The Ins and Outs of Interventional Radiology

Mark Baerlocher, B.Sc. (OT5)
Perry Choi, B.Sc. (OT5)

Abstract
The field of interventional radiology is new; however, it is growing at a quickening pace. Interventionalists have come up with numerous non-invasive treatments to replace or supplement traditional, invasive ones. The basis of much of interventional radiology, in particular vascular interventional radiology, is the Seldinger technique, involving the use of vascular access to reach various sites of pathology. We review a few of the many interventions currently available.

Introduction
One of the more exciting and evolving aspects of medicine is interventional radiology. This is a relatively new specialty with a lot of potential for future applications. According to the Canadian Interventional Radiology Association, interventional radiology is “a branch of medicine that diagnoses and treats disease using small needles, guidewires, and catheters introduced through tiny skin incisions, and guided by X-ray, ultrasound, or other form of radiologic imaging.” Interventional radiologists have expertise in medical imaging, angiography, and clinical skills.1

During medical school, most students do not have any exposure to interventional radiology. However, as many conditions require their services, it is important to have some understanding of the local interventional radiology department. Our article will briefly introduce the reader to a few interesting procedures that interventional radiologists perform.

Image-Guided Venous Access
The “bread-and-butter” of interventional radiology is providing venous access, which is essential to image and/or treat a wide variety of conditions. One of the more common specialized lines requiring image guidance is the PICC line. PICC stands for peripherally inserted central catheter.

In this procedure, the PICC line is inserted through one of the smaller veins in the upper arm. The line is then guided into the larger subclavian vein near the SVC. Ultrasound is used to guide the insertion of the line and fluoroscopy is used to confirm the placement location.

Common indications for the use of PICC lines include outpatient intravenous management, the administration of strong medications that may irritate smaller veins such as chemotherapeutics, and for individuals requiring long-term venous access as in TPN.

PICC lines are considered very safe. However, there are several complications associated with this procedure. The common ones include an infection at the site of insertion and phlebitis. The less common, but more serious complications include venous thrombosis and pulmonary embolism (<0.1%).2

Percutaneous Transluminal Angioplasty
Percutaneous Transluminal Angioplasty (PTA) is an important development in interventional radiology. This procedure is used to mechanically recanalize an occluded or stenotic artery via a percutaneously inserted balloon catheter. The most common material occluding or stenosing the artery is an atherosclerotic plaque. To recanalize the artery, the percutaneously inserted balloon catheter is inflated in the area in question. The effect is an increase in vessel caliber and the luminal narrowing is improved.3

PTA can be used in a number of arteries. Common ones include the coronary arteries to treat angina, the femoral arteries to treat intermittent claudication, and the renal arteries to treat renovascular hypertension (i.e. renal artery stenosis). The actual success rate varies with the artery and with other factors like the length and number of plaques in the arterial segment. PTA is best used when the artery has a short and single stenosis. The success rate is lower when multiple stenoses are present. Overall, the technical success rate is over 90-95%; however, some of the patients may re-stenose their arteries.4,5

PTA is relatively safe in comparison to surgery, which is often an alternative to the treatment of some of the conditions listed above. The major concern with PTA is arterial vessel damage and dislodgement of the plaque. Also, depending on the arterial site, there may be additional risks.

As an aside, it should be noted that there are currently “turf” battles between interventional radiologists and other specialists with respect to who should be performing these various PTA procedures. In some cases, such as coronary PTA, the radiologists have “lost”; in almost all the centers in Canada, this procedure is now performed by cardiologists.
Arteriovenous Malformation Embolotherapy

An arteriovenous malformation (AVM) is a tangle of abnormal blood vessels that includes both arteries and veins that do not have a capillary bed or brain parenchyma separating them. AVMs affect roughly 0.1% of the population. If they occur in the brain, they can bleed and result in stroke. One of the new and exciting procedures performed by interventional radiologists to treat AVMs in the brain is called “embolization”, or “embolotherapy”, and has been used as a treatment option since the early 1980s.

In embolotherapy, a catheter is inserted into the femoral artery, and advanced until it is in the specific blood vessels of the brain that supply the AVM. Glue is then injected which solidifies and occludes the vessel, preventing further blood flow to the AVM and therefore decreasing any risk of bleeding. The procedure is usually relatively short, and patients generally leave the following day. A follow-up angiogram or magnetic resonance angiogram is often done to determine post-procedural changes.

Side effects of embolotherapy are experienced by a minority of patients, and are for the most part benign. This can include headaches lasting a few days to a few weeks, muscle weakness, tingling, numbness, and speech and visual problems. Strokes resulting from embolotherapy are relatively rare (1-3%), as are other embolic phenomena, including pulmonary embolisms.

Embolotherapy has a cure rate of up to 40% on its own. Sometimes additional embolotherapy runs are required, particularly for larger AVMs. Other times, AVMs are more amenable to radiation and/or surgical treatment. Finally, even if embolotherapy does not completely cure an AVM, it is often still useful simply to shrink the size of AVM somewhat. This can be useful prior to surgery in order to reduce blood flow to the AVM at least to some extent.

Toronto Western Hospital is one of the locations where embolotherapy is performed, and it is done by both neurosurgeons and interventional neuroradiologists. For more information, please visit http://www.brainavm.uhnres.utoronto.ca.

Uterine Fibroid Embolization

Uterine fibroids, also known as uterine leiomyomas, are benign smooth muscle tumors within the uterus. They are by far the most common tumor found in the female gynecological system; estimates range from 20-25% of menstruating women. Uterine fibroids can be within the submucosa (submucosal fibroids), within the uterine wall (intramural), and/or in the outer portion of the uterus (subserosal). Possible symptoms include abnormal uterine bleeding during and/or between menstrual periods, pelvic pain, pelvic pressure, abdominal distension, urinary frequency, flank pain, and infertility. One of the newest treatment options for uterine fibroids is uterine fibroid embolization (UFE).

Uterine fibroid embolization was first performed on humans less than a decade ago. The concept behind UFE is quite simple: a catheter is inserted into the femoral artery, and advanced into the uterine arteries (Figure 1). Once there, embolization beads/particles are injected (Figure 2), which block blood flow to the fibroids. Without the blood, the fibroid infarcts and eventually shrinks, relieving symptoms (Figure 3).
Side effects of the UFE procedure include a post-procedural intense, cramping pelvic pain, and a well-described “postembolization syndrome” consisting of pelvic pain, nausea, vomiting, fever, leukocytosis, and malaise.\(^\text{10}\) In order to control the symptoms of the postembolization syndrome, most centres admit post-UFE patients for a 24 hour observation period.\(^\text{11}\) There have, however, been recent attempts to perform UFEs as an outpatient (day) procedure.\(^\text{12}\) In order to perform UFE’s as an outpatient procedure, an effective medication regimen must be provided to patients to control the postembolization syndrome. Other possible complications of UFE include temporary amenorrhea, and post-UFE menopause.

UFE has a clinical success rate of over 85%, which, combined with its minimal complication rate, minimal invasiveness, and significant improvement in morbidity make it a very attractive option compared to surgical intervention, or even laparoscopic myomectomy.

**Summary**

The field of interventional radiology is definitely growing as radiologists find new ways to improve/cure human diseases. This article has only presented a glimpse of the fascinating activities that occur in your local interventional department. The future should be exciting!

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**References**