A Brief Overview of Vascular and Interventional Radiology

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Vascular and interventional radiology (VIR) is also called image-guided minimally-invasive therapy, a procedure-based therapeutic subspecialty of modern medicine. With the invention of devices and treatment procedures such as angioplasty and the catheter-delivered stent, the pioneers of VIR have seen the development of the subspecialty in clinical application at an amazingly rapid pace in the last couple of decades.

Interventional radiologists are medical specialists who are well trained in state-of-the-art medical imaging and diagnosis, in clinical experience across multiple medical specialties, as well as in-depth knowledge and skills of VIR treatment procedures. They are fully equipped for partnership in the treatment and clinical management of patients for a wide variety of disease conditions on a multi-disciplinary basis.

With advancement in technology and knowledge, endovascular procedures of VIR have been found to be a less invasive treatment option alternative to open surgery in some disease conditions and the only viable treatment option in the others. Due to the scope of this article, the following conditions are selected to illustrate the role of VIR: 1) uterine artery embolisation for uterine fibroids, 2) endovascular aortic repair for aortic dissections, 3) Transvenous embolisation of dural carotid cavernous fistulae, and 4) stenting of intracranial carotid cavernous fistulae, and 4) stenting of intracranial aneurysms. Indications

Pathological studies of uteri after embolisation typically show hyaline necrosis or coagulative necrosis of the tumour mass. However, incompletely infarcted fibroids may increase in size again, new fibroids may also develop over time. It has been shown in a number of large-scale observational studies that symptoms of fibroids such as menorrhagia, pelvic pain, pressure, and urinary symptoms are improved in 85 to 95% of patients. The American College of Obstetricians and Gynecologists (ACOG) concludes “based on good and consistent evidence (level A), uterine artery embolisation is a safe and effective option for appropriately selected women who wish to retain their uteri. The Society of Interventional Radiology and the Cardiovascular and Interventional Radiological Society of Europe state that uterine artery embolisation is indicated for the presence of uterine leiomyomata that are causing significant lifestyle-altering symptoms, specifically mass effects on the bladder or intestines, and/or dysfunctional uterine bleeding that is prolonged, associated with severe dysmenorrhoea, or is causing severe anaemia.

Endovascular Aortic Repair for Aortic Dissections

Acute aortic dissection is one of the most catastrophic diseases that can affect the aorta. There are 10 to 20 cases per million population per year, and if the condition is left untreated, 36 to 72 percent of patients die within 48 hours of diagnosis, and 62 to 91 percent die within one week. For patients with acute Stanford type A dissections (which involve the ascending aorta), surgical intervention is performed immediately after diagnosis to avert the high risk of death due to various complications, including cardiac tamponade, aortic regurgitation, and myocardial infarction. In contrast, the preferred treatment for most patients with Stanford type B dissections (which do not involve the ascending aorta) is medical therapy, including the use of antihypertensive drugs and beta-blockers. Indications for intervention in acute type B dissections include persistent back or chest pain, pseudoaneurysm >4 cm in diameter, uncontrolled hypertension, distal malperfusion with end organ ischaemia, localised false aneurysm, cardiac and coronary complications resulting from proximal extension of the dissection, progression of dissection and impending rupture. The current mortality rate among patients who receive medical
therapy for type B dissections remains about 20 percent, whereas the mortality rates among patients who undergo surgical repair of acute type A and B dissections are currently about 29 percent and 35 percent respectively. However, for acute disease complicated by end-organ ischaemia, the surgical mortality rate exceeds 50 percent. Among patients with acute type B aortic dissections, more than 60 percent of associated deaths are due to local rupture, usually of the false lumen. Surgical therapy usually consists of limited replacement of the descending aorta at the level of the initial entry tear; the flow into the false lumen is obliterated by circumferential repositioning of the dissected septum to the aortic wall at the distal graft anastomosis. The rationale for surgical therapy is to obviate the most frequent cause of death. Current clinical evidence suggests that stent-graft placement over the primary entry tear in patients with acute type B dissections may be an alternative to open surgery. The result is similar to surgical obliteration of the entry tear because it can exclude the flow through the initial tear in the intima and redirect aortic blood flow exclusively into the true lumen. In addition to promptly averting serious end-organ ischaemia or infarction, stent-graft placement over the intimal tear can prevent the eventual formation of an aneurysm by facilitating complete thrombosis of the thoracic aortic false lumen. Even if only partial thrombosis of the false lumen is achieved, it still can be advantageous: it may protect the false lumen from enlarging over time, since systemic blood pressure is no longer directly transmitted from the aorta through a large primary tear in the intima. Following endovascular stenting the false lumen is thrombosed completely in the portion of the aorta covered by the stent-graft in over 88% of patients by the end of first year, with 60% having thrombosed the entire length of dissection. Complete regression of the false lumen following endovascular stenting occurs in 58% of cases. These figures suggest that a significant minority would have a patent false lumen, which is related to the retrograde filling from the true lumen at the site of distal tear. The combined data from EUROSTAR and United Kingdom Thoracic Endograft registries reported a high technical success rate of 88.6% for endovascular stenting. The complication rates remained low with a reported incidence of paraplegia and stroke at 0.8 and 1.5% respectively.

