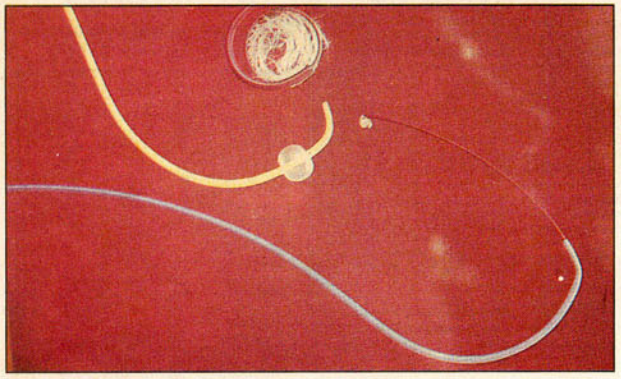
Opening new frontiers in medicine

INNOVATIONS and improvements in diagnostic imaging techniques such as Ultrasound, C.T. and MRI have resulted in a general trend towards less invasive radiology. The same period witnessed the rapid growth of a new sub–speciality known as interventional radiology. The term is used to describe procedures that are in some way therapeutic or curative rather than purely diagnostic. The radiologist intervened in the natural history of the disease.

Advances in catheter and instrument technology, together with improvement of polythyene catheters. The introduction of the double lumen balloon catheter a decade later in 1974 by Gruntzig revolutionised the field. In the next two decades percutaneous transluminal angioplasty (PTA) established its efficacy. In the last ten years after techniques and devices have expanded the application of percutaneous vascular intervention, notable among these are lytic therapy, where blood clot is dissolved and stents, which are metal tubular meshes delivered through a catheter into the diseased segment to stabilise the dilatation. Yet other techniques such as atherectomy and



Spring coils used in embolisation.

appropriate radiological expertise and development in image monitoring systems have made it possible to cannulate vessels and ducts throughout the body. This has also helped perform a variety of procedures including drainage, dilatation, occlusion, selective infusion, insertion of mechanical devices and extraction of materials.

Most interventional radiology techniques are performed under local anasthesia. They can be applied to most areas of medicine and have become established as routine methods of management. The application of interventional methods can bring many benefits. The patient may avoid general anaesthesia and a surgical operation; an operation can be postponed until the increased risk has been eradicated or minimised. The surgeon may be saved a difficult or dangerous operation by preliminary embolisation of an appropriate vascular territory.

There are also considerable financial benefits to be derived from interventional radiology especially when inpatient time can be often cut dramatically.

In 1964 Charles Dotter successfully restored perfusion in the leg of an old woman who had refused amputation reversing the gangrenous changes that had begun with coaxial lasers have undergone scrutiny for possible use in the peripheral vascular system but elude a well defined role. Percutaneous transluminal angioplasty (PTA) remains the cornerstone of percutaneous treatment of atherosclerotic vascular disease.

Patients with occlusive disease present with claudication, the pain experienced by the patient in the region supplied by the diseased vessels during exercise. Thus patients who suffer from aorto iliac disease present with claudication of the calves, thighs, hips and buttocks. Impotence in men may be a presenting or accompanying complaint. As the disease progresses the patient may have pain, develop ulcers or have frank gangrene. If the onset of the disease is acute, symptoms may be more severe.

Contrary to popular belief, Burgers disease, a form of arteritis involving vessels below the knee in both legs is rare. Most patients with peripheral vascular disease actually suffer from atherosclerosis and they can be successfully treated. Poor referal systems and misinformation have been the primary limiting factor in dispensing definite management for peripheral vascular disease in this country.

The average hospital stay is about 24 hours and the patient is allowed to get back to routine activity the next day.

Balloon PTA is safe, less invasive than surgery, and has demonstrated long-term hemodynamic benefit in patients with stenotic lesions or short occlusions.

Complications during angioplasty are possible. A vessel could rupture if the balloon is oversized. Acute reocclusion is a problem in long segment occlusions. A large sub intimal tear could also lead to occlusions, however, it can be easily managed by an intravascular stent.

Alternatives to PTA

Transluminal angioplasty has been applied to vessels in most areas of the body and now there are few contra- indications. One problem which however limits an even wider application of angioplasty is the presence of arterial blockage which defies the passage of a guide wire. A channel may be created through the obstructive lesion by the application of heat by lasers or radio frequency probes. Atherectomy devices can also be used to mechanically create a lumen. Eccentric lesions which have a higher restenotic rate after angioplasty can also be successfully dealt with atherectomy devices.

Atherectomy is a procedure whereby atheroma is removed from an artery leaving the wall of the vessel anatomically intact. The device consists of a long catheter bearing a cutting instrument at its tip. The atherectomy device either extracts the detached fragment or it pulverises the atheroma into small particles which are dispersed into the blood stream. Both lasers and atherectomy devices produce excellent results. However long term studies have not achieved results as one would expect.

A vascular stent is a cylindrical mesh work splint made of stainless steel alloy that is placed across a stenosis to maintain patency. Within two weeks the device becomes incorporated into the vessel. Stents have been used with great success to seal a large dissection, often following angioplasty. Stents also play an important role in lesions which do not dilate with PTA. Stents have also shown good results in obstruction of larger veins. Endovascular techniques are now established as an important and permanent addition to the available options for patients with peripheral vascular disease.

Intra arterial thrombolysis

Thrombolysis is the technique of dissolving blood clots. A patient can come with limb threatening ischaemia secondary to extensive thrombosis. Embolectomy, the surgical technique of removing clots, is a blind procedure. When acute thrombosis is secondary to significant peripheral vascular disease embolectomy does not re-establish circulation.

