clude all arterial flow into the fistula may result in recurrence or persistence of the arteriovenous shunt by retrograde flow. Proximal occlusion alone may make the limb more ischemic by decreasing the pressure in the fistulous chamber, thereby increase the "steal" from the distal circulation.

Embolization of the distal arterial segment poses the most difficult technical consideration. A variety of solutions are avaliable when this task must be performed. Distal occlusion can be accomplished by passing a catheter through the proximal vessel under two circumstance: 1、when the artery is only partially transected and part of its wall is intact and 2、when both ends of a totally transected vessel flow into a false aneurysm which connects both ends of the artery with a vein. The catheter can be advanced through the pseudoaneurysm or partial laceration across the fistulous site into the distal vessel. A gently curved catheter and a straight guidewire have been useful in this traversal. The vessels at the fistula may be thinned and atheromatous. The angiography must use great caution not to perforate during these manipulation. Once the guidewire has traversed the lesion, the catheter is advanced into the distal artery. Coil occlusion of the distal vessel is done first. Then the catheter is withdrawn back into the proximal artery which is then occluded by coils.

Transarterial catheterization of the distal vessel may be impossible if the proximal vessel has become very tortuous or enters the fistula chamber at a such an angle or location that the origin of the distal vessel cannot be cannulated through it. Another approach to the distal segment must be performed. This can be through the venous side of the fistula back into the fistulous chamber and then into the distal artery. Another approach is to directly puncture the aneurysm chamber and cannulate either the proximal artery and or the distal arterial segment. The distal artery can also be approached through a proximal collateral branch that connects to the distal artery. Finally a more distal artery can be punctured percutaneously or exposed surgically and a catheter can be directed in a retrograde fashion to the site of fistula.

In summary, treatment of an arteriovenous fistula requires occlusion of all connections between the arterial system and the fistula. Exquisite diagnostic arteriography to identify all these connections is mandatory. A number of different approaches to the distal side of the arteriovenous fistulas are available to complete the embolization.

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Interventional radiology in the management of pelvic retroperitoneal hemorrhage

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Introduction

Pelvic fractures are common, potentially life-threatening injuries which are caused by high energy impact trauma. Pelvic fractures account for about 3% of all skeletal injuries and are the third most common injury described in patients who have sustained motor vehicle accidents. The management of patients with these pelvic injuries is controversial, difficult and fraught with danger. The treatment options available are often contradictory and the associated injuries of-

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ten require decisions which may impact negatively upon the evaluation and treatment of the pelvic injury.

Significant hemorrhage does not occur in most patients with pelvic fractures. The majority of patients with pelvic fractures do not bleed so profusely that they require replacement of shed blood volume. Indeed more than 80% of patients will require less than six units of blood transfusions. Bleeding in most cases is likely to be venous or osseous in nature and is self-limited without specific treatment. Radiological intervention is not commonly needed in patients with pelvic fractures. However, exsanguinating bleeding may occur.

Mortality rates may be extremely high, depending upon the subpopulation studied. A 5% death rate among all patients with pelvic fractures has been reported, although the death rate among that subpopulation with unstable pelvic fractures is much higher ranging to as much as 50%. While many of these deaths are caused by extrapelvic injuries such as intracranial hemorrhages, chest trauma and abdominal hemorrhage, hemorrhage is the leading cause of death in patients who sustain pelvic fractures.

In those that do have a major bleed, hemorrhage is rapid and massive, and clinically occult. Eleven per cent of Gruen's series of 312 patients with pelvic fractures sustained hemorrhagic hypovolemic shock. Moreno reported that seventeen per cent of 538 patients with pelvic fractures required more than six units of blood transfusion in the first twenty four hours of hospitalization.

Mechanisms of injury

The majority of pelvic fractures are caused by blunt trauma and, therefore, posttraumatic pelvic hemorrhage is often related to blunt trauma. The most common mechanism for pelvic fractures is motor vehicle accidents which accounts for more than one half of all of pelvic fractures in the United States. The remainder are the result of falls, pedestrians struck by motor vehicles and crush injuries. Falls from heights result in unstable vertical shear pelvic fractures which render the pelvis both vertically and axially unstable. Patients with vertical deceleration pelvic fractures are also at risk for deceleration trauma to other structures such as the thoracic aorta, the renal arteries and the lungs.

