicotine replacement therapy, or bupropion.

Intermittent Claudication

Exercise

- Regular exercise such as walking or treadmill use should be encouraged (30 - 45 min/d, 3-5 times/week).
- Exercise therapy for intermittent claudication (IC) is ideal in a supervised vascular rehabilitation program. In one study, exercise provided a 24% relative risk reduction (RRR) in cardiovascular mortality, and a meta-analysis of randomised trials found that exercise training increases maximal treadmill walking distance by 179 m (95% CI, 60-298 m). Nevertheless, the lack of availability of supervised exercise programmes, has limited their overall effectiveness.

Pharmacological Treatment

Multiple drugs regimens have been tested in claudication.

- Cilostazol: Cilostazol (100 mg orally 2 times per day), a phosphodiesterase inhibitor, is indicated as an effective therapy to improve symptoms and increase walking distance in patients with lower extremity PAD and intermittent claudication (in the absence of heart failure). Cilostazol has shown a 40% increase in walking distance at 3 months and has become the drug of choice in the pharmacologic management of intermittent claudication in the US (not currently available in Europe).
- Pentoxifylline: Pentoxifylline (400 mg 3 times per day) may be considered as second-line alternative therapy to cilostazol to improve walking distance in patients with intermittent claudication. Pentoxifylline (oxypentifylline) has been shown in a meta-analysis, to improve walking distance by 29 metres over placebo (the improvement was approximately 50% compared with baseline in the placebo group; pentoxifylline provided an additional 30% improvement).

- Naftidrofuryl has shown an increase in walking distance of up to 30% when compared with a placebo at 6 months.
- The effectiveness of L-arginine, propionyl-L-carnitine, ginkgo biloba, inositol nicotinate, cinnarizine, oral prostaglandins and vitamin E for patients with intermittent claudication is not well established.

Critical limb ischaemia

About 60% of patients with CLI may be cases for revascularization (endovascular or open surgery), 15-20% are in need of an amputation, while the remaining 20-25% require some other form of treatment, as they are not operable, either for technical or medical reasons, and amputation is not immediately demanded.

Another very important issue is the bad prognosis for patients with CLI. Due to concomitant disorders, mainly cardiovascular, the mortality rate is high, at least 20% during the first year after the initial diagnosis.

Pharmacotherapy

In the early days, vasodilatation was an aim of the treatment and vasodilators were prescribed to patients with CLI. Little positive effect was achieved and steal phenomena were seen due to dilatation of non-diseased vascular beds. This kind of treatment has no indication whatsoever.

The drugs used exert their effect on the microcirculation by reducing blood cell aggregation and adhesion. Thus, the undesired effects of proteolytic enzymes and other substances increasing the ischemic stage are reduced. Prostanoids are presently the kind of drugs which are most efficiently investigated.

Antiplatelet drugs

Aspirin (ASA) and clopidogrel prevent platelet aggregation to the damaged endothelial surfaces.

Anticoagulation

Unfractionated heparin is frequently used as a prophylaxis and as adjuvant treatment to vascular surgical procedures, but it has not been tried in an efficient way for the symptoms of CLI. There are, however, two studies using low molecular weight heparin (LMWH) which have shown beneficial results concerning the healing of ischemic ulcers.

Prostanoids

The first trials evaluating prostanoids were performed using PGE₁, but since then the prostacyclin analogue iloprost has been the most frequently tried drug. The largest trial investigating the effect of PGE₁, the ICAI study treating 1560 patients compared to routine treatment showed that symptoms of CLI were significantly reduced.

Iloprost has been used in six larger trials compared to placebo with variation in follow-up time. In general terms, ulcer size and rest pain were significantly reduced after treatment of at least 3 weeks. Mortality and amputations were reduced in the studies which enabled follow-up at 3 months.

Other treatments

Gene therapy

Angiogenic growth factors stimulate the development of collaterals during ischaemia. Two growth factors have aroused the greatest interest, the fibroblast growth factor (FGF) and the vascular endothelial growth factor (VEGF). In human studies so far, improved perfusion of the myocardium and reduced coronary symptoms have been seen. Although currently this is purely experimental there is great interest in the effect on peripheral ischemia. One recently published study utilised gene transfer of VEGF in nine patients with CLI. New collaterals were documented by angiography, also ankle brachial pressure index was improved and healing of ischemic ulcers was seen in four out of seven limbs.

Stem cells

There have been several successful animal experiments with the use of stem cells. Iba et al and Khaldi et al. showed, in animals, that the injection of circulating mononuclear or bone marrow cells improved the capillary density in ischemic limb models. Iba et al also, demonstrated in rats, that the injection of mononuclear cells of human bone marrow in ischemic limbs caused the formation of collateral circulation through angiogenic factors, mainly the vascular endothelial growth factor (VEGF) and cytokines, and that anti-VEGF antibodies inhibited the formation of new vessels.

Following on from the successful animal experiments, there have been limited clinical trials with adults stems cell in humans which have shown very encouraging results. Yuyama et al. published, in 2002, their results from a randomized clinical trial of 47 patients. These patients also showed a significant improvement in the ankle-brachial index, in the transcutaneous pressure of oxygen and, at 6 months, the angiography showed a remarkable improvement in the collateral circulation in 27 out of 47. There have been further successful studies by Kawamura and Yang et al with improved ulcer healing and limb salvage.

Sympathectomy

Techniques with effect on the sympathetic nerve system, sympathetic block or sympathectomy increase blood flow, mainly due to opening of arteriovenous shunts and without any increase of nutritional blood flow. However, some patients may benefit in terms of reduced pain. Little evidence exists but a review from 1985 concluded that sympathectomy could be beneficial in patients with rest pain and pregangrene. It is, however, most unlikely that diabetic patients can respond as they usually have a reduced sympathetic tone in the ischemic leg. Epidural spinal cord stimulation is another kind of treatment presently under evaluation in some European trials.

Follow Up

It remains incumbent on the physicians involved with endovascular therapy to document success of the procedures by improvement in objective outcome (ie treadmill testing), symptomatic improvement, quality of life and proof of patency ie duplex ultrasonography, angiography, CTA or MRA.

Immediately post procedure objective technical success in the aorto-iliac arteries is defined as a resting gradient of $<10\text{mmHg}$. Ankle Brachial Pressure Index ABPI or ABI) are the most widely used measures in the assessment of arterial disease. An index of >0.9 is considered normal with the index decreasing with increasing severity of disease. The ABPI must have increased by at least 0.1 following treatment and must not have deteriorated by more than 0.15 from the maximum post procedure to be deemed a success. However this measure has many limitations particularly in diabetic patients where vessels are heavily calcified and there can be a large inter-observer variability and failure to detect disease.

Direct visualization with angiography is still considered by many to be the gold standard, however duplex, CTA and MRA now give a more acceptable non invasive option. Duplex can be difficult in large patient and in the presence of heavy calcification, however these can usually be overcome in the vast majority of patients. CTA can also be limited by heavy calcification and MRA by some types of stents.. MRA may also be contra-indicated in some patient such as those with pacemakers and cranial clips.

Allowing for these limitation direct imaging post intervention is feasible in the vast majority of patients. Currently there are no standardized protocols for imaging and surveillance post endovascular intervention, however it would seem reasonable to carry out imaging to document outcome at 6 and 12 months post procedure.

Indications for endovascular treatment of PAD:

There are a number of classifications used to stratify peripheral arterial disease. Common clinical classifications used to grade the severity of limb ischemia are the Fontaine and Rutherford classifications.

Fontaine and Rutherford classifications of peripheral vascular disease.

FONTAINE			RUTHERFORD	
Stage	Clinical	Grade	Category	Clinical
I	Asymptomatic	0	0	Asymptomatic
IIa	Mild Claudication	I	1	Mild Claudication
IIb	Moderate to severe claudication	I	2	Moderate claudication
		II	3	Severe claudication
III	Ischemic rest pain	III	4	Ischemic rest pain
IV	Ulceration or gangrene	III	5	Minor tissue loss
		III	6	Major tissue loss

In general, the decision on whether to treat a patient with symptoms of PAD is based on the severity of symptoms. PAD is a very slowly progressive disease and the vast majority of patients with claudication do not develop critical limb ischemia. As a result, in view of the risk of potentially severe complications arising from revascularization, most patients with mild claudication are treated conservatively with cessation of smoking, a program of exercise and drug therapy, in the form of statins and antiplatelet medication, forming the mainstay of therapy. Revascularization should be reserved for patients with severe lifestyle-limiting claudication i.e. Rutherford categories 3-6 or Fontaine stages IIb, III and IV.

If a decision has been made to intervene on a patient, the next task is to decide on the method of treatment i.e. whether to treat the patient by endovascular techniques or by conventional surgery.

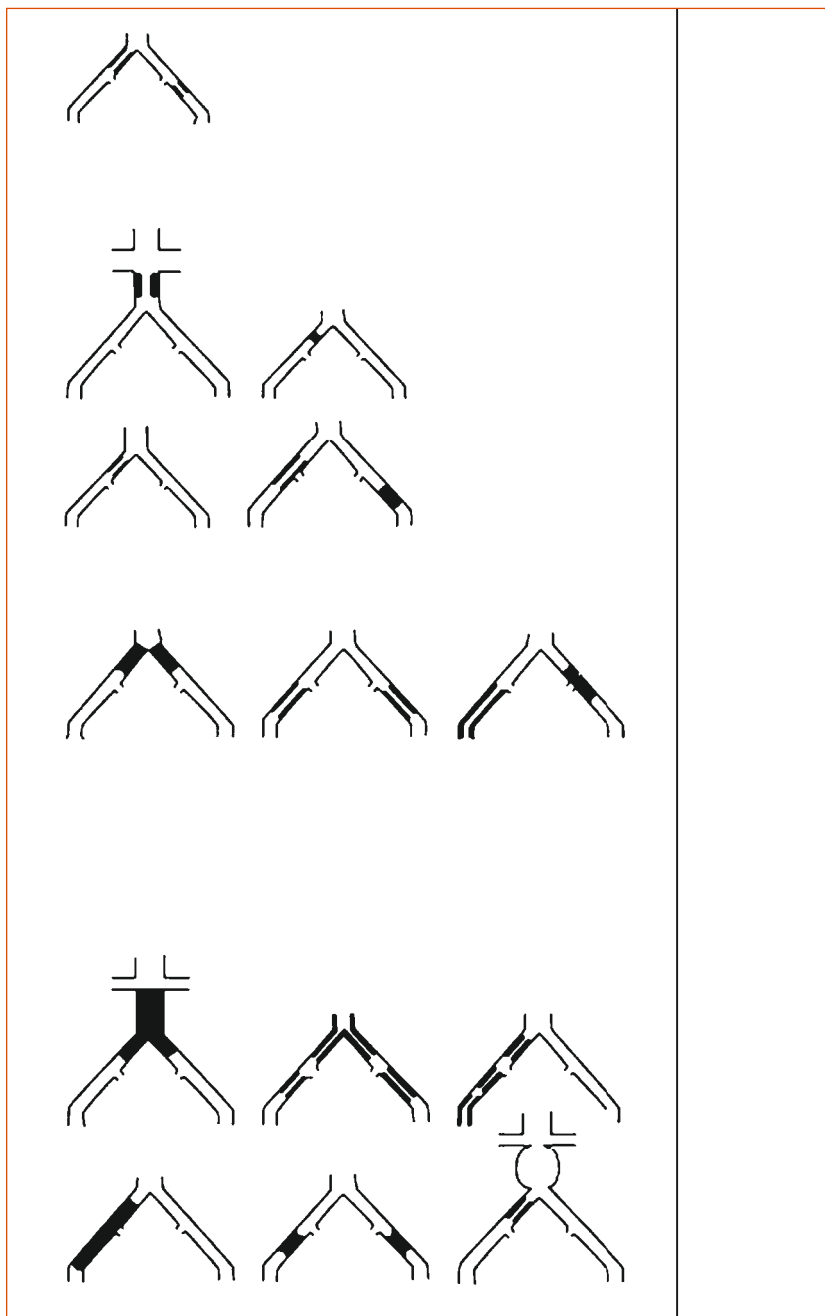
In order to resolve these issues, the Transatlantic Inter-Society Consensus Document on the management of peripheral arterial disease was published in January 2000. This document reported the evidence to date on all aspects of the management of patients with PVD and made recommendations on which patients should be investigated, who should be treated and how they should be treated. This document has recently been updated (TASC II, J Vasc Surg 2006).

The document classifies lesions based on the recommendations for the optimal method of treatment. Type A and B lesions are those which give excellent results after endovascular treatment and should be treated by this method. Type D lesions do not respond well to endovascular treatment and should generally be treated by surgery. Type C lesions fall somewhere in between these extremes. In general, type B lesions are more severe than type A lesions although the results of endovascular treatment are still good enough to recommend this method instead of surgery. The long-term results of surgical revascularization with vein bypass for type C lesions are generally sufficiently better than with balloon angioplasty or stenting, however, a most recently published randomized trial reported similar 1-year patency rates for synthetic bypass vs. Viabahn endografts. These recommendations should be used as guidelines and are

not absolute. The choice of endovascular treatment vs. surgery may also depend on the local availability of endovascular and surgical expertise and the individual enthusiasm of the clinicians at each institution.

The updated TASC classifications for aortoiliac and femoropopliteal lesions are indicated in Figures 1 and 2 (compare Inter-Society Consensus for the Management of Peripheral Arterial Disease - TASC II, JVS 2007).

