Endovascular treatment of iatrogenic vascular injuries

Poster No.: C-2066
Congress: ECR 2010
Type: Educational Exhibit
Topic: Interventional Radiology
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Keywords: Iatrogenic, Vascular Injuries, Endovascular Treatment
DOI: 10.1594/ecr2010/C-2066

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Learning objectives

To review the major angiographic findings of vascular iatrogenic injuries and their endovascular treatment.

Background

Iatrogenic vascular injuries amenable to endovascular repair are becoming more frequent.

Vascular injuries are a potential complication of numerous different medical procedures and its incidence has been rising due to rising new interventional procedures and more accurate diagnosis.

Vascular injuries are a long time known and feared complication of surgery and percutaneous interventions. They can occur following open or laparoscopic surgeries, biopsies, drainage procedures, percutaneous radiofrequency ablation, arterial or venous access, sclerotherapy, injection of anaesthetic agents, infusions, catheterisms and endoscopic procedures. A consistent minority of these procedures will result in vascular injuries requiring treatment. Most injuries involve the arterial system.

There are many different types of complications such as arteriovenous fistulas, arterial pseudoaneurysms, thrombosis, rupture, dissection, embolization, laceration/avulsion, haemorrhage or indwelling intravascular devices.

Clinical signs can be acute or chronic with hemodynamic instability, ischemia, and even death. Diagnosis can sometimes be very difficult and reached late, so that procedures are frequently not treated until in a later stage because they are initially overlooked.

Balloon occlusion or dilatation, embolization with coils, polyvinyl alcohol (PVA) and/or gelfoam particles, stent deployment, stents covered with polytetrafluoroethylene (PTFE) and wallgraft endoprosthesis are some of the endovascular options available nowadays. Treatment must be tailored in each situation according to the organ or vessel involved, clinical presentation and type of vascular lesion found at angiography.
Imaging findings OR Procedure details

Hepato-Biliary and Pancreatic Injury
(figures 1 and 2)

Aetiology - surgery (laparoscopic cholecystectomy for gallstones, pylorus-preserving pancreaticoduodenectomy, conventional pancreaticoduodenectomy, distal pancreatectomy, segmental resection of the pancreas, total pancreatectomy, bile duct resection with partial hepatectomy, hepatopancreatoduodenectomy, hemihepatectomy and hepatic resection with removal of the bile duct with lymphadenectomy within the hepatoduodenal ligament generally for malignancies). A less common procedures is laparoscopic splenectomy.

Type of lesions - pseudoaneurysm, artery stump, intact but ectatic artery with surgical clips closely applied, arterial erosions/lacerations and arteriovenous, arterio-portal or arterio-biliary fistulas.

Vessel affected - The hepatic artery (common, proper, right and left branches) is the commonest vessel affected. The celiac trunk, the splenic, left gastric, gastro-duodenal, subphrenic, lumbar and superior mesenteric arteries are less affected.

Treatment options - embolization with coils with proximal and distal deployment in the injured vessel. Other embolizing agents used are polyvinyl alcohol (PVA) and/or gelfoam particles and cyanoacrylates. When indicated covered stents are a reasonable treatment option.

Renal Injury
(figures 3 - 6)

Aetiology - Percutaneous nephrostomy, renal biopsy, or biopsy-related vascular injuries in renal allografts and percutaneous nephrolithotomy are the most common causes.

Type of lesions - pseudoaneurysms, arteriovenous fistulas and contrast extravasation.
Vessel affected - The main renal artery or one or multiple interlobar arteries are frequently injured, although the ureteric artery can also be affected.

Treatment options - Coils are first line option as embolizing agents with proximal and distal deployment in the injured vessel. Other embolizing agents used are polyvinyl alcohol (PVA) and/or gelfoam particles. Cyanoacrylates with or without Lipiodol are increasingly being used to treat renal arterial lesions with good results.

Orthopaedic Injuries
(figures 7 and 8)

Aetiology - Spinal operations (cervical, lumbosacral or herniated disc arthrodesis), shoulder operations (recurrent dislocation, excision of first rib), hip surgery (prosthesis, plate and screws, fractured acetabulum), and operations on the lower limbs (osteosynthesis of femur or tibia, meniscus operations, total knee arthroplasties, total hip arthroplasties, and ankle reconstructions).

Type of lesions - False aneurysms, arteriovenous fistulae, ischemia and arterial thrombosis are the most common abnormalities identified. Arterial laceration/avulsion is less common.

Vessel affected - The iliac, common femoral, profunda, superficial femoral, popliteal, or tibial arteries are the most frequently involved. Concomitant venous injury may be present in some cases.