Pelvic fractures are the result of a variety of forces applied across the pelvis. Internal forces may result in avulsion fractures of a variety of apophyses and attachments of ligaments do not usually result in pelvic hemorrhage. External forces, on the other hand, may break the major and minor pelvic rings which therefore result in disruption of ligaments and their associated arteries and veins. The fracture fragments themselves may impinge and tear adjacent vascular structures in the region of the fractures.

The three major fracture patterns which are used to describe pelvic fractures include anterior compression, lateral compression and vertical shear. Anterior compression applies forces extending from anterior to posterior across the symphysis pubis such as occur when a pedestrian is struck anteriorly by a motor vehicle. It is thought that these forces are initially applied across the anterior aspect of the pelvis and result in disruption of the ligaments fixing the symphysis pubis, although fractures of the pubic rami can occur instead. As anterior forces are continued, there is stress across the sacroiliac ligaments initially across the anterior sacroiliac ligaments and subsequently across the posterior sacroiliac ligaments. If the ligaments are strong enough, fracture across the sacral may occur instead of S1 diastasis. These pelvic injuries result in an enlargement of the pelvis and have been reported to be a common pattern in patients with massive pelvic hemorrhage.

Lateral compression fractures are those in which the major vector of force is applied from the side from lateral to medial as might occur when a driver is struck on the driver's door by another motor vehicle. This is the most common pattern seen after motor vehicle accidents. Vertical shear injuries are the result of falls in which the hip is directed cephalad through the acetabular complex of the pelvis or through the pubic rami and the sacroiliac complex. They result in fractures of the pubic rami or diastasis of the symphysis pubis and complex fracture/dislocations of the sacroiliac complex in which there is vertical incongruity of the fracture fragments with one side of the hemipelvis usually displaced cephalad. These injuries are often associated with thoracolumbar spinal fractures. Vertical shear fractures are often associated with gross displacement, massive hemorrhage and skeletal instability.

Fracture patterns can also be defined with regard to the amount of displacement of fracture fragments. It has been shown by Cryer et al that displacements greater than 0.5cm are associated with more bleeding and hemodynamic instability than those that are not displaced.

Pathology of vascular injury

Vascular injuries are caused by pelvic fractures in two ways. The fragments of bone created by the fracture can penetrate or perforate vascular structures. Fragments of the superior pubic ramus can tear the internal pudendal or obturator artery. Fractures through the sciatic notch can also tear the superior gluteal artery as it crosses from the pelvis into the buttock. Vessels are also disrupted when they are torn simultaneously with the ligaments which are injured by shear forces. The lateral sacral arteries may be torn when the sacroiliac joints are disrupted. The lateral sacral arteries, for example, may be torn when the contiguous sacroiliac ligaments are disrupted. Displacement of unstable pelvic fractures may also result in stretch injuries of the vessels.

Algorithm for working up patients with pelvic fractures

The management of patients with pelvic fractures is a complex affair with confilicting issues which make it difficult to form a definitive recommendation. The common association of pelvic fractures with abdominal and head injuries and with spinal and long bone fractures requires that diagnostic and therapeutic options be prioritized. As in most trauma algorithms the management of patients with pelvic fractures is highly dependent upon hemodynamic stability. An appropriate method of management of a stable patient with pelvic fractures would be quite unorthodox and possibly life-threatening in the unstable patient.

The methodologies of diagnostic and therapeutic imaging in the management of patients with pelvic fractures who are hemodynamically unstable is distinctly different from those who are stable. Hemodynamic instability indicates that hemorrhage is massive and must be addressed rapidly, appropriately and decisively. When patients with hemorrhagic shock have no evidence of pelvic fractures, bleeding is most likely the result of intraperitoneal injuries and the approach is more clearly defined. Exploratory laparotomy is usually the next step in management once hemoperitoneum is diagnosed.

However when pelvic fractures are present, the decisions are more complicatied and risky because instability could be the result of either massive intraperitoneal injury or retroperitoneal pelvic hemorrhage. Arteriographic embolization is an effective method of controlling of bleeding from torn branches of the hypogastric artery while exploratory laparotomy will release the tamponading effects of the abdominal wall upon the pelvic hematoma and result in expansion of the hematoma and exacerbate hemorrhage.