Figure 1: TASC classification of aorto-iliac lesions



Type A lesions

- Unilateral or bilateral stenoses of CIA
- Unilateral or bilateral single short (< 3 cm) stenosis of EIA

Type B lesions

- Short (< 3 cm) stenosis of infrarenal aorta
- Unilateral CIA occlusion
- Single or multiple stenosis totaling 3-10 cm involving the EIA not extending into the CFA
- Unilateral EIA occlusion not involving the origins of internal iliac or CFA

Type C lesions

- Bilateral CIA occlusions
- Bilateral EIA stenoses 3-10 cm long not extending into the CFA
- Unilateral EIA stenosis extending into the CFA
- Heavily calcified unilateral EIA occlusion with or without involvement of origins of internal iliac and/or CFA

Type D lesions

- Infra-renal aortoiliac occlusion
- Diffuse disease involving the aorta and both iliac arteries requiring treatment
- Diffuse multiple stenoses involving the unilateral CIA, EIA and CFA
- Unilateral occlusions of both CIA and EIA
- Bilateral occlusions of EIA
- Iliac stenoses in patients with AAA requiring treatment and not amenable to endograft placement or other lesions requiring open aortic of iliac surgery

Legend to figure 1: CIA - common iliac artery; EIA - external iliac artery; CFA - common femoral artery; AAA - abdominal aortic aneurysm

Figure 2 TASC classification of femoral popliteal lesions

Type A lesions

- Single stenosis <10 cm in length
- Single occlusion < 5 cm in length

Type B lesions

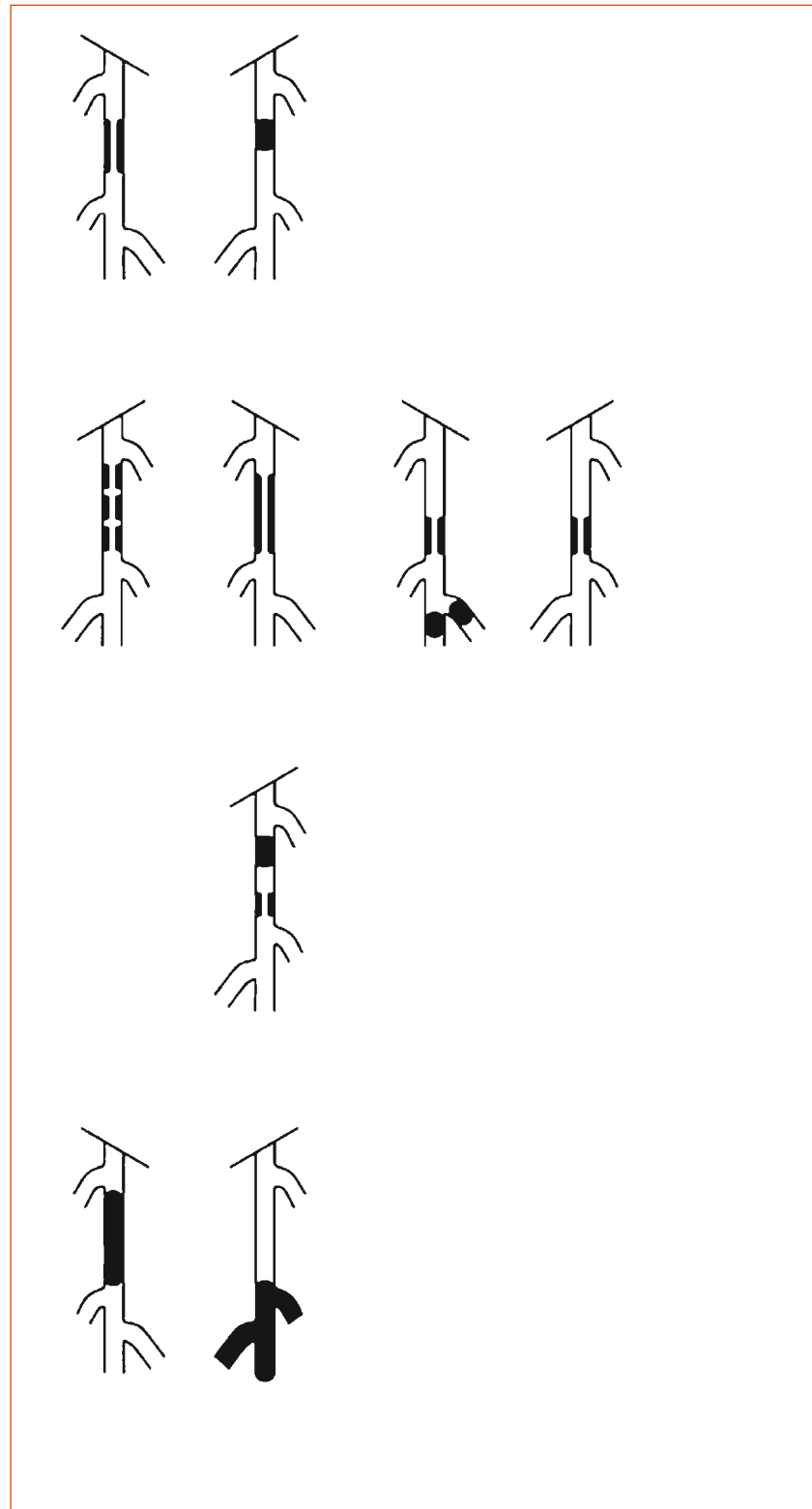
- Multiple lesions (stenoses or occlusion), each < 5 cm
- Single stenosis or occlusion < 15 cm not involving the infra geniculate popliteal artery
- Single or multiple lesions in the absence of continuous tibial vessels to improve inflow for a distal bypass
- Heavily calcified occlusion < 5 cm in length
- Single popliteal stenosis

Type C lesions

- Multiple stenoses or occlusions totaling > 15 cm with or without heavy calcification
- Recurrent stenoses or occlusions that need treatment after two endovascular interventions

Type D lesions

- Chronic total occlusions of CFA or SFA (> 20 cm, involving the popliteal artery)
- Chronic total avulsion of popliteal artery and proximal trifurcation vessels



Legend to figure 2: CFA - common femoral artery; SFA - superficial femoral artery

The aorta and iliac arteries

Stenosis: The standard method of treatment of iliac artery stenoses is PTA. Stents should be used if PTA is unsuccessful or when there are recurrent lesions after a recent PTA. There is no evidence that primary stenting is better than a policy of angioplasty with selective stenting for PTA failure. Four year patency rates for PTA are around 60%-70%.

Stents may be used instead of PTA if the iliac arteries are diffusely diseased, although these lesions are regarded as TASC D lesions and are generally treated by surgery.

Occlusions: Common iliac artery occlusions can usually be recanalized with a success rate of 80%. The treatment of choice is usually by primary stenting because of a significant risk of distal embolization to the calf vessels after PTA of occlusions in 10-40% of procedures. Either self-expanding or balloon-expandable stents may be used. The patency rates after successful endovascular treatment of common iliac artery occlusions are similar to the results for stenoses. The results for the endovascular management of external iliac artery occlusions are less impressive than for the common iliac artery. Total iliac artery occlusions are TASC D lesions and are generally treated surgically.

Common femoral artery and profunda femoris

Stenoses of the common femoral artery are amenable to angioplasty although common femoral endarterectomy is a relatively straightforward procedure. Endarterectomy can be performed under local anesthesia and is usually the treatment of choice for these lesions. Stenoses in the profunda femoris are generally only treated if the SFA is occluded and cannot be salvaged by intervention. PTA of profunda origin stenoses is effective with success rates similar to the results for the SFA (see below).

The superficial femoral and popliteal artery

Stenosis: Stenoses in the femoropopliteal segment are regarded as TASC A, B or C lesions and should be treated by PTA. Patency rates are 50% or less at 4 years and the results depend on lesion length and the integrity of the run-off vessels. Although the results of PTA are lower than outcomes of surgical vein bypass, the procedure has low complications, can be repeated and does not preclude future surgical bypass in the majority of patients.

Occlusions: Occlusions are regarded as TASC A to D lesions depending on length. While many surgeons prefer to treat these lesions by bypass, good results especially in terms of limb salvage can be achieved by intraluminal or subintimal recanalization followed by PTA and stenting. Many patients with occlusions in the femoropopliteal segment, which are classified as TASC D lesions, are treated by PTA in many centers with satisfactory results.

In older studies comparing stainless steel stents with PTA the results of stents in the femoropopliteal segment have not been better than PTA. However, recent results of randomized trials comparing nitinol stents with PTA in this location reported significantly better patency rates after primary stent placement.

Infrageniculate arteries

Intervention should only be performed in patients with symptoms of critical limb ischemia (CLI) i.e. Rutherford Categories 4-6, because of the potential for severe complications in the form of worsened ischemic symptoms or limb loss if the procedure is unsuccessful. PTA is the standard treatment method for focal or diffuse stenoses or occlusions of the tibial and peroneal arteries. The outcomes of infrageniculate PTA are good in terms of limb salvage with rates of 50%-70% at 2 years, although actual patency rates are somewhat less. At the current time, limited data are available for the use of stents in the infrageniculate vessels although the results of some smaller studies are promising.

Acute Limb Ischemia

As stated previously, the majority of patients present with chronic symptoms of PAD. Some patients present with acute limb ischemia which is defined as any sudden decrease in limb perfusion which causes a potential threat to the viability of the limb. Clinical presentation may occur up to two weeks after the underlying event. The most common causes of acute limb ischemia are arterial embolism and thrombosis in situ often when there is an underlying arterial lesion.

The main aim of assessment is to decide whether the limb is viable without treatment, whether the limb is threatened without immediate intervention or whether the limb is beyond salvage by surgical embolectomy or bypass and amputation of the limb is required to prevent metabolic dysfunction produced by the sequelae of a dead limb. The presence of rest pain, sensory loss and muscle weakness are signs of threat to the limb and are an indication for urgent revascularization. On the other hand, profound paralysis and anesthesia in the presence of muscle tenderness with inaudible arterial and venous Doppler signals and absent capillary return are signs of irreversible acute limb ischemia and indicate that the limb is beyond salvage.

Treatment

The immediate aim is to prevent further propagation of thrombus, occlusion of the microcirculation and worsening of ischemia. Therefore, all patients should be anticoagulated with heparin. If the patient presents to the interventional radiologist, immediate consultation with a vascular surgeon is mandatory. Between the interventional radiologist and the vascular surgeon, a treatment plan as to whether treatment is required and which technique should be used should be formed.

In general, conventional surgery is the treatment of choice. Endovascular techniques may be used to treat patients with ALI although the results are not better than surgical revascularization. Patients with a relatively small volume embolic or thrombotic load may be treated by thrombectomy, either by percutaneous aspiration thrombectomy (PAT), or by using one of a variety of mechanical thrombectomy devices. PAT is effective for small localized emboli and for distal embolization following upstream angioplasty or stent procedures. However, it is not effective for large volumes of thrombus. Although they have been available for over a decade, none of the iterations of mechanical thrombectomy devices has ever achieved widespread usage for ALI and their role remains confined to selected patients by some enthusiasts.

Transarterial thrombolysis was favored by many vascular interventionalists in the 1990s. However, the overall results of this technique are not better than surgery. Thrombolysis is usually time-consuming and if rapid revascularization is mandatory, valuable time may be lost if revascularization is not achieved. Although there may be a role for thrombolysis in patients with ALI in whom immediate revascularization is not essential, this technique is much less commonly used than it was before the millennium.

Diagnostic tests before endovascular treatment

When a patient presents with symptoms suggestive of PAD, the first task is to confirm that the symptoms are due to underlying PAD. In addition to the clinical examination, this is achieved by non-imaging evaluation usually by assessment of the ankle-brachial index and exercise testing. If the presence of PAD is confirmed risk factors such as hypertension, hyperlipidemia and diabetes should be assessed by laboratory examinations. Is the patient a candidate for revascularization, non-invasive imaging (usually one or more of CDU, MRA or CTA) should be performed to identify the underlying cause of the symptoms.

Laboratory tests

The following serological tests are performed in patients presenting with symptoms suspicious of PAD:

- Full blood count
- Hemoglobin
- Platelet count
- International Normalized Ratio (I.N.R.)
- Serum urea, creatinine
- Electrolytes
- Lipid profile

Ankle-brachial index

The initial test for the evaluation of patients with suspected peripheral vascular disease is the ankle-brachial index (ABI). It should be a routine measurement in any interventional practice. The usual method is to place a sphygmomanometer cuff just above the ankle joint and with Doppler probes placed on the dorsalis pedis and posterior tibial arteries in turn; the systolic pressure is measured in these vessels and compared with the higher brachial pressure of either arm to form the ABI.

$$\text{ABI} = \frac{\text{Pedal artery systolic pressure}}{\text{Brachial artery systolic pressure}}$$

The ABI provides evidence that the patient has peripheral vascular disease and the lower the index, the more severe the disease. A normal ABI signifying absence of PAD is 1 or greater.

The usual threshold for diagnosing PAD is 0.9 or less. Patients with claudication have ABI results of 0.5-0.9. Patients with critical limb ischaemia have ABI results less than 0.5. The ABI is also useful in the follow-up of patients to provide a non-imaging method.

Exercise testing

Some patients have PAD and a normal ABI at rest. These may be patients with isolated iliac stenoses which are not hemodynamically significant at rest but which become significant in terms of their effects when patients exercise. During exercise, the previously normal ABI is decreased thereby indicating the presence of PAD. Typically these patients present with symptoms of claudication rather than critical limb ischaemia.

The procedure commences with an assessment of the ABI at rest followed by a period of exercise (usually on a treadmill at 3.2Km/h at 10-20% grade of incline) for five minutes or until the patient develops claudication pain. After either of these endpoints, the ABI is again measured. A decrease in the ABI of 15-20% signifies the presence of PAD.

Other stress tests can be used if the patient is unable to walk on the treadmill or exercise by walking in other ways e.g. up a flight of stairs, because of the presence of co-existing pathology such as significant cardiorespiratory disease.

These include active pedal plantar flexion, and reactive hyperemia produced by inflating thigh cuffs well above systolic pressure for five minutes.

Other non-invasive tests

Additional tests which may be used to assess patients with PAD include:

- Segmental limb systolic pressure measurement
- Segmental plethysmography/pulse volume recordings
- Toe pressures and the toe-brachial index

A full description of these tests is outside the scope of this chapter.

Imaging

Imaging should generally be reserved for patients with an established diagnosis of PAD when there is an intention to treat the patient.

Color Duplex ultrasound

Until recently, color duplex ultrasound (CDU) has been the main imaging method used to assess the lower extremity circulation. In many centers, it has been replaced by MR and CT angiography. Ultrasound is inexpensive, requires no more space than a small office, is relatively quick, and can be performed portably. Its main disadvantage is its operator dependency and the lack of the visible "road map" provided by MRA and CTA. The main advantage of CDU compared with other modalities is its ability to quantify the severity of stenoses by velocity estimation. The results in the femoro-popliteal and infragenicular segments are good, although the ability to adequately evaluate the aortoiliac segment is reduced by the presence of abdominal gas in many patients.