Intra arterial thrombolysis on the other hand is a controlled technique where a perfusion catheter is placed within the thrombus and a thrombolytic drug is directly infused into the occluded segment. Following thrombolysis the underlying stenosis is always dilated. Thrombolysis is thus an option when there is limb threatening ischaemia.

Embolisation

The deliberate occlusion of arteries, vein or abnormal vascular spaces by embolic materiel injected through a selectively positioned catheter is one of the major therapeutic applications of interventional radiology.

Embolisation can be achieved by either solids like gelatin foam, polyvinyl alcohol sponge, spring coils and detachable balloons or liquids, absolute alcohol and neo-butyl cyanoacyralate.

Indications for arterial embolisation:

1. Acute bleeding:

Embolisation can be used to prevent active bleeding and may be life saving in the case of massive haemorrhage.

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Bronchial embolisation has an important role to play in the control of haemoptysis (coughing out blood).

The renal arterial branches can be super selectively catheterised and embolized in case of haematuria (blood in the urine) following trauma, surgical procedures or when associated with tumours. This technique has been used extensively in the management of gastro-intestinal bleeding, especially for the stomach and distal oesophagus.

Embolisation can be used effectively in bleeding associated with pelvic fractures, epistaxis and gynaecological haemorrhage.

2. Tumours:

Embolisation can be used in the management of tumours in three different ways.

a) Benign tumours like haemangiomas, parathyroid adenomas and benign bone tumours can be sometimes successfully treated by embolisation alone.

b) Embolisation hours or days before surgical resection of a vascular tumour can significantly reduce blood loss, duration of operation and morbidity.

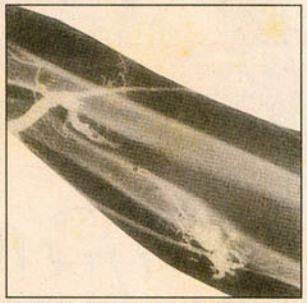
c) Embolisation can be used as a primary mode of treatment as a palliative procedure in the management of inoperable malignancies.

3. Vascular abnormalities

Aterio venous malformations, aterio venous fistulae, benign tumours of vascular origin and aneurysms in certain sites are often treated most appropriately by embolisation. These lesions affect the patient in a variety of ways including serious disfigurement, bleeding, pressure symptoms and in the case of aterio venous malformations cardiac failure. The lesions usually present formidable problems to the surgeon because of their vascularity and their tendency to recur. In aterio venous malformation, occluding individual feeding arteris proximally (which was a common surgical practice) nearly leads to enlargement of other feeders and development of multiple new path ways to the lesion. The result is recurrence within a matter of months.

Embolisation obliterates the abnormal vascular bed and thus produces better long term results with less morbidity. Even if embolisation is inappropriate as a definite form of treatment in a particular case it may be valuable preoperative procedure to reduce the vascularity of the lesion before surgical excision.

In conclusion it is important to realise that if a surgeon ligates the feeding arteries collateral vessels will continue to supply the lesion and it may be then difficult or impossible for the radiologist to embolize the lesion because of inaccessibility of the new feeding vessels.



A large malformation in the forearm.

Excellent results after embolisation.

Clearly this kind of situation is most undesirable. Thus ideally a patient with an aterio venous malformation should be assessed jointly by a vascular surgeon and an interventional radiologist so that the lesion can be treated in the most appropriate manner.

4. Other areas where embolisation has found a role is in the management of bleeding from the spleen or when surgical splenectomy is contra-indicated.

Embolisation can be extended to the venous system especially in venous malformations.

Complications

The incidents of serious complications following embolisation is low provided the procedure is conducted with patience and care and that only suitable patients are selected for treatment by the technique.

Vascular infusion of anticancer agents

It is possible to selectively catheterise the blood vessel supplying a tumour and deliver a high local concentration of an appropriate anticancer agents. Intra arterial infusion exposes the tumour to a higher local concentration of chemotherapy with no increase in systemic toxicity.

Temporary or permanent occlusion of branch vessels can be used to minimise the exposure of normal tissues and maximise the infusion of the tumour.

Kato incorporated an anticancer drug in ethyl cellulose micro capsules and delivered them into the tumour site for producing local ischemia and increasing the contact time between the tumour and the drug. Gelfoam particles or power can be used instead of ethyl cellulose.

Intra arterial chemotherapy and chemo embolisation have been successful in the management of musculoskeletal, genitourinary and gastro intestinal neoplasms.

The clinical management of variceal haemorrhage and ascites secondary to portal hypertension is a challenging problem. Medical therapy, endoscopic sclerotherapy, transphepatic variceal embolisation and surgical portosystemic decompression have all been used to treat variceal haemorrhage. Today it is clear that the rebleeding frequency from oesophageal varices is lower with surgical shunting than with any other form of therapy. The high morbidity and mortality rates associated with shunt surgery, especially in patients with poorly compensated liver disease, have led investigators to find an equally effective and safer means of achieving portal decompression.

A percutaneous portosystemic shunt was conceived by Joseph Rosch in 1969. In 1982 Colapinto reported the first attempt on humans. In 1985 Julio Palmaz proved that a percutaneous portosystemic shunt was clinically feasible when he achieved prolonged shunt patency by the placement of a metalic stent with the parenchymal tract in the liver.

The indications of TIPS are expanding beyond the treatment of variceal haemorrhage to include patients with refractory ascites and hepato renal syndrome. It is clear that TIPS serves as an effective bridge towards hepatic transplantation because it facilitate surgical operation and minimises intraoperative blood loss.

Interventional radiology has played an important role in changing the status of radiology, making it one of the most exciting and rapidly developing branches of modern medicine. ■

DR. MATHEW CHERIAN