The diagnostic evaluation of hemorrhage in the unstable patient

In either case, it is critical to try to determine the most likely source of hemorrhage as soon as possible. Computed tomography, in this author's view, is the best single examination in patients with pelvic fractures for evaluating the potential sources of hemorrhage. However, in the unstable patient computed tomography is not usually satisfactory because of the delays required for preparation, transport and performance of the examination. Diagnostic peritoneal lavage (DPL) and peritoneal ultrasound have been acceptable methods of evaluating patients with blunt abdominal trauma. However, there are limitations of the use of DPL in patients with pelvic fractures. It does not assess the possible presence and degree of retroperitoneal hemorrhage and, therefore, has limitations in the patient who has both intraperitoneal and retroperitoneal injuries. Moreover, DPL is less reliable in patients who have sustained pelvic fractures. The false positive rate for identifying intraperitoneal hemorrhage is as high as 30 per cent.

Ultrasound has been shown to be a rapid and reliable alternative to DPL in detecting intraperitoneal fluid, even when performed by non-radiologists with limited training and experience. While ultrasound may not determine the source of bleeding, it is a quick method of determining that there is intraperitoneal hemorrhage and thus is useful in guiding subsequent treatment.

The diagnostic evaluation of hemorrhage in the stable patient

The diagnostic algorithm changes dramatically when the patient is hemodynamically stable. In this circumstance bleeding is not massive and a more orderly approach to diagnosis can be used. The absence of instability and transfusion demands suggests, in most cases, that urgent arteriography will not be needed. The vast majority of pelvic fractures will not require transfusion or die of trauma.

Methods of hemostasis for pelvic hemorrhage

There are multiple approaches to hemostasis of retroperitoneal hemorrhage and each has a role in the management of these patients. External skeletal fixation has been strongly recommended by orthopedic surgeons and some trauma surgeons as an method of hemorrhage tamponade in patients with unstable pelvic fracture patterns which open the pelvis and increase the pelvic volume. It can be rapidly placed at the bedside and provides structural stability and decreased fracture motion as these patients travel around the trauma center for multiple examinations and treatments.

It is theorized that unstable pelvic fractures result in increased pelvic volume which decreases resistance to bleeding. By placing a fixator on the pelvis and closing the displacement and decreasing pelvic volume, venous and fracture bleeding can be inhibited and thereby result in transfusion requirements. Furthermore stabilization of the fracture prevents recurrence of bleeding when the patient' s fractures are moved. While external fixators theoretically may diminish venous hemorrhage, this author finds it difficult to accept the concept that arterial hemorrhage can be diminished or stopped by placement of an external. Nonetheless, external fixators is used more liberally than arteriography at many institutions and may be in place when arteriography is performed.

In the presence of massive pelvic hemorrhage resulting in hypovolemic shock, arterial bleeding is likely to be a major contributor to blood loss. Transcatheter arterial embolization of massive pelvic hemorrhage is felt by many to be the most effective method of controlling massive hemorrhage. This procedure is directed at the multiple small branches of the internal iliac artery which are primarily responsible for massive blood loss.

Prioritization of control of intraperitoneal and retroperitoneal hemorrhage

In the unstable patient, it is vital to detect and treat life-threatening intraperitoneal hemorrhage before undertaking hemostasis of retroperitoneal pelvic hemorrhage. Massive intraperitoneal hemorrhage usually results from injuries of the liver, spleen or mesentery which may bleed unconfined and freely into the peritoneal cavity, while pelvic hemorrhage tends to be limited by the surrounding retroperitoneal muscles, fascia and organs. Exploratory laparotomy is the most expeditious method of controlling free bleeding. Therefore the hemodynamically unstable patient with pelvic fractures and evidence of intraperitoneal hemorrhage (by DPL or US) should undergo exploratory laparotomy first and then, depending upon what is found at laparotomy and the patient' s perioperative hemodynamic status, undergo pelvic arteriography to evaluate pelvic hemorrhage. Pelvic hemorrhage may also be the primary cause of hemodynamically instability. Intraperitoneal injuries may be minor or be absent. Primary laparotomy in this circumstance is as problematic as primary arteriography would be in patients who have intraperitoneal injury as the major source of bleeding. Laparotomy results in a delay in definitive hemostasis. It decreases the tamponade of the abdominal wall and may exacerbate hemorrhage. Hypothermia resulting from laparotomy may exacerbate that resulting from blood loss and replacement. This in turn may increase coagulopathy resulting in more pelvic bleeding.