MR Angiography

MR angiography has had a substantial effect on the evaluation of patients with PAD. In comparison with conventional angiography, MRA has the obvious advantages of no ionizing radiation, the lack of necessity for iodinated contrast medium and the absence of the risks of arterial puncture. It has clear benefits in patients with a history of previous allergic reaction to contrast medium and with preexisting renal insufficiency. Contraindications to MRA include patients with cerebral aneurysm clips, cardiac pacemakers, defibrillators and claustrophobia.

A moving table is an essential requirement for MRA of the entire lower extremity. Modern scanners have the capability to image the entire arterial tree from the head to the toes. Most radiologists use contrast enhanced 3D angiography (CE-MRA). MRA is useful for planning interventions even when there is a previous duplex examination if the results of the aortoiliac segment are suboptimal.

Regarding the diagnosis of PAD, the results of CE-MRA are excellent with sensitivity and specificity results above 93% compared with conventional catheter angiography. Favorable results of CE-MRA vs. CDU have also been achieved.

CT Angiography

With the increasing availability of the newest generations of multislice CT scanners, the use of CTA for the evaluation of patients with PAD is becoming more widely adopted. The limitations of CTA compared with MRA are obvious in terms of contrast mediated nephrotoxicity and allergy and radiation dose. Excellent resolution of the lower limb vessels can be achieved, although if the vessels are calcified, this can make assessment of the lumen problematic. Nevertheless, although data on the sensitivity and specificity of CTA compared with MRA and invasive angiography is limited, early results of this technique are encouraging. These techniques may be complementary. Their use should be tailored to the individual patient.

Invasive Angiography

In this era of CDU, MRA and CTA, invasive angiography is generally performed immediately prior to an interventional procedure. The role of non-invasive imaging is to identify and locate the course of patients' symptoms and the role of invasive angiography is to confirm the findings of CDU, MRA or CTA and to enable a percutaneous intervention at the same procedure. There are limited indications for purely diagnostic invasive angiography of the extremities in PAD.

Medication prior to intervention

Patients referred for endovascular procedures may be on medication which may need to be taken into account before the procedure is performed. Some medication may need to be temporarily discontinued e.g. anticoagulation medication, while other types of medication may require some other form of action, e.g. conversion to a sliding scale of insulin therapy for diabetic patients. The main medications that require attention are oral anticoagulants, steroid medications and diabetic medication. The management of patients taking these medications is described below.

Aspirin

It's routine practice to have patients on aspirin before and during the procedure.

Warfarin

Patients taking oral anticoagulant medication should be advised to discontinue the medication at least three days before the procedure. Vitamin K administration may help to restore the coagulation system. If patients need any anticoagulation (i.e. mechanical cardiac valve, atrial fibrillation) full dose anticoagulation with LMWH should be started at the same time. One or two days before the procedure, blood should be taken and assessed for the INR (International Normalised Ratio). An INR of 1.5 or less is considered to be adequate to enable the procedure to go ahead. If the INR is greater than 1.5, the IR can elect to delay the procedure until the INR is acceptable. If the procedure can be delayed, this is generally the safest course of action. If the procedure cannot be delayed, the measures used by the IR depend to a large extent on the type of procedure. Emergency procedures can go ahead after the blood coagulation has been normalised by the administration of fresh frozen plasma and if vascular closure devices are used.

Heparin

In view of the relatively short half life of heparin, cessation of heparin 3 hours before the procedure is usually adequate to return the aPTT to within normal limits. It is not generally necessary to perform a serum aPTT to assess whether the effects of the heparin have resolved before the procedure. A quick test which can be performed in the cathlab before the procedure is to measure the activated clotting time (ACT). An ACT of less than 200 seconds allow any arterial procedure.

Clopidogrel

Arterial interventions can be done under Clopidogrel medication. However, the use of closure devices should be considered at the end of the procedure. Patients are usually prescribed this medication by Cardiologists after coronary artery stenting. Therefore, it is usually sensible to stop the Clopidogrel only after discussion with the cardiologist concerned, as the Cardiologist may require additional anticoagulation measures to offset the cessation of the Clopidogrel.

Diabetic patients

There are a few basic principles regarding the management of diabetic patients who undergo interventional procedures. Patients who are managed by restriction of their diet only, need no specific management.

For patients who are taking oral hypoglycemic drugs or insulin, if there is no need to fast or avoid fluid intake before or after the procedure. If patients are on metformin, the medication should be discontinued for 48h post procedure and have renal function checked before it is restarted.

If patients need to avoid food and/or fluid for a period of time before their procedure, some alteration to their usual routine is required. Patients on oral hypoglycemic therapy are usually advised to avoid taking their medication on the morning of the procedure and to restart the medication at the usual time when oral intake is restored. There is a wide variety of ways to manage patients who are insulin dependent diabetics (IDDs). The choice of regime varies between physicians and will depend to some extent on the individual patient's insulin regime and their control. Most IDDs are placed first on the list during the day so that they can avoid a long period of food and fluid restriction. The morning dose of insulin may be reduced by half or avoided altogether and the patients usually receive a 5% Dextrose intravenous infusion. Frequent blood sugar estimations should be performed. Many patients, particularly patients whose control is problematic, or who are prone to hypoglycemia, are managed by a sliding scale of insulin and a 5% dextrose infusion regime. It is usually sensible to involve clinicians who are experienced in the care of diabetic patients with regard to the specific measures for these patients.

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Carotid Artery Stenting

INDICATIONS

Stroke is a major cause of morbidity and mortality in the modern world. Carotid artery atheromatous disease is responsible for a significant number of these events (30-35%). The effects of carotid artery disease may be prevented by appropriate treatment.

All patients with known atheromatous disease should be treated with best medical therapy. This usually takes the form of an antiplatelet agent, usually aspirin, blood pressure control and lipid lowering medication.

Despite this, some patients remain at high risk of stroke, which may be reduced by the selective use of additional therapies such as carotid endarterectomy or carotid artery stenting (CAS).

Patients elective for carotid revascularisation

- Symptomatic patients: Patients who have had recent neurological symptoms within 6 months. Patients who have had symptoms within the previous four weeks benefit most from revascularization. The operation needs to be performed with low complication rates (< 6% periprocedural death and stroke).
- Asymptomatic patients: Some groups of patients who have been free of neurological symptoms may also benefit from these additional therapies (?90% carotid stenosis; >80% carotid stenosis and ipsilateral silent ischemia on brain CT suggesting microembolism; rapid progression of carotid stenosis; contralateral occlusion />90% carotid stenosis) However, these patients have a much lower inherent risk of stroke, and so the potential benefits are less. In such circumstances it is even more important that the operations are performed with minimal morbidity (< 3% death and stroke).

CLINICAL EXAMINATION

Prior to CAS a clinical examination should include:

- Neurological examination including motor and sensory function test, basic intellectual function tests (local, temporal orientation etc.)
- Blood pressure, pulse rate
- Peripheral pulse status
- Auscultation of the heart and the carotid arteries

LABORATORY EXAMINATIONS

Patients with carotid artery disease often have symptomatic vascular disease elsewhere, including the renal and coronary circulations.

Routine laboratory investigations should include:

- **Renal function:**
 - Blood urea nitrogen
 - Serum creatinine
- **Diabetes:**
 - Fasting blood sugar
- Lipid profile
- Coagulation
- Full blood count
- ECG

IMAGING

In many centres ultrasound examination is considered to be of sufficient sensitivity and specificity to plan carotid bifurcation intervention with CEA. When considering CAS there are a number of other morphological factors which need to be considered including:

- Aortic arch disease
- Great vessel artery disease close to the aortic arch
- Carotid artery tortuosity
 - common carotid artery with respect to access and
 - internal carotid artery with respect to protection device placement.
- Distal internal carotid artery stenosis (siphon stenosis)
- Obstruction and/or tortuosity of iliac arteries (access artery)

In practical terms, duplex scanning alone is not sufficient for safe selection of patients for CAS. A further imaging technique is therefore required.

The imaging techniques that can be utilised for the further imaging include:

- Catheter angiography
- Magnetic resonance angiography (MRA)
- CT angiography (CTA)

MEDICATION

It is recognised that all patients with symptomatic vascular disease (carotid, coronary and peripheral) derive benefit from secondary prevention of further vascular events by the use of antiplatelet medication. This usually takes the form of aspirin, but other agents may be used alone or in combination. It is to be expected that patients being considered for CAS will already be taking at least one antiplatelet drug.

- **Prior to CAS:**
 - Aspirin 70-300mg/day
 - Clopidogrel 75 mg/day for at least 3 days prior to the CAS procedure, or a loading dose of at least 300 mg at least 6 hours prior to the procedure.
 - Most authorities would recommend that patients should commence on dual antiplatelet treatment.
 - Warfarin: It is not recommended to perform CAS with a patient formally anticoagulated with warfarin.
- **During the CAS procedure:**
 - Continuous monitoring of blood pressure, ECG and pulse oxymetry is required.
 - Heparin: Once arterial access has been secured, then patients should be anticoagulated, and this is usually with heparin (although some authorities suggest other agents such as Bivalirudin). The usual dose is 5000 IU of Heparin. However, because patients may react differently and thrombogenic devices such as filters and stents are used, monitoring is recommended. The activated clotting time (ACT) can be measured easily in the cathlab and should be at 250-300 seconds throughout the procedure. Once completed, there is no need to continue anticoagulation in a routine fashion, provided that dual antiplatelet agents are continued.
 - Atropine: Prior to manipulation of the carotid bifurcation an anticholinergic medication should usually be administered because of the risk of bradycardia and cardiac arrest.

- **Emergency cases:**

- Nitroprussid 0,25-10 µg/kg per min. (RR monitoring required).
- Nitroglycerin 5-100 µg/min. within 2-5 minutes.
- Esmolol (Brevibloc®) 200-500 µg/kg p/min. for 1-2 min. followed by 50-300 µg/kg p/min. i.v.
- Labetalol (Trandate®) 20-80 mg i.v. bolus for 5-10 min., followed by 2 mg/min. i.v.-infusion. Adverse events (AE): nausea, AV-bloc.
- Urapidil (Ebrantil®) 20mg i.v. bolus, 10-20 mg/h i.v.

- **Oral medications:**

- Nifedipin (Adalat retard®) 20 mg p.o., (repeat after 15-30 min. if required). AE (adverse events): delayed prolonged hypotension; in patients with aortic stenosis.
- Captopril (Lopirin®) 25 mg p.o., (repeat after 15-30 min. if required). AE: renal failure in patients with bilateral renal artery stenosis.
- Clonidin (Catapresan®) 0,15 mg p.o., (repeat after 30 min. if required for a maximal dose of 0.6 mg). AE: Hypotension, Sedation.
- Labetalol (Trandate®) 200-400 mg p.o., (repeat after 30 min. if required). AE: bronchospasm, AV-bloc.

FOLLOW-UP

Once the procedure has been completed, this is not the completion of the CAS process. It is important that the staff on the ward to which the patient is transferred is familiar with the procedure, and the possible complications. Local protocols should be produced for the ward management, including awareness that the patient may have a unilateral dilated pupil secondary to the use of atropine/glycopyrolate (particularly if this has been administered via the unilateral carotid sheath).

- Monitoring of blood pressure and pulse rate for 24 hours: Many patients may have a variable period of hypotension and bradycardia following the CAS procedure. In the majority of patients this episode is both asymptomatic and harmless. However in some patients (e.g. those with symptomatic coronary or renal disease) this period of hypotension needs to be carefully monitored, and in some cases treated with fluid replacement or vasoactive substances. In addition, hypertension following CAS may predispose to intra cranial bleeding, and so persistent hypertension should be treated. Headaches following CAS may be an indication that reperfusion injury may be imminent, necessitating the use of blood pressure lowering agents (IV nitroglycerin, nitroprussid or labetalol, urapidil). Such manipulations may require the use of invasive intra-arterial monitoring and the use of Intensive Care facilities.
- Monitoring of neurological status.

If the circumstances are favourable and the patients observation satisfactory, it may be possible to allow the patient home the same day as the procedure (or within 24 hours).

It is generally recommended that dual antiplatelet therapy (Aspirin 70-300 mg/day, Clopidogrel 75 mg/day) has to be continued for a period of 3-6 month following CAS.

It is also important for CAS, as with other procedures, that a thorough audit process is followed, after the procedure.

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Hemodialysis Fistulas

INDICATIONS FOR FISTULOGRAPHY

Vascular access has a high incidence of complications, in particular thrombosis. It is estimated that arteriovenous fistula (AVF) have an incidence of 0.2 per patient/year and for grafts 0.8-1 per patient/year. Using prospective surveillance improved cumulative patency of up to 70% can be seen in combination with prophylactic surgery or PTA. Monitoring of venous pressure, flow or both combined with PTA reduces the incidence of thrombosis in grafts to <0.5 events per patient/year.

Surveillance assessment of fistula indicative of a significant stenoses of >50% or presence of accessory veins i.e:

- difficulty during cannulation,
- frequent withdrawal of clots,
- increased venous pressures,
- decreased flow rates at dialysis (<500-600mL/minute in autogenous AVF's and <600-800mL/minute for grafts) or
- reduction of 20-25% compared to previous measurements
- Increase in the ratio of aIAP(arterial Intra-access Pressure) / vIAP (venous Intra-Access Pressure) by 0.2 units over time is also indication for evaluation.

Criteria for referring patient for angiography/intervention using intra-access pressure in AVF:

Stenoses degree	aIAP/MAP	vIAP/MAP
<50%	0.13 to 0.43	0.08 to 0.34
>50% in:		
Venous outflow segment	≥ 0.44	or 0.35
Mid-segment	≥ 0.44	and <0.35+
Arterial inflow segment	< 0.13 +	clinical signs
	clinical signs	

Pressures are normalized for mean arterial pressure at the arterial puncture site (aIAP) and at the venous puncture site (vIAP).