Treatment options - Coils placed on the pseudoaneurysm are a viable option. When endovascular management is aimed to restoring blood supply angioplasty and stent placement are the preferred choices.

Injury related to endovascular procedures
(figures 9 - 11)

Aetiology - complications at the site of vascular puncture, migration of embolizing agents, arterial laceration or even rupture or migration after angioplasty and stent deployment. Intravascular devices such as guide-wires or catheters can brake with
detached portions inside the arterial vessel. Catheters and guidewires can also cause arterial spasm or dissection.

**Type of lesions** - haematoma, dissection, arteriovenous fistula or a pseudoaneurysm. Arterial or venous thrombosis, organ ischemia after embolization, infectious complications or rebleeding can also occur.

**Vessel affected** - femoral or braquial arteries or veins at the site of puncture, hepatic, renal and iliac arteries, innominate, jugular and subclavian veins are the most frequently injured.

**Treatment options** - Retrieval of misplaced coils is possible with snares or detachable coils. Ischemic complications can be avoided with superselective embolization. Arterial dissections can be treated with stent placement, arterial rupture with covered stents, arterial spasm can be managed with intra-arterial nitro-glycerine or verapamil. Rebleeding can be avoided with correct embolization and repetition of the procedure. Thrombotic complications can be treated with fibrinolytics.

**Images for this section:**
Fig. 1: Pseudoaneurism of a right hepatic artery branch following percutaneous cholecystectomy. Right hepatic artery pseudoaneurism.
**Fig. 2:** Pseudoaneurism of a right hepatic artery branch following percutaneous cholecistectomy. Following embolization with coils the pseudoaneurism is gone.
Fig. 3: Hematuria after left percutaneous nephrolithotomy. Left renal angiography through a catheter placed in the lower branch. Arteriovenous fistula with renal vein opacification.
Fig. 4: Hematuria after left percutaneous nephrolithotomy. After embolization the arteriovenous fistula disappeared and the renal vein did not opacificate in the arterial fase.
**Fig. 5:** Hematuria after right renal biopsy Image on the left - right renal angiography - pseudoaneurism. Image on the right - after embolization - the pseudoaneurism disappeared.

![Image of hematuria after right renal biopsy](image)

**Fig. 6:** Hematuria after biopsy of a transplant kidney Image on the left - Angiography of right iliac artery - pseudoaneurism with arteriovenous fistula and opacification of the inferior vena cava. Image on the center - Angiography though catheter placed selectively at the level of the fistula Image on the right - After embolization with coils the fistula dissapeared with no venous opacification.

![Image of hematuria after biopsy of a transplant kidney](image)
Fig. 7: Pseudoaneurism of the peroneal artery after tibial osteosynthesis. Image on the left - angiography of the popliteal artery - laceration of the peroneal artery with pseudoaneurism formation. Image on the right - after embolization with a single coil the pseudoaneurism is gone.
**Fig. 8:** Pseudoaneurism after right hip arthroplasty Image on the left - right femoral angiography - large pseudoaneurism. Image on the right - after embolization - the pseudoaneurism is gone.

![Image](image1.jpg)

**Fig. 9:** Image on the left - plain film of left inguinal zone after angioplasty - detached piece of guide wire. Image on the right - angiography after insufflation of the balloon at the level of the retained piece of wire with nonsignificant dissection and preservation of blood flow.

![Image](image2.jpg)

**Fig. 10:** Image on the left - superior vena cava occlusion induced by central venous catheter. Image on the right - central venous repermeabilization after stent placement.

![Image](image3.jpg)
Fig. 11: Image on the left - flebography of right axilar vein of a patient with pacemaker - thrombosis of the right axilar and subclavian veins and superior vein cava. Image on the right - results after regional fibrinolysis shows total recanalization of the thrombotic veins.
Conclusion

Although rare, iatrogenic vascular lesions are becoming more and more frequent with the increasing interventional diagnostic and therapeutic medical and chirurgical procedures.

Angiography is generally mandatory when there is clinical suspicion of a vascular lesion following an iatrogenic procedure.

The main lesions found involve the arterial system with arteriovenous fistulas and arterial pseudoaneurysms being the most frequent. Arterial thrombosis, rupture, dissection, embolization, laceration/avulsion, haemorrhage or indwelling intravascular devices are less frequent complications.

Management of arterial iatrogenic lesions must be individualized according to the site of bleeding, clinical presentation and type of vascular lesion.

Interventional radiological procedures are effective in the management of iatrogenic lesions of the majority of arterial vessels since they are minimally invasive, have a high success rate, and a low incidence of complications compared to the more complex and dangerous surgical or laparoscopic options.

Personal Information

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