Peritoneal lavage or ultrasound is useful in this circumstance. When these tests in hemodynamically unstable patients do not show evidence of massive intraperitoneal hemorrhage, pelvic hemorrhage should be suspected and pelvic arteriography should be performed as soon as transport can be accomplished.

Indications for pelvic angiography

The indications for pelvic arteriography in patients with pelvic fracture are fundamentally based upon the degree of blood loss and the clinical response of the patient to that blood loss. While there are certain types of fractures and fracture patterns which appear to be associated with massive blood loss, the appearance of the pelvic fracture on radiography or the degree of hematoma seen on computed tomography are not reliable determinants of the need for arteriography and embolization. Indeed the vast majority of patients who sustain pelvic fractures do not bleed massively, will spontaneously stop bleeding and do not require arteriography and embolization.

1. Hemodynamic instability with no evidence of intraperitoneal blood. Hemodynamic instability is the most important indication for arteriography.

2. Hemodynamic stability with blood loss greater than 4 units in the first 24 hours or 6 units in the first 48 hours. In many patients with retroperitoneal bleeding, shock can be reversed by rapid volume and blood replacement. However, hemodynamically stabilized patients may continue to bleed from pelvic fractures but at a slower correctable rate. While bleeding from the bony injury and venous lacerations can continue, these sources do not usually result in massive blood loss. Estimation of predicted blood loss from pelvic fractures per se is difficult and fraught with inaccuracies depending upon the number and degree of fracture fragments. Traditional estimates of anticipated blood loss from fractures of the pelvis are around 4 units of blood in the first twenty four hours or six units of blood in the first 48 hours. When these limits are exceeded, one can anticipate finding angiographic evidence of arterial extravasation from the branches of the internal iliac artery. This author believes that delays until there is massive blood loss should be avoided because it results in higher risks of hepatitis, transfusion complications and multiple organ failure. Furthermore such transfusion requirements are also associated with hypothermia, and coagulopathy which increases the rate of venous and osseous bleeding, even when the arterial bleeding has been controlled.

3. Massive or expanding pelvic hematoma seen on laparotomy. There are circumstances where exploratory laparotomy is performed for significant intraperitoneal injuries. There may also be an associated pelvic hemorrhage seen during exploration. It may be manifested as an expanding or a tense hematoma of the retroperitoneum or there may be tears of the posterior peritoneum with resultant intraperitoneal hemorrhage from the retroperitoneum. In either circumstance, the operating surgeon may decide that angiography is the next appropriate step. The reader is cautioned against operative exploration of pelvic hematomas associated with pelvic fractures in order to attempt ligation of pelvic bleeding sites. Ligation of the internal iliac artery is an ineffective technique because collateral circulation will maintain sufficien blood pressure and flow to allow persistent bleeding.

4. Massive pelvic hematoma seen on CT. A thoretical indication for angiography is the detection of a massive hematoma on CT. However, this author has not found the size of the hematoma to be predictive of the need for angiography, although arterial contrast extravasation within hematomas does suggest active bleeding and may be a useful triage sign. However, once indications for arteriography are met, there is little role for computed tomography before angiography.

5. Post-traumatic priapism. Angiography can also be used to evaluate and treat the uncommon entity of post-traumatic priapism. This condition of persis-

tent erection which is not associated with sexual stimulation is usually caused by venoocclusive disease but may also result from trauma. The mechanism of injury may be blunt or penetrating in origin. The perineum may be traumatized by being crushed against the bars or seat of a bicycle or motorcycle or during a fall from a height where the patient straddles some structure. The pathophysiology is usually vascular engorgement and hypertension within the cavernosal bodies rather than the more typical mechanism of venous oucclusion and cavernosal outflow as is seen in sickle cell anemia. It is caused by an arteriovenous fistula or false aneurysm of a cavernosal branch of the internal pudendal artery. Superselective arteriography of both internal pudendal arteries may be particularly helpful when the injury is not easily identified. This author has not experience with the modality in this condition.

Techniques of pelvic angiography

Access

The femoral artery is preferred for vascular access in these patients. There are, however, some technical difficulties in these patients. Palpation of pulses can be particularly difficult because pelvic hematomas may spread below the inguinal ligament, which itself may be disrupted. Hypovolemia, hypothermia and vasoconstriction due to catecholamine release may result in narrowing of the artery. Lateral displacement of the hemipelvis may occur in unstable fractures and this may result in a more lateral position to the femoral artery.