Most vascular access stenoses are located at the arteriovenous anastomosis of AVFs and at or near the venous anastomosis of arteriovenous grafts (AVGs). Early detection and treatment of stenoses may prevent hemodialysis access thrombosis and, therefore, may prolong the life of dialysis access fistulas and grafts. It is for this reason surveillance should be performed on all AV fistulas and grafts. The NKF-K/DOQI guidelines for vascular access recommend the use of vascular adequacy parameters and physical examination for monitoring AVF and AV grafts. The methods for surveillance of AVF are summarised in Table 1.

Table 1 Methods of surveillance for arteriovenous fistula (AVF)

Clinical Evaluation	Recirculation	Blood flow measurement
Physical evaluation	Static access pressure	Doppler ultrasound
Bleeding time	Arterial intra-access pressure	Thermal dilution
	Arterial intra-access pressure	
	Dynamic venous pressure	

Clinical evaluation

Physical evaluation

Bleeding time

Recirculation

Static access pressure

Arterial intra-access pressure

Venous intra-access pressure

Dynamic venous pressure

Blood flow measurement

Doppler ultrasound

Thermal dilution

The optimal surveillance method has so far not been identified and may be different for grafts and AVF's. Venous pressures for example is less accurate in AVF's than in grafts and static venous pressures with a SVP rate of >4 in grafts result in a sensitivity and specificity of the predictive value of thrombosis within 1 month of 73% and 47%. With a threshold of >0.5, it is 48% and 75% respectively.

IMAGING PRE-PROCEDURE

Direct imaging other is generally performed when these surveillance techniques suggest a significant stenosis. Several imaging modalities are available for the depiction and localization of access stenoses.

- Color Doppler ultrasonography (CDUS) is a readily available, inexpensive, and non-invasive method, although the quality of the images depends on the skill of the operator. Other drawbacks of CDUS are the inaccurate detection of central venous obstruction and the absence of an angiographic map, which may be desired for surgery or percutaneous therapy.
- Digital subtraction angiography (DSA) is the gold standard for the evaluation of access patency.
- Contrast-enhanced magnetic resonance angiography (CE-MRA) and Computer tomography angiography (CTA) have also been introduced for the evaluation of failing access fistulas and grafts.

INDICATIONS FOR INTERVENTION

- Significant stenoses >50%,
- Occlusion or
- Presence of accessory veins.

CONTRA-INDICATIONS FOR INTERVENTION

- Local sepsis
- Severe derangement of clotting parameters

DRUG THERAPIES IN DIALYSIS ACCESS

Antiplatelet agents

There is some evidence to support the beneficial effects of using antiplatelet agents. However there is no direct evidence of an impact on the incidence of stenosis and intimal hyperplasia.

Heparin

Although heparin is routinely administered at the time of angioplasty (PTA), there is no evidence of improved outcomes or data from randomized trials to show any superior efficacy to angioplasty without heparin.

Thrombolytic agents

Thrombolytic agents have been used very successfully in the management of blocked arteries and grafts in peripheral vascular disease as well as on the venous circulation to prevent post thrombotic syndrome. More recently these agents including the newer drugs such as Tenecteplase have been used very successfully in blocked grafts. These agents can be used either on their own or with in combination with mechanical thrombectomy to clear blocked grafts and AVF's . However additional PTA or surgery will almost certainly be required in addition to these, to treat the underlying stenosis.

While the immediate success rate is higher in grafts (99% v. 94% for forearm grafts and fistulas), the primary patency rates are higher for AVF's compared to grafts (49% v. 14%). One year secondary patency rates are 80% and 50% respectively for forearm and for upper arm AVF's. There are few randomized trials comparing surgical and thrombolytic therapy. The study by Dougherty et al showed equivalent outcome but a higher cost for thrombolysis with PTA. However meta-analysis of studies looking at salvage of thrombosed grafts suggests a higher failure rate for endovascular management and a poorer primary patency.

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Hepatocellular Carcinoma (HCC)

INTRODUCTION

Hepatocellular carcinoma (HCC) is the fifth most common cancer in the world and the fourth most common cause of cancer related death. HCC will kill almost all patients who have it within a year. There are data as to survival in untreated patients with HCC which show that the major factors influencing overall survival are severity of underlying liver dysfunction and tumour size at initial detection. Between 50 and 90% of patients with Child-Pugh A cirrhosis will survive a year untreated compared with only 20% with Child-Pugh C.

There is a strong association of hepatocellular carcinoma (HCC) and liver cirrhosis, hepatitis B and C virus (HCV) infection, chronic alcohol consumption, aflatoxin B1, estrogens, hemochromatosis, primary biliary cirrhosis, and primary sclerosing cholangitis. In HCV infection there is compelling evidence that HCC development occurs with higher frequency at an advanced stage of the liver disease: up to 30% of patients undergoing liver transplantation for end stage HCV cirrhosis have undetected HCC found in the explanted liver.

TREATMENT OPTIONS

Medical treatment has not proven to be effective so far. However, some trials are under way (e.g. Thalidomide, Avastin).

Surgery remains the only proven potentially curative option for patients with HCC. However, as a result of underlying cirrhosis, only a minority are candidates for curative surgical resection: patients with limited disease (1 tumour <5 cm or three tumors <3 cm each) should be evaluated for transplantation or surgical resection as the first option. Resection is suitable only for patients with preserved liver function (Child-Pugh A).

Percutaneous treatment has two options: percutaneous ethanol injection (PEI) and radiofrequency ablation (RF). PEI has been shown to produce necrosis of small HCC and is best suited to peripheral (e.g. subcapsular) lesions < 3 cm in diameter. The complete ablation of the tumour requires several sessions of PEI, with a complication rate less than RF. In large series, complete response rates of 75% in tumours < 3 cm in diameter have been reported, with five-year survival rates of 35-75%. These studies have generally been restricted to patients with good underlying liver function. One problem in the interpretation of the outcome in these series is that biopsy or fine needle aspiration diagnosis of HCC was not obtained in all series and possibly, tumours < 2 cm that are not HCC are included. RF is a good alternative ablative therapy to PEI, with the best results with an average of approximately 1.2 treatment sessions to obtain complete tumour necrosis, but it also has a higher complication rate and data suggest a possibly higher rate of tumour seeding. A single probe can destroy lesions of up to 3 cm, and a multiple tipped probe or placing the radiofrequency needle in different parts of the tumour has been used to target lesions of up to 6 cm in diameter.

Chemoembolization is a palliative treatment and has demonstrated to significantly improve survival versus symptomatic treatment. Poor outcomes can be directly linked to treatment of patients with advanced disease and to administration of excessive therapy. These outcomes reinforce the need to treat patients with well-compensated cirrhosis and to repeat therapy only when a viable tumour is present on cross-sectional imaging. Patients with small tumours may also be considered for percutaneous ablative therapies alone or in combination with chemoembolization. Side effects of chemoembolization are those of the chemotherapeutic agent used (usually doxorubicin) in addition to the complications of arterial embolization, such as pain, fever, hepatic failure, and rarely infarction of organs other than the liver.

LABORATORY EXAMINATIONS

- Alpha-fetoprotein: The commonest clinical situation is a patient with a mass discovered on ultrasound where alpha-fetoprotein (AFP) may or may not be increased. If the patient is known to have pre-existing cirrhosis and the mass is > 2 cm in diameter, there is a greater than 95% chance that the lesion is a HCC. If AFP is elevated, this confirms the diagnosis and further investigation is only required to establish the most appropriate therapy. If AFP is normal two positive imaging tests are diagnostic for HCC. Therefore, further radiological imaging which will usually be contrast enhanced CT or MRI should be performed.

The normal range for AFP is < 10 ng/ml and a level >500 ng/ml is usually regarded as diagnostic. Moderate levels up to 400 ng/ml can be seen in patients with chronic hepatitis. Two thirds of HCCs less than 4 cm, however, have AFP levels < 200 ng/ml and up to 20% of HCC do not produce AFP, even when they are very large.

Therefore alpha-fetoprotein is diagnostic in only 60% of HCC.

- Des-gamma-carboxyprothrombin has been used as an alternative tumour marker for HCC; 67% of HCC have elevated levels but only 8% of small (<2 cm) HCCs have abnormal levels and it has not gained wide acceptance. Using AFP testing also produces false positives; levels in the range 20-250 ng/ml are frequently seen in regenerating nodules in viral cirrhosis. A rise in AFP over time, even if the level does not reach 400 ng/ml, is virtually diagnostic as HCC.

Before treatment, preprocedural evaluation also includes laboratory evaluation with

- Full blood count,
- Coagulation parameters including prothrombin time, INR (international normalized ratio - INR will be increased if synthesis of vitamin K-dependent coagulation factors has been impaired), aPTT (activated partial thromboplastin time) and platelets
- Liver function including
 - Total bilirubin,
 - Aspartate aminotransferase (AST) or serum glutamic oxaloacetic transaminase (SGOT) raised in acute liver cell necrosis but not liver specific and also in muscular tissue. The reference range is 0-45 U/L in most laboratories.
 - Alanine aminotransferase (ALT) or serum glutamic pyruvic transaminase (SGPT) is present in hepatocytes only. The reference range is 0- 50 U/L in most laboratories.
 - Serum albumin levels are decreased in chronic liver disease, such as cirrhosis.
 - Alkaline phosphatase (ALP) is an enzyme in the cells lining the biliary ducts of the liver. ALP levels in plasma will rise with large bile duct obstruction, intrahepatic cholestasis or infiltrative diseases of the liver. The reference range is usually 40-150 U/L.
 - Gamma glutamyl transpeptidase (GGT) is reasonably specific to the liver and a more sensitive marker for cholestatic damage than ALP. GGT is raised in alcohol toxicity (acute and chronic).

- Kidney function including
 - serum creatinine, blood urea nitrogen (BUN) and electrolytes.

During follow-up: Immediately after chemoembolization liver enzymes such as AST and ALT may rise up to 500 U/l or more. Serum values of more than 1000U/l are highly suggestive of liver failure and may require a more intensive observation of the patient and a prolonged hospital stay. Before additional chemoembolization sessions the laboratory tests as mentioned above should be performed again to ensure the patient is still an appropriate candidate.

Exclusion criteria to chemoembolization based on laboratory values are not definitively established. However, the constellation of

- severe ascites,
- hepatic encephalopathy,
- bilirubin level > 3 mg/dL, which all together are parameters for
- liver cirrhosis Child-Pugh C,
- more than 50% liver replacement with tumour,
- lactate dehydrogenase level > 425 mg/dL,
- aspartate aminotransferase level > 100 IU/L, and
- serum creatinine > 2 mg/dl

has a strong association with increased post procedural morbidity and mortality.

Child-Pugh Score

Criteria for classification

- Total Serum Bilirubin
 - Bilirubin <2 mg/dl: 1 point
 - Bilirubin 2-3 mg/dl: 2 points
 - Bilirubin >3 mg/dl: 3 points
- Serum Albumin
 - Albumin >3.5 g/dl: 1 point
 - Albumin 2.8 to 3.5 g/dl: 2 points
 - Albumin <2.8 g/dl: 3 points
- INR
 - INR<1.7: 1 point
 - INR 1.7 to 2.20: 2 points
 - INR >2.20: 3 points
- Ascites
 - No ascites: 1 point
 - Ascites controlled medically: 2 points
 - Ascites poorly controlled: 3 points
- Encephalopathy
 - No encephalopathy: 1 point
 - Encephalopathy controlled medically: 2 points
 - Encephalopathy poorly controlled: 3 points

If using PT alone instead of INR then:

- < 4 s prolonged: 1 point
- 4-6 s prolonged: 2 point
- >6 s prolonged: 3 point

Classification

Child Class A: 5 to 6 points

Child Class B: 7 to 9 points

Child Class C: 10 to 15 points

Okuda staging system

Finding / score	0	1
Tumor size	≤ 50%	>50%
Ascites	absent	clinically detectable
Serum albumin	≥ 3 mg/dL	<3 gm/dL
Serum total bilirubin	≥3 mg/dL	>3 gm/dL

Staging: Stage 1 = 0; stage 2 = 1 or 2; stage 3 = 3 or 4

Imaging and Follow-up

Ultrasound can detect large HCCs with high sensitivity and specificity. It is less able to reliably identify smaller lesions, which is required if better therapy is to be offered. Expertise of the team is important in enhancing results: ultrasound detects 85-95% of lesions 3-5 cm in diameter and can achieve 60-80% sensitivity in the detection of lesions of 1 cm. However, detection of lesions below 2 cm by ultrasound is uncommon. Combining AFP and ultrasound improves detection rates. Ultrasound screening was initially suggested at six monthly intervals on the basis of tumour doubling time. There is some evidence that more frequent examinations may enhance sensitivity but at the expense of more false positive tests. Patients with a negative ultrasound and an elevated but not diagnostic level of AFP appear to be at high risk and more frequent ultrasound examination in this group, probably three monthly, may have a higher yield.

Radiological imaging with ultrasound, CT, and angiography usually understages HCC. The development of ultrasound contrast agents and MRI, using iron or gadolinium contrast agents, may enhance the ability to detect satellite or second distant lesions within the liver.

All patients should undergo **preprocedural contrast material-enhanced** CT of the thorax and abdomen to ensure that the disease is liver-dominant. The main portal vein should be evaluated and patent or collateral flow should be present with hepatopedal flow, if chemoembolization is the therapy option.

Biopsy is rarely required for diagnosis, and seeding of tumour in the needle tract occurs in 1-3%. Biopsy of potentially operable lesions should be avoided where possible.

Postprocedural imaging follow-up after chemoembolization should be performed at 4-6 weeks. Signs of tumour necrosis on CT include pattern distribution lipiodol and absence of arterial-phase enhancement when it was present before chemoembolization. Disappearance of arterial enhancement is the principal determinant of tumour necrosis on MRI. Gross enlargement of a lesion or nodular enhancement in portal vein or delayed phase imaging has been described as evidence of residual or recurrent tumour after radiofrequency ablation of lesions without initial arterial phase enhancement. Similar findings may be present in the setting of residual or recurrent tumour after chemoembolization.

Patients without active disease at follow-up should undergo imaging every 3-4 months. Individuals with HCC require further treatment when new or residual disease is detected.