Transvenous Embolisation of Dural Carotid Cavernous Fistulae

Dural carotid-cavernous fistula (DCCF) is a specific type of dural arteriovenous fistulae characterised by abnormal arteriovenous shunting within the cavernous sinus. Approximately 25% of DCCF occur spontaneously, especially in middle-aged to elderly women, and may be associated with atherosclerosis, systemic hypertension, collagen vascular disease, pregnancy, connective tissue disorders, and minor trauma. DCCF presents commonly with ocular symptoms such as proptosis, chemosis, diplopia in 80% of cases, and loss of visual acuity is also a common symptom. When the visual loss becomes severe, it rarely improves even if the fistulae are obliterated. Patients with visual deterioration therefore require early intervention and they constitute 26% of all. In patients with high-risk DCCF such as those presenting with retrograde filling of cortical veins, neurologic deficits, worsening ocular symptoms, or significant atherosclerosis of the carotid bifurcation, transvenous embolisation of the cavernous sinus with embolisation coils is the treatment of choice. Direct surgical exposure and obliteration of DCCF requires craniotomy and it is rarely indicated due to the high success rate of transvenous embolisation. Transvenous embolisation is a highly efficient and safe treatment in symptomatic carotid-cavernous fistulae. In a majority of patients, a significant and permanent improvement in clinical signs and symptoms can be achieved. The overall technical success rate of transvenous embolisation of DCCF is 81 to 86%. Residual symptoms may occur in up to 11% of patients. Transient VIth cranial nerve palsy may occur in 2% after transvenous embolisation for a period of 1 to 2 months. There is a tendency for ocular pressure-related symptoms and visual impairment to resolve rapidly within the first 2 weeks after endovascular treatment, while cranial nerve palsy and diplopia improve slowly (65%) or do not change (11%). There is usually no recurrence.

Stenting of Intracranial Atherosclerosis for Stroke Prevention

Intracranial atherosclerotic stenosis is responsible for approximately 33% of acute ischaemic strokes in Asian populations. The annual stroke risk from all causes in patients with intracranial atherosclerosis is estimated to be from at least 3.6% to more than 13% annually with the definitive National Institutes of Health (NIH) study demonstrating a first year ischaemic stroke rate in the pertinent vascular territory of at least 11%. The multi-centre, randomised, double-blind NIH -sponsored Warfarin-Aspirin Symptomatic Intracranial Disease Trial (WASID) performed from 1998 to 2003 showed that patients with transient ischaemic attacks or minor strokes caused by an angiographically verified stenosis of >50% of a major intracranial artery and with no other apparent aetiology were associated with ischaemic strokes in the same vascular territory in one year at the rate of 12% and 11% when treated with aspirin and warfarin respectively. In the mean follow-up period of 1.8 years, ischaemic or haemorrhagic strokes or vascular deaths occurred in 21.1% in the aspirin group versus 21.8% in the warfarin group. There is therefore currently no approved surgical option for the patient population with intracranial arterial stenosis. The device and techniques of angioplasty and stenting procedure for intracranial atherosclerotic stenosis using nitinol stent has been improving. Major peri-procedure complication rates of such procedures as represented by stroke or death rates at 30 days in these studies varied from 4.5% to 9.6%. The American Society of Interventional and Therapeutic Neuroradiology, Society of Interventional Radiology, and American Society of Neuroradiology have concurred that sufficient evidence now exists to recommend that intracranial angioplasty with or without stenting should be offered to symptomatic patients with intracranial stenoses who have failed medical therapy.