While a femoral cutdown can be done quickly in the angiography suite, this is seldom necessary. Fluoroscopy can be used to determine the best location for punctures of the non-palpable femoral artery. The vessel usually lies at the junction of the medial and middle third of the arc of the acetabulum; the inguinal ligament usually is at or above the junction of the upper and middle thirds of the femoral head. If the femoral vein is inadvertently punctures, a guidewire and or a sheath can be placed within the vein and used as a radiopaque marker of its position. This sheath also provides a conduit for fluid resuscitation or caval filter placement.

The SMART NEEDLE® is a most helpful device in these patients. It allows access in the most difficult situations, such as the unstable patient with absent pulses.

Catheters

A sheath is recommended for pelvic arteriography for trauma embolization. A number of catheter shapes can be used for these cases; because both hypogastric vessels must be selectively catheterized, these shapes should allow movement across the bifurcation of the aorta and the common iliac artery. Coaxial catheters are sometimes necessary to catheterize bleeding vessels, although the time and effort are usually unnecessary.

I prefer the Headhunter catheter with a long loop created by Waltman' s. Other catheters include the Bookstein or Stein catheter which have a long distal limb which allows the angiographer to manipulate proximally and distally and bilaterally.

Aortograhy

Aortography of the abdomen and pelvis should be performed before selective catheterizatoin for a number of reasons. Associated injuries of the liver, spleen and kidneys as well as vascular injury to the lumbar vessels may also be present and identification and treatment of arterial bleeding from these injuries should be attempted simultaneously. A selective pelvic arteriogram is also essential because it allows visualization of the anatomy of the hypogastric arteries, as well as delineation of external iliac or femoral branch injuries at the same time. Bleeding sites are better visualized on selective hypogastric arteriography than on aortography.

It is not uncommon to have a normal pelvic aortogram while selective hypogastric arteriography demonstrates multiple bleeding sources.

Both hypogastric arteries should be studied even when the pelvic fractures are unilateral or when a prior CT demonstrates the presence of a unilateral hematoma. Huittinen and Slatis reported that bleeding was bilateral in two thirds of studied autopsy material. Hemorrhage may emanate from a contralateral vessel because of anomalies or because of contralateral retrograde filling of proximally occluded vessels.

The angiographic findings of pelvic arterial hemorrhage are the same as those of other arterial injuries; they include extraluminal extravasation, occlusion, arteriovenous fistula, vasospasm, dissections and filling defects. Contrast extravasation and occlusion are the most common findings. Arteriovenous fistulae are uncommon in blunt. The appearance of extravasation is dependent upon the timing of arteriography; when arteriography is done early, it demonstrates small extravasation, when done late, studies show larger accumulations of the contrast medium. This no doubt is caused by liquefaction of the hematoma with time. The appearance also depends upon mechanisms of injury and the individual vessel which is injured. Arterial bleeding associated with many pelvic fracture and the result of disruption of multiple small vascular structures surrounding bone and paralleling ligamentous structures. These present as small punctate puddles of contrast medium, often multifocal in location. Other fractures cause tearing of muscles and ligaments and disruption of medium sized vessels. These extravasations tend to be larger and more focal. Finally larger vessels such as the superior gluteal artery may be torn or avulsed and result in large accumulations of contrast.

Indications for embolotherapy

The indications for embolization are based upon the hemodynamic status and the degree of blood loss seen. Therefore embolization should be considered whenever arterial extravasation is seen. Embolization of occluded arteries identified at angiography is a more difficult decision. One could argue that since no bleeding is seen, embolization should be deferred until a repeat or followup arteriography is needed. I recommend that all arterial injuries, including occlusions, be treated preemptively by transcatheter embolization to secure the injury and protect against delayed or recurrent hemorrhage. Another difficult decision is how to treat patients who have angiography which shows no evidence of arterial hemorrhage or other angiographic abnormality. One would presume that such bleeding is venous in origin. Some angiographers would perform bilateral hypogastric embolization in this scenario, trying to diminish hypogastric venous bleeding. This author does not believe that it is possible to diminish pelvic and hypogastric venous flow by arterial embolization. The practice " blind embolization" is not recommended.