EASL Response Criteria

Complete Response (CR)

complete disappearance of all known disease and no new lesions

Partial Response (PR)

50% reduction in viable tumour area of all measurable lesions via uptake of contrast in the arterial phase of a Triphasic CT scan

Stable Disease (SD)

all other cases

Progressive Disease (PD)

25% increase in size of one or more measurable lesions or the appearance of new lesions

Objective Response

CR and PR

Medication and pain treatment

Premedication before chemoembolization must be standard.

- Hydration is essential with intravenous administration of normal saline solution.
- Antiemetics should be continued as long as needed. The 5-HT₃ inhibitors are the most effective antiemetics. Approved 5-HT₃ inhibitors include: Dolasetron (Anzemet®), Granisetron (Kytril®), and Ondansetron (Zofran®), and Palonosetron (Aloxi®).
- Pain treatment:
 - Embolization usually causes pain in the epigastric area due to liver capsule tension. A cocktail infusion of NSAIDs and opioids such as Tramadol is recommended to relieve pain during and immediately post treatment.
 - Percutaneous treatment with PEI and RF ablation is preferably done under general anaesthesia or pain control of an anaesthesiologist.
- Sedative medication management (Midazolam) is highly recommended during the percutaneous treatment and also during chemoembolization.
- Antibiotic coverage immediately before and at least in large tumours for 3-7 days after chemoembolization for gram-negative enteric organisms is recommended.

Postoperative care

After percutaneous treatment and chemoembolization the patient has to be hospitalized for at least 1 day. During the stay the following parameters have to be checked:

- Clinical parameters:
 - Signs of bleeding - pulse, blood pressure, hematocrit
 - Pain and nausea
 - Fever - low grade fever of less than 38° C for up to 5 days is observed in 50% of the patients.
- Laboratory parameters:
 - complete blood count,
 - liver function including total bilirubin, AST, ALT, ALP, and GGT.
 - kidney function including serum creatinine, blood urea nitrogen (BUN) and electrolytes.
- Imaging is usually not required. However, in case of complications (e.g. bleeding) US or CT may be required. Gas bubbles within the tumour after RF ablation or chemoembolization are normal and not suggestive for infection.

The post embolization or post treatment syndrome with pain, nausea and fever should be treated with hydration, NSAIDs and 5-HT₃ inhibitors. Immediately after chemoembolization liver enzymes such as AST and ALT may rise up to 500 U/l or more. This does not need any specific treatment. However, serum values of more than 1000 U/l are highly suggestive of liver failure and may require a more intensive observation of the patient and a prolonged hospital stay. At least in patients with large tumours or any clinical signs of sepsis an antibiotic treatment for gram-negative enteric organisms is recommended.

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Neuro-Endocrine Tumours (NET)

Neuroendocrine tumours (NETs) represent a heterogeneous group of neoplasms originating from neuroendocrine cell compartments such as gastrointestinal and respiratory tracts.

Many different physicians (surgeon, oncologist, pathologist, nuclear medicine expert and radiologist) must hence cooperate to offer the proper therapeutic option for each patient.

Even though surgery is the only available curative treatment, the overall therapeutic approach should comprise:

- symptoms control with somatostatin analogs,
- surgical or radiological debulking (in case of metastatic disease) and
- radionuclide therapy (Y90DOTATOC) combined with -INF or chemotherapy in case of poorly differentiated lesions.

Successful treatment of disseminated NETs requires a multimodal approach that should be adapted to every single patient.

Radiologists play a role not only in diagnosing, staging and making the follow-up, but they can also consider interventional therapeutic options available, such as arterial transcatheter chemoembolization (TACE).

Since the presence of metastasis is closely associated with a more aggressive biological behavior and with a poor prognosis, hepatic lesions can be an ideal target for loco-regional treatments such as TACE in order to increase survival. Hepatic metastases from gastroentero-pancreatic NETs usually show a hypervascular arterial vascularization which is the most important rationale for TACE.

Furthermore, when symptoms of carcinoid syndrome depend on hepatic disease TACE is a therapeutic option.

PATIENT SELECTION

A multimodal approach is the best way to manage NETs liver metastatic patients for both diagnosis and treatment. Different physicians (surgeon, oncologist, pathologist, nuclear medicine expert and radiologist) should get together regularly (neuroendocrine meeting) to take any decision about patients with NETs. In patients with liver metastases, the main problem is to find the best combination of treatments. Therefore TACE could be a useful alternative to chemotherapy in patients with progressive hepatic metastases, but the most difficult decision is whether this treatment should be used early or late during the course of the disease.

Debulking

- **Surgery (Primary and metastatic tumours)**
- **TACE (metastases)**

Cytoreduction**Disease Control**

- **Radionuclide therapy (DOTATOC)**
- **Chemotherapy**

Symptoms

- **Somatostatin analogs**
- **Alfa - Interferon**

INDICATIONS

Even if NET is usually associated with a better prognosis compared to other epithelial tumours, development of liver metastases is related to a 5 years survival rate less than 50% and is usually associated with deterioration of a patient's quality of life.

Surgical resection of primary tumours is still considered the treatment of choice in NET, sometimes even in patients with synchronous metastatic disease. However treatment of liver metastases is usually associated with a better outcome and many local treatments have been reported as effective in hepatic tumour control. Concerning local treatments, TACE is the most frequently employed technique in progressive hepatic metastases (Endocrine Review June 2004, 25(3), 458-511).

EVALUATION BEFORE TREATMENT AND FOR FOLLOW-UP

Imaging

Most of the available imaging techniques could be useful for managing patient with NET, both for morphologic and functional purposes. Some of them play an essential role for staging and for local treatment planning (CT, MRI and Octreoscan) meanwhile other examinations are indicated mainly for follow up.

When local treatment for liver metastasis from NETs is indicated, imaging should be focused mainly for local staging and anatomical findings. Number, dimension and location of liver nodules are crucial in treatment planning, first of all for TACE, which should be closely tailored in each different patient.

In our experience, multi detectors enhanced spiral CT (MDCT) easily allow for lesions detection and location. The latter is very important in case of multisession treatment planning, together with the vascular intrahepatic anatomy, coming from angiography. Post processing 3D and MIP reconstruction of early arterial phase of enhanced MDCT may be very helpful even for providing very important finding in vascular anatomy such as variation as well as pathological modification that can technically influence the vascular approach (brachial vs. femoral access). MDCT can give a well detailed vascular map showing the right vessel for each lesion. That way angiographic-time is shorter and no diagnostic runs is required.

Anyway if CT is more sensible in detecting lung metastases, MR is often required when bone metastases are supposed, because of his high sensitivity (J Nucl Med 2003; 44(2):184-191). Moreover, MRI is still considered the gold standard for lesion characterisation, even when it is important to detect residual tumor tissue after local or systemic therapy. For this purpose, functional imaging such as somatostatin analogs scintigraphy (111- In Octreotide, Octreoscan) should be always considered before and after any treatment.

Biopsy for histologic assessment is usually required.

Combination of functional and anatomic techniques is usually required and the interventional radiologist must be skilled in matching octreoscan uptake together with morphological CT finding:

- TACE indication is usually given with the only intention to reduce the amount of tissue with somatostatin receptor followed by DOTATOC.
- Functional imaging plays a key role for TACE programme. If a secreting lesion is treated an effective medication should be given before and after procedure (see intro scheme) to avoid or reduce carcinoid symptoms.
- When possible post TACE evaluation should be done not only with CT scan to check lipiodol uptake and contrast enhancement. Octreotide scintigraphy can clearly show functional reduction of treated lesions (fig 1).

Fig 1a: NET's liver metastases before TACE. CT lesions and octreotide scintigraphy matching

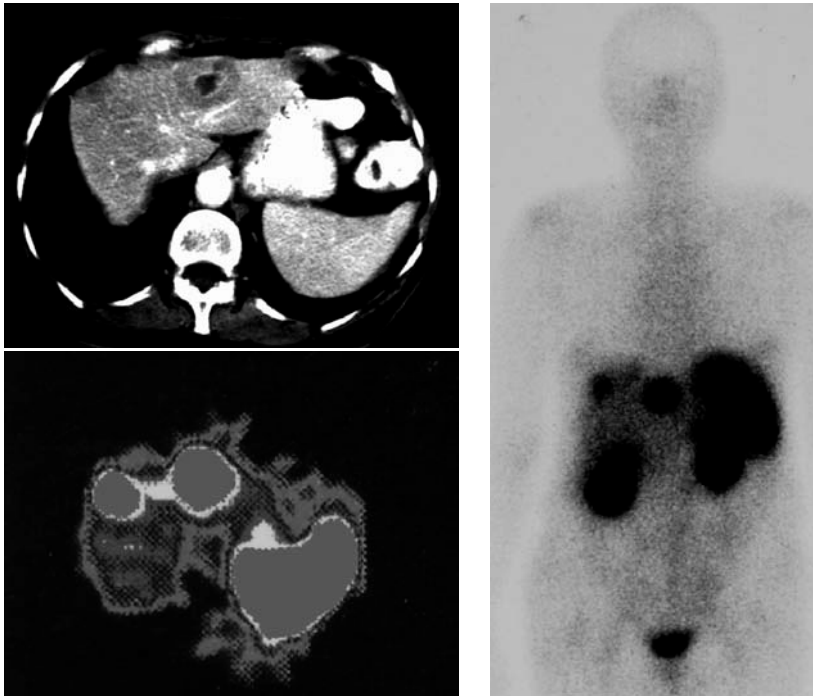
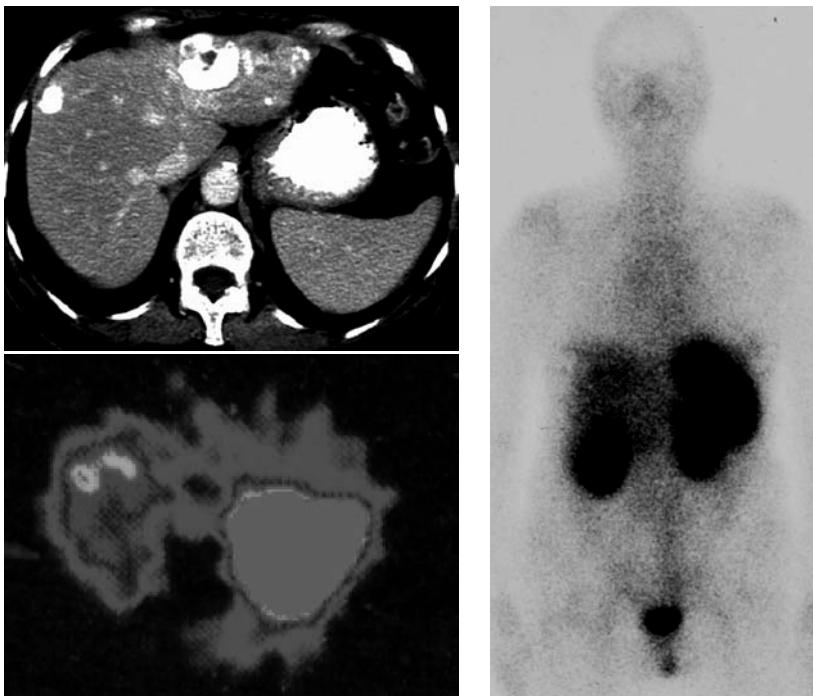


Fig 1b: NET's liver metastases after TACE. CT lesions and octreotide scintigraphy matching



TREATMENT

Treatment Schedule

- Debulking, surgery if feasible and/or one or more courses of chemoembolisation
- Octreotide scan to test for octreotide receptor positive metastases
- Radionuclide therapy (DOTATOC) followed by systemic chemotherapy

During all the above steps somatostatin analogues and alpha-Interferon for symptoms control.

- Debulking purposes of the main hepatic lesion or controlling the biggest number of lesions should be the end point of local treatment, as shown in the selection flow-chart reported into the introduction. For multimodal treatment approach in this way we may obtain a better radionuclide distribution, outside the liver, into the pathological tissues located elsewhere in the whole body. Therefore multisession technique for TACE is considered the gold standard treatment in order to reach the optimal synergic effect together with radionuclide therapy and for reducing side effect of both therapies: 1) renal failure (middle to high risk after DOTATOC); 2) post TACE syndrome.
- Even if a single liver lesion is a very uncommon clinical offset, treatment strategy could change undertaking loco-regional options such as radiofrequency ablation alone or together with particle embolization.
- Even if symptoms can be easily controlled with somatostatin analogues in the majority of patients affected by functioning neuroendocrine tumor, TACE role in hepatic mass control has not to be underestimated. Chemoembolization must be also considered an effective tool in controlling carcinoid syndrome for patients not responding to the long-acting medical treatments (Radiology 1993 Nov; 189 (2):541-7) when the main amount of secreting neoplastic tissue is located in the liver.

Before treatment

All clinical characteristics have to be considered such as age, general conditions, comorbidity factors, recent blood tests and the radiological evaluation (US and CT scan). The most important point that should be focused on is the liver reserve: the potential capacity to respond to TACE in order to maintain the liver function. This can be evaluated by means of:

- hepatic function blood tests (serum bilirubin, albumin, alkaline phosphatase, transaminases, prothrombin time and blood count.)
- radiological considerations: percentage of normal liver parenchyma left by metastatic involvement, portal vein patency, ascites.

The patient is residing in the hospital at least 3 days: during this time the patient is completely in charge of interventional radiologist. Since he already knows all details regarding TACE, informed written consent is easily obtained.

The day before procedure he undergoes:

- medical examination
- cardiologic evaluation
- new blood tests (only if the waiting time has been longer than 3-4 weeks)
- hydration plus
 - methadone chlorhydrate 10 mg,
 - octreotide 1 mg,
 - metoclopramide 40 mg
- All drugs are delivered during the 12 h before chemoembolisation.

During the procedure

The procedure is done when is possible by 2 interventional radiologist with nurse assistance; patient parameters (arterial blood pressure, oxygen saturation and heart rate) are under constant control.

The patient receives an infusion cocktail to reduce pain and nausea:

- NSAIDs (e.g. paracetamol 4g)
- Opioid (e.g. tramadol 400 mg or methadone chlorhydrate 10 mg)
- Antiemetic (e.g. metoclopramide 40 mg or ondansetron 8mg)
- When soft or deep sedation is required we use midazolam 1-5 mg i.v. with special attention to blood saturation: it should be used carefully because of previous medication with opioids.
- Octreotide 1 mg
- Antibiotic coverage is required (e.g. ciprofloxacin 500mg)

A technical aspect that strongly regulates clinical output is the choice to treat with super selective catheterisation a single or a small amount of lesions each TACE in order to avoid a broad "carcinoid syndrome" that could bring patient close to liver failure and to heavy discomfort during hospitalisation.

After treatment

In the next hours following treatment the patient has to get

- more hydration (3000 ml saline solution/24 hours) and goes on with the same drugs than the day before:
- methadone chlorhydrate 10 mg,
- octreotide 1 mg,
- methoclopramide 40 mg
- antibiotic therapy started (e.g. ciprofloxacin 500mg/day) for at least 5 days.

In case of flushing, diarrhoea and swelling octreotide 1 mg s.c. is given. In case of temperature higher than 38 C° paracetamol 1 g po. is given.

Every morning liver blood test and blood count are checked in order to control the liver damage.

When blood tests and clinical conditions are progressing toward normalisation patient is discharged with following instructions:

- MDCT scan 1 month after treatment
- Tramadol: 1 tablets in case of abdominal pain
- Blood test after 1 week (send results by fax)
- Clinical evaluation with referring physician after CT scan

The last step is the same of the beginning: new multimodal discussion in order to evaluate TACE clinical impact.

FOLLOW UP

- Post procedural care: during the days following TACE patient should still be in charge of interventional radiologist. As already recorded clinical complete check is needed: daily abdominal visiting and pain observation looking for early complications. Vital signs such as blood pressure and urine output are fundamental especially for functioning tumor at least for the first days after. Temperature should not rise over 38 C° earlier than first week but has still to be checked together with white cells count for infective complications control. Monitoring of liver function tests may help to assess the hepatic response after TACE.
- Post discharge: this is a very delicate moment for the patient. It is important that patients should not feel neglected. Therefore, the IR should continue to provide care as an outpatient so that he retains the trust of the patient. A clinic visit with blood test should be performed one week after discharge. The patient should be provided with a phone no. or an e-mail address to contact in case of need.
- Late follow-up: if no complications occur and outpatient blood tests fit to a post TACE situation a MDCT scan is performed one month after discharge. After a multidisciplinary discussion, the next most appropriate therapeutic steps should be chosen:

for example

- Switch patient to DOTATOC treatment if enough amount of somatostatin receptors and neoplastic tissue is reduced.
- Repeat TACE because a considerable amount of non treated lesions (with or without somatostatin receptors) are still growing while treated ones are reduced.

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Uterine Fibroid Embolization (UFE)

INDICATIONS AND CONTRAINDICATIONS

The gynaecologist and interventional radiologist should closely cooperate in establishing the indication for fibroid embolization and carefully weight the indications and contraindications in light of the range of therapeutic options available for the individual patient. UFE must not be performed without careful pre-interventional diagnostic workup of the patient's symptoms by the gynaecologist.

INDICATIONS

- Symptomatic leiomyoma:

UFE is an alternative therapeutic option in patients with symptomatic leiomyoma who would otherwise undergo surgery.

The "ideal" candidate for UFE is

- a symptomatic premenopausal woman
- with a single or multifibroid uterus
- in whom surgery is indicated and
- who does not desire to preserve fertility and
- prefers a minimal invasive intervention.

As a rule, both single and multiple fibroids can be treated by UFE. The number and location of the individual tumours (subserosal, intramural, transmural, submucosal) does not affect the approach or technique of UFE. Kido et al. reported successful treatment even in diffuse leiomyomatosis of the uterus.

Nevertheless, one must always thoroughly evaluate the clinical symptoms, imaging findings, and the patient's preferences on an individual basis to decide when UFE should be preferred to uterus-sparing surgical approaches or hysterectomy. This holds especially true for submucosal fibroids, which can often be resected hysteroscopically and are more often associated with symptomatic expulsion, chronic vaginal discharge or infection if embolized.

RELATIVE CONTRAINDICATIONS

The **limitations** of UFE still need to be defined and valuable studies have been performed to analyze the efficacy of UFE in subgroups of patients.

- **Subserosal pedunculated and intraligamentous fibroids:** Embolization of subserosal pedunculated and intraligamentous fibroids is considered more risky because postprocedural necrosis of the tumours may cause peritoneal adhesions and decomposition of the fibroids into the free abdominal cavity. However, Katsumori et al. reported excellent results for patients with pedunculated subserosal fibroids which have been a concern to many interventionalists.
- **Size:** From the interventional radiologist's perspective, there is no size limit above which it becomes technically impossible to perform UAE. Early reports on higher complication rates in fibroids > 10 cm were not confirmed by later studies, which found good clinical results after embolization of large uterine leiomyomas. However, the patient must be aware that a markedly enlarged uterus will persist after UAE despite shrinkage of the fibroids. Spies et al. reported that women with a volume reduction of less than or equal to 30% were three times more likely to be dissatisfied with outcome than women with greater than or equal to 56% volume reduction.

- **Wish to conceive:** Since data on the effect of UFE on fertility and the course of pregnancy after UFE is still inadequate, the wish to conceive is a contraindication to embolization in those women in whom other therapeutic approaches (e.g. laparoscopic/abdominal myomectomy) are an option. While the majority of reports did not find an effect of UFE on ovarian function in younger women, patients >45 years may experience amenorrhea more often. Hormonal changes can be observed in this group of patients but their significance is unclear to date while the data on fertility after UFE suggests that uneventful pregnancies are possible, there are still too few studies to draw definite conclusions.
- **Adenomyosis:** UFE for adenomyosis occurring either alone or in conjunction with uterine leiomyomas is still under investigation. Contrary to previous reports, UFE has been shown to be effective in the mid- and long-term for both scenarios although less effective than for fibroids alone.

CONTRAINDICATIONS

UFE should not be performed

- in patients with **contraindications to angiography** (uncorrected clotting disorder, renal insufficiency, manifest hyperthyroidism)
- in **women with pelvic or urogenital infections (adnexitis, endometritis, urinary tract infection), adnexal tumor, status post pelvic radiotherapy, and suspected malignant tumour.** However, UFE may be considered as a treatment alternative in immunocompromised patients with HIV infections, as reported by Prollius.
- Patients unwilling to undergo follow-up examinations is a relative contraindication because follow-up is absolutely necessary to evaluate the success of the intervention and to identify and treat possible complications.

LABORATORY TESTS

Before UFE is performed in a patient, it is typically required that she has been seen by a gynaecologists and an interventional radiologist.

- **Gynaecologic examination:** In addition to the gynaecologic examination, a recent (within 12 months) Pap smear is required, and women with irregular periods (menorrhagia, metrorrhagia) should undergo endometrial sampling before UAE to exclude endometrial carcinoma or endometrial hyperplasia as the cause of bleeding. Patients with a history of pelvic inflammatory disease (PID) should have high cervical swabs and cultures for gonorrhoea and Chlamydia. If pregnancy cannot be excluded by patient history, a pregnancy test should be performed.

To proceed with UFE, a

- **Full blood count** should be taken. It is especially important to screen for anemia in patients with menorrhagia to have a baseline status for follow-up. Although blood transfusions are not needed during the procedure, one should be aware that fibroid expulsion and intense bleeding may occur early and late after UFE (Kerlan et al., 2003).
- **Coagulation parameters:** international normalized ratio (INR), platelet count, activated partial thromboplastin time and prothrombin time.
- **Renal function:** Serum creatinine level and blood urea nitrogen.
- Evaluation of a patient's reproductive hormone status is not routinely necessary. Given the fact that serum follicle-stimulating hormone (FSH) levels are extremely variable throughout a patient's menstrual cycle and no immediate consequences are drawn when it is known, measurement of the serum FSH level is of uncertain benefit.

IMAGING

Imaging of the uterus and adnexa is vital for patient selection for uterine artery embolization (UAE), both to confirm the diagnosis and to assess the extent of symptomatic leiomyomas. The diagnostic work-up is depending on local practice patterns, availability, and patient insurance coverage.

- Pelvic ultrasonography (US) has been commonly used prior to and following UAE. In the majority of cases, an US examination can provide sufficient detail to determine a patient's suitability for embolization and to identify relative contraindications such as endometriosis, adenomyosis, pelvic malignancy, pregnancy, and pedunculated fibroids.
- Contrast material-enhanced MR imaging exceeds ultrasound's technical limitations in precise fibroid mapping and characterization. Thus, MR imaging may result in a change in management. However, neither size, localization or MR signal intensity characteristics have shown to be useful predictive factors of clinical success. In addition, although some MR appearances may suggest uterine sarcoma, there is no accurate test available.

Following embolization, US can be used to monitor the regression or involution of fibroids. However, the amount of fibroid and uterine shrinkage does not correlate with the degree of symptomatic improvement at follow-up after embolization. The predictive of treatment failure is thought to be persistent perfusion of the fibroid. In terms of complications, the most common symptom manifesting late after this procedure is pain, caused by cramping, fibroid expulsion, sloughing of submucosal fibroids, endometriosis, or uterine abscess. None of these findings is well characterized with US, but can be adequately answered with contrast-enhanced MR imaging. Thus, MR imaging has important advantages over US in monitoring for post treatment changes and recurrences. The follow-up imaging protocol should include a single contrast-enhanced MR imaging study 3 - 6 months after embolization. If the fibroids are not completely infarcted, a contrast-enhanced MR imaging study should be performed at the time of clinical recurrence.

PATIENT INFORMATION BEFORE TREATMENT

To ensure an optimal therapeutic outcome and patient satisfaction, it is advisable to inform the patient during the initial consultation for UFE about the concept behind the treatment, potential side effects and the medication given alongside the procedure and offer time for questions. It is recommended to explain briefly the environment of an angio suite to the patient. The patient should then be informed about the level of mental awareness she can expect during the procedure combined with the offer to sedate her, if preferred. The preparation for the procedure including insertion of a Foley catheter, shaving, draping etc. and administration of local anesthesia are explained. The time course, duration, and severity of the postprocedural pain, the components of the postembolization syndrome and the corresponding medications that will be administered to relieve these temporary effects of UFE should be discussed. Certainly postembolization symptoms and potential complications have to be discussed.

MEDICATION AND PERI-PROCEDURAL CARE

UFE requires medication similar to many other procedures performed by interventional radiologists. However, certain differences exist regarding the optimal combination and time to administer these drugs during the pre-, peri- and post-interventional period. To ensure optimal periprocedural medical therapy, it is advisable to inform the patient during the initial consultation for UFE about the concept behind the medication given alongside the procedure and offer time for questions. The time course,

duration, and severity of the postprocedural pain, the components of the postembolization syndrome and the corresponding medications that will be administered to relieve these temporary effects of UAE should be discussed.

Although not elaborated upon here, vital sign **monitoring** including pulse oxymetry, blood pressure and ECG should be performed in all patients in order to detect and adequately treat and monitor respiratory depression, bradycardia and hypertensive episodes.

- **Sedation:** For sedation usually a short-acting benzodiazepine such as midazolam can be administered either intravenously or intramuscularly. Midazolam has the additional advantage of inducing retrograde amnesia, so patients do not recall details of the procedure. Additionally, a light level of sedation can be maintained, allowing the patient to assist in the procedure by keeping still (especially during roadmapping) and holding her breath as needed during angiographic runs. Effects of midazolam can be reversed by flumazenil, a specific benzodiazepine receptor antagonist that reverses benzodiazepine-induced effects.
- **Antibiotics:** On the day of the procedure, a broad-spectrum antibiotic covering relevant urogenital germs (i.e. cefazolin or metronidazole in combination with cefuroxime) is administered. Some IR administers additional doses for up to 7 to 10 days after the procedure. However, there is no proven benefit for either regimen and the latter may even lead to secondary problems such as allergies, diarrhea and fungal infections. Moreover, most infections occur long after discharge of patients from the hospital and are mostly related to fibroid sloughing and expulsion.
- **Analgesia:** Of paramount importance is controlled and timely analgesia to treat pain during and after UAE. Inadequate pain control is the most common reason for a patient's return or readmission to the emergency department after UAE and pain is the single most remembered side effect of the procedure. The severity of pain associated with UAE is not related to the size or number of fibroids. It varies significantly among patients and consists of an early ischemia-related component followed by pain that is modulated by the inflammatory response to tissue necrosis. Ischemic pain usually occurs by the end of the procedure. However, it may not become apparent until the patient is back in the ward. Pain levels peak within the first 6-8 hours and need to be addressed by a continuous and potent analgesia regimen. Pain may be constant, crampy or in waves, can be quite severe and is unrelated to the size, location or number of fibroids. However, pain may be aggravated in patients with adenomyosis and fibroids. Knowledgeable patients often express concern about the nature and course of pain symptoms when inquiring about UAE. It is therefore advisable to describe in detail the variable course, intensity and duration of pain, its causes and the treatment regimen at one's hospital. Moreover, it is of utmost importance to ensure that responsibilities for patient surveillance in the angio suite, during transfer and on the ward as well as the analgesia regimen including a plan of action / alternative medication in case of insufficient pain control are clear to everyone involved. Pain medication should be started after catheterization of the uterine artery and not after the procedure. Adjunct intra-arterial lidocaine remains controversial regarding its effect on procedural pain. While in a study by Zhan et al. it was shown to affect pain after UAE, Keyoung YA et al. found that intra-arterial lidocaine had no impact on analgesia requirement but induced spasm (Keyoung et al., 2001). Alternatives to intravenous opioids for pain control are spinal or epidural anesthesia. However, these analgesic regimens require the help of anesthesiologists, leading to a technically more complex scenario. Although the ischemic component is treated effectively by these measures, the inflammatory component needs to be addressed separately by NSAID medication.

A variety of **drugs** can be used for **analgesia during UAE**. PCA (patient-controlled analgesia) is commonly used as the primary analgesia.