Techniques of embolotherapy

The nature of pelvic fracture hemorrhage from multiple and bilateral small vessels supplying or running adjacent to muscles, tendons, ligaments, nerves and bone requires small sized embolic material. The emboli must reach into the distal small vessels and bypass the numerous and extensive peripheral and central collateral circulation. While these collaterals maintain adequate perfusion to the tissues supplied by the embolized vessels, they also increase the risks of recurrent bleeding as these collaterals enlarge. This is the reason that bilateral hypogastric artery ligation is unsuccessful in controlling pelvic hemorrhage.

Surgical gelatin is the preferable embolic material for hemorrhage associated with pelvic fractures. It is readily available at any facility. It is rapidly prepared and delivered. The size and shape of the emboli can be tailored to the specific injury. Gelfoam has an intermediate occlusion time which is ideal for this type of injury where healing of the fractures and soft tissue lacerations can be expected to begin early.

Pledget size is dependent upon the size of the vessels which are injured but one must consider the effects of vasospasm and hypovolemia in determining the size of the vessels. The ideal size is generally between two and four millimeters cubes; this allows collateral flow to reach the tissues while direct flow to the bleeding site is terminated. Smaller pledgets are not recommended because they may reach too far distally and result in ischemia or infarction.

The optimum site of embolization is to the artery of the distribution of bleeding. Howerver, superselective catheterization of these multiple small vessels is more difficult and often requires coaxial techniques. This is time consuming and may not be warranted in hemodynamically unstable patients. Moreover, superselective catheterization may result in vasospasm which can prevent delivery of the emboli to the periphery either mechanically or by flow direction.

Therefore the site of delivery of emboli depends upon the ability to place the catheter in the desired position. An alternative which is used by Kings County Hospital is to place the catheter more proximally and allow blood flow to carry the emboli to the site of bleeding. The advantages of a more central location in the hypogastric artery are the avoidance of vasospasm, a more expeditious and less complicated embolization, and maintenance of flow direction of the emboli. This "spray" of emboli also creates multiple sites of occlusion which diminish direct flow to the zone of hemorrhage.

The disadvantage of this non-target embolization is that emboli may flow to areas of the pelvis which are not bleeding and this may result in ischemia to normal tissues. Bilateral hypogastric embolization has been well tolerated by our patients with minimal complications.

"Coil blockade" can be used to prevent embolization of uninjured pelvic vascular beds. This technique occludes the origins of normal vascular beds with spring coils which act as "filters" to block the flow of pledget emboli into depths of the normal vascular bed. Embolization with gelfoam through a catheter placed proximally allows flow of the small particulate emboli to the area of bleeding. The vascular bed of the normal vessels that have had their origins occluded remain perfused through the rich collateral network.

Coils are rarely appropriate for the treatment of pelvic fracture bleeding. Superselective catheterizaton and microcoil occlusion has been described for these injuries but we have found the time and expense to be unnecessary.

The end point of embolization is stasis within the bleeding vessel. It is vital that pelvic aortography and bilateral hypogastric angiography be performed after embolizatio to assure that bleeding does not persist through collateral circulation. Hypogastric arteriography alone may not visualize the collaterals from the femoral arteries.

Post traumatic priapism may be reversed by embolization of the internal pudendal artery to close the fistula. Because this condition is less life-threatening than that for arterial hemorrhage resulting from pelvic fracture, there is usually time to attempt superselective catheterization of the internal pudendal artery or the injured branch. The use of coaxial catheters to get as close to the injury allow precise occlusion without compromise to uninjured vasculature and minimize the chances of recurrence by collateral flow. Surgical gelatin is the embolization material of choice because it may be temporary and the sizing of the emboli can be tailored to the patient. If a high flow large connection fistula exists, surgical gelatin may be inadequate and result in recurrence. In such situations Tracker® or Hilal® coils may be better suited to a favorable outcome.

This treatment is usually successful in rapidly clearing the priapism with response occurring within 24 hours. If priapism persists, it suggests that the emboli have washed across the venous connection or collateral circulation has been recruited to maintain the fistula. Arteriography should be repeated in this situation to determine the reason for failure of the treatment. Complications of this treatment are uncommon and most patients are able to develop tumescence and maintain an erection during sexual activity. However, impotence has been described in one patient.