- **Opioids** that can be used for PCA include fentanyl, morphine sulfate, and hydromorphone. Providing details on dosages and time of administration is beyond the scope of this chapter. IRs are advised to set up a protocol with the anesthesiology department to ensure appropriate dosage, mode of administration, monitoring and alternative pathways. In this respect it is also important for the IR to be familiar with the opioid antagonist naloxone.
- **Nonsteroidal Antiinflammatory Drugs (NSAIDs):** In addition to PCA, periprocedural regimens should include administration of NSAIDs such as ketorolac (i.v.) or ibuprofen (p.o). While the initial pain is usually described as constant, it may change to crampy over time. Administration of butylscopolamine relaxes smooth muscle and is effective in these cases.
- **Antiemetic agents** should be provided as needed. For nausea, intravenous antiemetic agents should be provided as needed. Ondansetron, a potent central-acting antiemetic (serotonin receptor antagonist) can be given intravenously. Metoclopramide and domperidone, two dopamin antagonists, may be of use as well but are usually not helpful in severe cases. Alternatively haloperidol, a neuroleptic drug, may be considered.

POSTPROCEDURAL CARE

Usually PCA and all other intravenous medications are discontinued one day after the procedure and an oral pain medication regimen is instituted. Nonsteroidal Antiinflammatory Drugs (NSAIDs), particularly ibuprofen, have been well documented to effectively reduce post-UFE inflammation and pain and should be continued after UFE for about 5 days and beyond as needed. Additional pain medication may include paracetamol (acetaminophen) which also has an antipyretic effect.

During bedrest the patient should receive standard prophylaxis against deep vein thrombosis.

Stool softeners may be prescribed since some patients may have problems resulting from opioid administration.

A detailed written discharge instruction should be provided for patients and explained before discharge. Patients should be instructed to call the IRs or a designated person in charge if severe pain, high fever, or any other symptoms of concern persist.

FOLLOW-UP

The role of the IRs is as important during follow-up as it is during preprocedure evaluation and the intervention itself. Patients regard the IRs as their treating physician and expect to receive post-procedure care and assurance during their convalescence as much as they do from our clinical colleagues. Moreover, the course of recovery and typical sequelae as well as complications are not well understood beyond the IR community. It is in the interest of the IRs and the patient to ensure that side effects and complications are adequately treated and inappropriate measures (e.g. hysterectomy) avoided.

Early follow-up

An early phone interview allows the IRs to verify the expected gradual decrease in pain and physical weakness patients experience after UFE. Patients are reassured, minor problems such as minimally increased temperature, onset of minor vaginal bleeding etc. discussed, and adequate pain medication checked. Some centres with an outpatient interventional radiology clinic may also see the patient at 4 weeks for a regular check-up. Four-week follow-up may also be performed by the patient's gynaecologist on condition that he or she is familiar with the typical clinical course after UFE.

Clinical and Imaging Outcome

It is important to be aware that uterine or individual leiomyoma size reduction is not a good indicator of the clinical success of UFE. Symptom relief remains the single most important measure of clinical success. Improvement in clinical symptoms is generally seen three months after the procedure. At this time, only negligible size reduction of fibroids may be observed. Interventional radiologists should be aware of this discrepancy since patients might be irritated by imaging reports and may need reassurance regarding the course of symptomatic improvement and size reduction of the fibroids treated.

While menorrhagia may improve as early as within the first cycle after UFE, bulk-related symptoms may take longer to recede. Transient amenorrhea for up to three cycles is common while permanent amenorrhea is uncommon. It is associated with patient age and rarely occurs in patients under the age of 45 years.

Follow-up imaging can be done by transvaginal ultrasound in those women who improve. At least one follow-up imaging exam is recommended and should include size measurements to verify fibroid shrinkage.

If patients do not report improvement of symptoms 4 months after UAE, the IRs should investigate the causes of failure. A detailed history of signs & symptoms in the preceding months should be collected to differentiate true persistence of symptoms from symptoms that may be related to ongoing fibroid sloughing, intrauterine residual fibroid tissue or infectious complications. In collaboration with a skilled gynaecologist, the IR should initiate adequate measures such as evaluation for infection and hysteroscopy to assess the uterine cavity (including hysteroscopic removal of residual fibroid).

Patients with persistent symptoms and no decrease or even an increase in uterine fibroid size should undergo contrast-enhanced imaging to rule out incomplete fibroid infarction after UFE and the possibility of a leiomyosarcoma.

MR imaging is particularly helpful in those patients who do not improve after 4 months following UFE. Typical imaging features are observed after fibroid embolization. The leiomyoma shows homogeneous low signal intensity on T2-weighted images after UFE, variably high signal intensity on T1-weighted images due to hemorrhagic infarction, and no enhancement after administration of a gadolinium-based contrast agent. MR imaging also depicts morphologic changes such as sloughing of fibroids in contact with the uterine cavity. The latter may be associated with vaginal discharge in patients having undergone UFE but do not require additional treatment in the majority of cases. MRI also identifies side effects and complications associated with UFE such as ongoing fibroid expulsion, endometritis, and uterine necrosis. In case of ongoing fibroid expulsion a dilated cervical os and leiomyoma tissue pointing towards the cervix may be observed. Endometritis is seen in 0.5% of cases after UFE, is associated with fibroid expulsion and usually responds well to antibiotics but may spread and result in septicemia if left untreated. At MR imaging tissue within the uterine cavity may be observed together with high-signal-intensity (retained) fluid on T2-weighted images. Punctuate foci of low signal intensity on T1- and T2-weighted images represent signal voids due to the presence of air. Contrast-enhanced MR images increase the conspicuity of intracavitary fluid collections and also depict hyperperfusion of inflamed adjacent endometrium. Contrast-enhanced MRI is helpful in determining persistent perfusion of fibroids after UAE which maybe the cause of clinical failure. It has been demonstrated that persistent perfusion may lead to regrowth of leiomyoma tissue and recurrence of symptoms.

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Vertebroplasty

INDICATIONS

The indications for vertebroplasty are listed below:

- Painful osteoporotic vertebral compression fracture (VCF), refractory to 3 weeks of medical treatment.
- Painful vertebral lesion due to aggressive lesion, such as hemangioma or giant cell tumor. If the lesion has an epidural extension sclerotherapy should be considered, once all the necessary precautions are taken (mapping of the anterior spinal artery in relation to the lesion).
- Painful vertebral lesion due to malignant or infiltrative lesion such as multiple myeloma or lymphoma. VP targets only pain relief. Specific tumor treatment should be provided.
- Painful VCF, associated with osteonecrosis, non union fracture or cystic degeneration.
- Reinforcement of the vertebral body or pedicle in conjunction with posterior surgical decompression.

CONTRAINDICATIONS

The contraindications are:

- Coagulopathy
- Oral anticoagulation medication: it may be prudent to stop Aspirin, LMWH (ie. Lovenox ®) and Clopidogrel (Plavix®), 7 days before injection, warfarin /coumadine (Coudamine ®) 5 days before injection.
- Infection at the injection site or systemic infection
- Pregnancy
- Motor deficit
- Medullar cone symptoms

A corticosteroid injection cannot be performed if there is:

- Uncontrolled diabetes
- Cushing syndrome

For a local anesthetic injection (with or without adrenaline):

- Allergy (can be tested)

LABORATORY EXAMINATIONS

Lab exams are the same as in any interventional radiology treatment. These include general blood examination and coagulopathy control. Anticoagulant drugs should be stopped. Limits are the same as in any interventional musculoskeletal procedure.

IMAGING

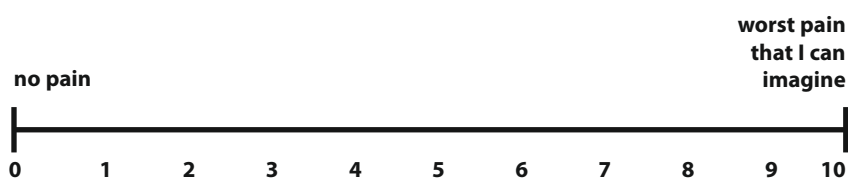
Appropriate patient selection is essential for achieving clinical success of percutaneous vertebroplasty (PVP) and kyphoplasty (PKP). Radiology has proven to play a key role in patient selection. The treatment location is commonly determined from both clinical findings and at imaging, which includes magnetic resonance (MR) imaging, bone scintigraphy, computed tomography (CT) and radiographs. Studies have shown that pain on palpation over the fractured vertebra is not a necessary requirement in selecting patients.

- Plain radiograph serve as a baseline examination to show alignment of the spinal column and rule out vertebral collapse. More important in treatment decisions are findings at MR imaging or bone scintigraphy.
- MR imaging include T1-weighted and fat-suppressed T2-weighted images, short-tau inversion-recovery sequences and contrast-material enhanced T1-weighted sequences. MR imaging provides information on anatomic vertebral collapse, including spinal canal stenosis or intravertebral clefts, and the loss of normal signal intensity from the vertebral bone marrow space, indicating presence of bone marrow edema (BME). Studies have shown that PVP results in significantly greater clinical improvement in patients with an extensive BME pattern. However, the presence of BME in osteoporotic vertebral compression fractures (VCF) detected by MR imaging as selection criterion for PVP or PKP remains speculative, because patients with acute or chronic VCF even with absent BME may respond favorably on pain.
- Bone scintigraphy, demonstrating an increased uptake in fractured vertebral bodies, has shown to be more accurate in the evaluation of elderly fractures. MR imaging is superior to bone scintigraphy in vertebral collapses due to multiple myeloma.
- The role of CT in the pre-therapeutic evaluation of PVP or PKP has not been well defined yet.

After successful PVP or PKP, recurrent or residual back pain is common, and many patients with these symptoms are evaluated by MR imaging. MR imaging may show progressive and persistent edema and interval height loss, but these findings should not be interpreted as sufficient evidence of ongoing pathology at the treated vertebral level.

PAIN TREATMENT

Self-assessment questionnaires for pain and mobility are very useful tools, to understand and appreciate the impact of pain. The questionnaires used should be validated for local population. Most of these are based on Visual Analogue Scale, as shown below.

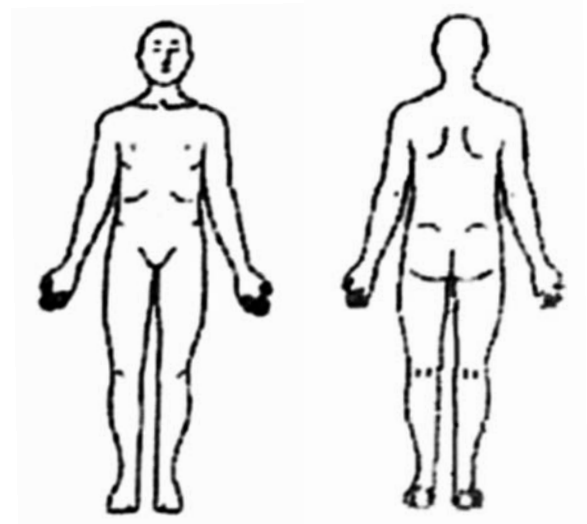


Quality of life questions, as shown below, are usually associated to these questionnaires:

Please reflect on the last week. How would you rate your quality of life?

- () *very good*
- () *good*
- () *moderate*
- () *bad*
- () *very bad*

Humanoid drawings are very useful tools and part of the clinical evaluation. The patient can mark the painful areas. These areas can be correlated to the imaging information.



Drug use should be noted dutifully. Elderly patients have a multitude of conditions and usually have an extensive list of drugs. Those should be noted in a list. Specific drugs related to their painful conditions should be part of the medical history, especially antiinflammatory, antidepressant and opioid drugs. If any changes are proposed, these should be done after consultation with the internist or GP of the patient or pain specialist.

Vertebroplasty will affect only the pain related to the fracture or lesion. Spinal stenosis and neurological status should be evaluated prior to the treatment. The patient should know that the primary target is pain treatment of the specific fracture. Neurologic amelioration can be expected for hemangiomas, especially when they are expanding into the epidural space and treated simultaneously with alcohol.

Sometimes, pain due to fracture is not the only source, so even if the pain due to the fracture is alleviated, other sources might still be present. These can be disco-radicular conflict, facet joint disease, disc disease, muscle spasm, neurological disorders, as well as systematic disease causing pain, such as pleural effusion, pneumonia, myositis, diabetes, vascular disease or even medically induced conditions, such as neurologic toxicity of drugs, can sometimes cause continuous pain. Those conditions should be addressed according to medical priority and clinical evaluation.

The topography of pain, associated with its character, distribution, occurrence etc. will help evaluate its origin and treat accordingly. Vertebroplasty is only one tool for pain treatment. Other include systematic drug use, local or fluoroscopically infiltration, discography and percutaneous discectomy, radiofrequency or drug induced denervation etc.

FOLLOW-UP

In the U.S. VP is proposed as an outpatient treatment. In Europe, patients are usually hospitalized for 24 hours (one day clinic). During the first four hours the patient remains bed-ridden. Studies have shown that PMMA, which is the usual product used for vertebral augmentation, acquires 80% of its strength 4 hours after the beginning of the polymerization reaction. Considering that fact, weight bearing can start 4-8 hours post the procedure. If other products are used, such as phosphocalcic cements, which have longer setting times, it is recommended to wait at least 24 hours, before weight bearing.

The patient can be usually discharged 24 hours after the procedure. Follow-up during this time include neurological, puncture site and vital sign evaluation. A CT scan may be performed on the vertebral augmentation area as a confirmation tool of vertebral augmentation procedure. If there are multiple puncture sites a mild fever may develop due to hematomas. If high fever develops during the first week, one should investigate the possibility of bone infection.

After one week a new appointment should be made to evaluate puncture site, neurological status and general condition of the patient. A new questionnaire, as described in the pain treatment section should be drawn and compared to the one prior to treatment. Drug use should be noted and compared. If vertebral tenderness is noticed, a new X-Ray should be performed. Specific information for osteoporotic or other treatment should be provided during consultation. Possibility of physiotherapy and/or other necessary treatment (infiltration etc.) should be explored, depending on medical condition.

A letter of the last consultation should be addressed to the GP. If there is none, regular telephone consultation every two months, for the first six months is advocated. In case of pain recurrence, X-Ray and MRI examination is proposed, as other fractures may occur.

Always keep a medical record, as these patients have a tendency to come back for similar or other minimally invasive pain treatment, during the following years. Finally, during long term follow-up, evaluation questionnaires, which include questions such as the ones included below, should be used in order to consolidate treatment options and help patient-doctor communication.

Over the course of treatment for your back problem, how satisfied were you with your overall medicine care in our hospital?

- () *very satisfied*
- () *somewhat satisfied*
- () *neither satisfied nor dissatisfied*
- () *somewhat dissatisfied*
- () *very dissatisfied*

Overall, how much did the operation that you had 1 year ago help your back problem?

- () *helped a lot*
- () *helped*
- () *helped only little*
- () *didn't help*
- () *made things worse*

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Appendix

PATIENT HISTORY FORM

All three forms presented here can be downloaded as a pdf from www.cirse.org

Use this form for patients seen in your office -
ask them to complete this form in the waiting room and review it with them during the exam.

Patient Health History

Patient Name: _____ Date of birth: _____

Address: _____

Chief Complaint

Reason for today's visit: _____

History of Chief Complaint

Past Medical History

Please list any prior major illnesses and / or injuries.

<i>Surgeries / Hospitalisations</i>	<i>Year</i>	<i>Complications</i>

Have you ever had problems with anaesthesia? ☐ Yes ☐ No

<i>Current Medication(s)</i>	<i>Dose</i>	<i>Frequency</i>

Allergies to medications: _____

Other allergies: _____

Is there a family history of disease? _____

Social History

Occupation: _____

Marital Status: ☐ Single ☐ Married ☐ Divorced ☐ Widowed

Do you have any children? ☐ Yes ☐ No How many? _____

Do you live alone? ☐ Yes ☐ No Who lives with you? _____

Do you smoke? Yes, I've smoked _____ packs of cigarettes per day for _____ years.

☐ Yes, I smoke cigars or a pipe

☐ No, I have never smoked

☐ No, I stopped _____ years ago. At the time I was smoking _____ packs a day for _____ years.

Do you drink alcohol? ☐ No never (or rarely) ☐ No I used to
 ☐ Yes ☐ Daily ☐ 1 or more times a week ☐ or more times a month

Are you at risk for HIV/AIDS (e.g. sexual orientation, drug abuse, previous blood transfusion)?
☐ No ☐ Yes (the physician will discuss with you during your visit)

Review of Systems

Are you currently having, or have you had, problems with:

Constitutional

Circle one

Fever	Yes	No
Weight loss	Yes	No
Excessive fatigue	Yes	No
Night sweats	Yes	No

Cardiovascular/vascular

Chest pain or angina - date of last ECG _____	Yes	No
High blood pressure	Yes	No
Irregular pulse	Yes	No
Heart murmur	Yes	No
High cholesterol	Yes	No
Swelling in feet or hands	Yes	No
Leg pain while walking	Yes	No
Leg pain at rest	Yes	No
Leg/foot ulcers or gangrene	Yes	No

Respiratory

Asthma	Yes	No
Chronic cough	Yes	No
Emphysema	Yes	No
Shortness of breath	Yes	No
Bronchitis	Yes	No
Pneumonia	Yes	No
Lung cancer	Yes	No
Bloody sputum	Yes	No
Date of last chest x-ray _____	Yes	No

Gastrointestinal

Indigestion or pain with eating	Yes	No
Nausea	Yes	No
Vomiting	Yes	No
Blood in your vomit	Yes	No
Liver disease	Yes	No
Jaundice	Yes	No
Abdominal pain	Yes	No
Change in your bowel habits	Yes	No
Ulcers or gastritis	Yes	No
Colon cancer	Yes	No

Genitourinary

Urinary tract infections	Yes	No
Painful urination	Yes	No
Blood in your urine	Yes	No
Difficulty starting or stopping stream	Yes	No
Incontinence	Yes	No
Kidney stones	Yes	No
Prostate cancer (males)	Yes	No
Endometriosis (females)	Yes	No
Uterine or cervical cancer (females)	Yes	No

Musculoskeletal

Broken bones - list	Yes	No
Arm or leg weakness	Yes	No
Back pain	Yes	No
Arm or leg pain	Yes	No
Joint pain or swelling	Yes	No
Arthritis	Yes	No

Integumentary

Skin disease	Yes	No
Skin cancer	Yes	No
Breast pain, tenderness or swelling (females)	Yes	No
Nipple discharge (females)	Yes	No
Date and result of last mammogram (females)		

Neurological

Fainting spells or "blacking out"	Yes	No
Seizures	Yes	No
Difficulty with your speech	Yes	No
Double or blurred vision	Yes	No
Face weakness	Yes	No
Coordination in arm and/or legs	Yes	No

Eyes, ear, nose, throat and mouth

Poor eyesight	Yes	No
Why?		
Glaucoma	Yes	No
Hearing loss	Yes	No
Ear infections	Yes	No
Balance disturbance (eg vertigo, spinning)	Yes	No
Nosebleeds	Yes	No
Nasal congestion or excessive drainage	Yes	No
Sinus problems	Yes	No
Sore throat	Yes	No

Mouth sores	Yes	No
--------------------	-----	----

Psychiatric

Anxiety	Yes	No
Depression	Yes	No
Other psychiatric disorder/treatment	_____	

Endocrine

Diabetes	Yes	No
Thyroid disease	Yes	No
Excessive thirst or urination	Yes	No
Hormone problems	Yes	No

Hematological/lymphatic

Anemia	Yes	No
Hemophilia	Yes	No
Bleeding tendencies	Yes	No
Persistent swollen glands or lymph nodes	Yes	No
Blood transfusion. If yes, when?	Yes	No

Allergic/immunology

Food allergies	Yes	No
Inhalant (nasal) allergies	Yes	No
Immunologic disorders	Yes	No

Patient name: _____ Date of birth: _____

The above information is accurate to the best of my knowledge

Patient signature: _____ Date: _____

I have reviewed the above information with the patient

Physician name (signature): _____ Date: _____

Physician name: _____

PHYSICAL EXAMINATION FORM

Constitutional	Well-developed	Y N	Obesity	Y N	Cachexia	Y N
Vital signs	Temperature		Pulse		BP	
Head/Face/Neck	Mass or scar	Y N	Lymph nodes	Y N		
Eye	Anemia	Y N	Scleral injection	Y N	Corneal arcus	Y N
ENT	Otorrhea	Y N	Nasal discharge	Y N		
Respiratory						
Inspection	Cough	Y N	Dyspnea	Y N	Asymmetry	Y N
Percussion/	Hyperresonant	Y N	Dull to percussion	Y N		
Auscultation	Decreased breath sounds	Y N	Crackles	Y N	Rhonchi	Y N
					Pleural rub	Y N
Cardiovascular						
Irregular pulse		Y N	Displaced apex beat	Y N		
Auscultation	Systolic murmur	Y N	Diastolic murmur	Y N	Continuous murmur	Y N
Carotid artery bruit		Y N				
Jugular vein distension		Y N				
Peripheral pulses						
Upper limb	Brachial	R L	Radial	R L		
Lower limb						
Femoral R L	Popliteal R L		Dorsalis Pedis R L		Posterior Tibial R L	
	ABI RIGHT		ABI LEFT			
Abdominal aorta	Palpable	Y N	Bruit	Y N		
Peripheral veins	Varicosities	R L	Leg edema	R L		
Lymphatic	Cervical nodes	Y N	Axillary nodes	Y N	Groin nodes	Y N
Gastrointestinal						
Inspection	Distension	Y N	Caput medusae			
Palpation	Tenderness	Y N	Rebound	Y N	Guarding	Y N
	Hepatomegaly	Y N	Splenomegaly	Y N	Mass	Y N
Auscultation/hernia	High pitched bowel sounds	Y N	Absent bowel	Y N	Bruit	Y N
Genitourinary	Testicular mass	Y N	Absent testis	Y N	Enlarged prostate	Y N
	Uterine mass	Y N	Distended bladder	Y N		
Skin	Lesion	Y N	Mass	Y N	Scar	Y N
Muskuloskeletal	Deformity	Y N	Immobility	Y N		
Neurological						
Cranial nerves	1st/2nd CN's	+ -	3/4/6 CN's	+ -	5th CN	+ -
	7th CN	+ -	8TH CN	+ -	9-12 CN	+ -
Peripherpheral NS	Motor	+ -	Sensory	+ -	Reflexes	+ -

Assessment / Plan:

VASCULAR EXAMINATION FORM

Name: _____ Date: _____

Hospital: _____ Age: _____ yrs: Sex: ☐ male ☐ female Physician: _____

Resident: _____

Tel: _____ Profession: _____ Insurance: _____

Risk Factors

1. Diabetes:

None 5

Adult onset, diet-controlled 5

Adult onset, insulin-controlled 5

Juvenile onset 5

2. Smoking:

None for the last 10 years 5

None current, but smoked during the past 10 years 5

Current, less than one pack per day 5

Current, more than one pack per day 5

3. Hypertension:

None 5

Controlled with one medication 5

Controlled with two medications 5

Requires more than two medications or uncontrolled by treatment 5

Diuretics 5, CE inhibitor 5, Beta blockers 5, Calcic antagonist 5,

ARA 2 antagonist 5, Other, specify _____

4. Hypercholesterolemia:

None 5

Controlled with one medication 5

Uncontrolled 5

5. Positive family history of atherosclerotic disease: Yes ☐ No ☐

6. End-stage renal disease: Yes ☐ No ☐

Medical History

Allergy: Trauma:

Infection/inflammation: Arthritis:

Obesity: Other diseases:

Pregnancy: Hormones/ contraceptive pills:

Alcohol abuse: Drugs: Ergotamine:

Pulmonary Embolism:

Neurological Disease (peripheral/ stroke):

Hormonal Disorder: Medication:

Renal Disease: Medication:

Pulmonary Disease: Medication:

Cardiac Disease

Coronary Disease:

Arrhythmia: Valvular Disease:

Cardiac Failure:

Medication:

Surgial Procedures

1.

2.

3.

4.

5.

Clinical Presentation

Main symptoms-clinical _____

Symptoms-Signs	Duration	Comments
Disabling claudication		-mild, moderate, severe -muscle fatigue, aching or cramping
Rest pain		-at night or continuous -response to foot dependency or only to opiates -localized in the distal part of the foot or in the vicinity of ischemic ulcer or gangrenous toe
Numbness / Paresthesia		
Sensory decrease /loss		
Pallor		
Swelling		
Ulceration		-initial presentation or progress through rest pain -dorsum toes, plantar (toes or foot), heel, dorsum foot, multiple -regular/irregular margins -red, pale, cyanosed appearance
Gangrene		-initial presentation or progress through rest pain -toes or heel -infection, eschar formation ,shrinkage, mummification -spontaneous amputation
Blue toes		
Limb hair loss		
Rigor		

Rutherford classification

Fontaine classification

Grade	Category	Clinical Presentation	Stage	Clinical
0	0	Asymptomatic	I	Asymptomatic
	1	Mild claudication		
I	2	Moderate claudication (> 200μέτρα)	Ila	Mild claudication
	3	Severe claudication (< 200μέτρα)	Ilb	Moderate-severe claudication
II	4	Rest pain	III	Ischemic rest pain
III	5	Minor tissue loss		Ulceration or gangrene
	6	Major tissue loss	IV	

Skin : Cold _____ Warm _____ Smooth _____ Glossy _____ Thin _____ Blue _____

Red _____ Hair loss _____ Pruritus _____ Dermatitis _____ Other _____

Nails: Hypertrophied ____ Friable _____ **Mycosis:** _____ Skin _____ Nails _____

Muscular system: Muscular tone: _____ Muscular atrophy _____ Symmetry _____

Impotence: _____

Physical Examination

Height: _____ cm Weight: _____ Kg Temperature: _____ °C

Pulses: _____ bpm, Blood pressure: _____ mmHg

Head+neck: _____

Chest - Lungs: _____

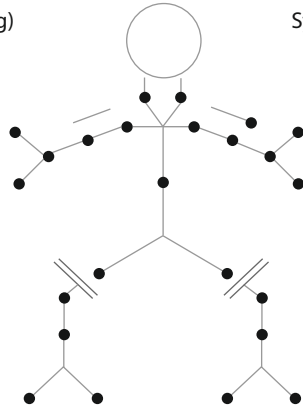
Heart: _____

Abdomen: _____

Arterial System Examination

Systemic BP Rt (mmHg)

Systemic BP Lt (mmHg)



Ankle pressure
(mmHg)

Ant tibia

Post tibial

Ant tibial

Post tibial

Ankle-brachial
Index (ABI)

Rt

Lt

Toe-brachial
Index (ABI)

Rt

Lt

Pulse examination

(●—●)

A: Aneurysm

++: very good

+: palpable - diminished

±: palpable (doubtful)

-: no palpable

B: Bruit

T: Thrill

Continuous wave Doppler waveform

T: Triphasic

B: Biphasic

M: Monophasic

∅: Absence of flow

Burger sign (+ or-)

L
R

Reactive
hyperemia (+ or-)

L
R

Venous filling (+ or-)
(normal 5-10 sec)

L
R

Allen test (+ or-)
(check integrity of
palmar arch)

L
R

Adson test (+ or-)
(thoracic outlet syndrome)

L
R

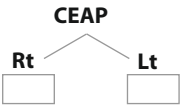
Exercise testing: Vel _____ km/hr grade: _____ % time _____ min distance: _____ m Symp: _____
% decrease in ABI _____

Comments: _____

Venous System Examination

Venous insufficiency signs

	Right	Left
Heaviness		
Edema		
Pain		
Tenderness		
Lipoedema		
Skin pigmentation		
Healed ulcer		
Active ulcer		



CEAP classification

Class	Clinical presentation
0	No visible or palpable veins
I	Telangiectasis
II	Varicose veins
III	Edema
IV	Skin changes
V	Healed ulcer
VI	Active ulcer

Clinical examination of superficial leg venous system

V: varix, T: thrombosis, I: insufficiency (Duplex)

	Right	Left
Greater saphenous (GSV)		
Lesser saphenous		
Anterolateral thigh		
Posteromedial thigh		
GSV anter. tibial branch		
Leonardo arch		
Calf perforator		
Thigh perforator		
Telangiectasis		



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