

Chapter 2

Vascular Emergencies

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Introduction

Vascular surgery is a relatively new specialty that used to be encompassed by general surgery involves multidisciplinary diagnosis and surgical treatment of cardiovascular disease. Medical management, minimally invasive treatment, and open surgical cases are key components of this specialty.

Now a days, separate on call rosters usually exist for vascular surgeons, as opposed to 10 years ago, when the general surgeon managed all vascular emergencies. Despite this, most junior trainees will often be the first point of contact, while on call.

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Because of the vital importance of time – ischemia from vascular injury may potentially result in loss of limb, loss of function, or loss of life – all junior trainees will be expected to have an excellent working knowledge of vascular conditions, as well as having a good understanding of expeditious management of vascular emergencies.

In this chapter, potentially life- and limb-threatening clinical cases are presented, with an emphasis on urgent recognition, through key features in the history and examination. The principles of acute management of these conditions are presented to avoid loss of limb, and loss of life, in day-to-day clinical practice.

Clinical Case Scenario 1: Ruptured Aortic Aneurysm (AAA)

Case Presentation

A 72-year-old hypertensive man presents with a 12-h history of severe and acute abdominal pain, radiating to the left flank, followed by collapse. On arrival in the emergency department, he appears pale, sweaty, and is tachycardic but normotensive. His pain persists. He is thought to have renal colic and is sent for a CT kidneys, ureters, and bladder (KUB) which shows a ruptured aortic aneurysm.

Key Features of History and Examination

Abdominal aortic aneurysm is most common in elderly male patients, but it does also occur in older women and may occur in younger patients where there is a genetic component. Smoking, hypertension, and hypercholesterolemia are all risk factors, as is a family history of the condition, so remember to ask about this or a family history of sudden death. Patients may have reported an abdominal pulsation. Often, there is a period of collapse, after which they regain consciousness and are hemodynamically stable. This is a result of a “herald bleed” contained within the

retroperitoneal space and is associated with pain which is usually, but not always, in the left flank. It can be confused with renal colic. The patient may be too unwell or unconscious and not able to provide much by way of history. The possibility of ruptured abdominal aortic aneurysm must be considered in all patients even if the aneurysm is not palpable. The aorta is a deeply placed organ, and even a large aneurysm may not be palpable through a well-padded abdominal wall. Beware of a ruptured iliac aneurysm and/or thoracic aneurysm. There may be other clues on examination, such as prominent popliteal artery pulsations. Any patient with a known aortic aneurysm presenting with abdominal pain, back pain, or collapse should be assumed to have ruptured until proven otherwise. An aortic aneurysm may be symptomatic but may not have ruptured. Such patients are generally not discharged from hospital until their aortic aneurysm is repaired. Consider this in cases where the aortic aneurysm is tender, causing distal embolization or associated with an aorto-enteric fistula (rectal bleed, hematemesis).

Principles of Acute Management

If suspected, then all members of the surgical and anesthetic teams should be notified as soon as possible. Inform theaters so they can prepare theater personnel and necessary instruments. Call intensive care as the patient will most likely be transferred there postoperatively. The patient should be given high flow oxygen. Intravenous access (2×14 gauge venflons) should be obtained, a urinary catheter inserted, and blood collected for full blood count, urea and electrolytes, a coagulation profile (if clinically indicated), and blood for cross match. Many hematology departments have “ruptured aneurysm” or “massive bleed” protocols so activate these.

Resuscitate the patient carefully. A policy of “permissive hypotension” is usually adopted. This does not prohibit the use of fluids, but they should be given to maintain a systolic blood pressure of just above 80 mmHg. Blood is ideal.

Ensure adequate analgesia. Call the family and discuss with the patient if there is time and the patient is conscious.

Computerised tomography (CT) angiography will confirm the diagnosis, show the extent of the aneurysm, and allow for procedural planning. If there is local expertise available, the aneurysm is anatomically suitable, and the patient is sufficiently stable, they may benefit from an endovascular aneurysm repair.

It is very important to image the thoracic aorta as well in order to exclude thoracic aneurysm or dissection. Ultrasound is of limited use as it will confirm the presence of an abdominal aortic aneurysm but not whether it has ruptured. If unstable, the patient should be taken straight to theater. Similarly, if a patient is being transferred from a referring hospital with a proven ruptured aneurysm, there is no place for assessment or resuscitation in the emergency room of the receiving hospital, and any assessment should take place in the anesthetic room.

Discussion

The prevalence of abdominal aortic aneurysm increases with age and occurs in 7–8% of males over the age of 65. It is six times more common in men than in women, and this is why only men are invited to participate in screening in the United Kingdom. Rupture of an AAA is the seventh most common cause for male death in the United Kingdom. Preventing rupture by population screening will hopefully reduce this number as the outcomes for elective repair are much better than for emergency repair (mortality rates of 5% versus 50%, respectively). Sharing common risk factors, patients with aneurysmal disease may also have Coexisting occlusive disease, so a complete peripheral arterial assessment is required in these patients. This is of considerable importance as one of the risks of aortic surgery is limb ischemia. Coexisting popliteal or femoral aneurysms must be looked for on examination.

Currently, trials are underway comparing open versus endovascular repair of ruptured abdominal aortic aneurysms. Successful outcomes are reported following endovascular repair, but the patient may develop abdominal compartment syndrome and require a laparostomy. This strategy depends

on local expertise. There is an overall mortality rate of 50% following open repair, and this has not changed over the last 50 years despite advances in anesthesia or intensive care. If stable, there is some evidence that outcomes are better if the patient is transferred to a unit with a vascular surgeon rather than attempting a repair by a nonvascular specialist.

The outcome following AAA repair is poor in the very elderly and in those patients who have suffered a concurrent cardiac arrest. It is also unfavorable in those patients persistently unconscious following initial circulatory collapse, and in these situations, a decision not to repair may be appropriate but can only be made by a senior vascular surgeon.

Clinical Case Scenario 2: Aortic Dissection

Case Presentation

A 50-year-old man presents with a sudden history of tearing chest pain, occurring centrally and radiating to his back. He describes this as the “worst pain” he has ever had. He is on treatment for hypertension, and his blood pressure on arrival was 230/110 mmHg. On arrival to the emergency department, he complains that his feet are cold and numb, he has ischemic legs, and is anuric.

Key Features of History and Examination

One of the main points in the history is the abrupt onset of pain that patients consistently describe as tearing in nature and frequently state is the worst they have ever experienced. They may be breathless or feel faint or give a history of collapse. The patient may give a history of hypertension and is usually hypertensive on arrival, as this is the commonest etiology. The patient may have marfanoid features (tall, high arched palate, arm span greater than height, arachnodactyly), or they may have a formal diagnosis of bicuspid aortic valve,

Turner's syndrome, Marfan's syndrome, Ehlers-Danlos syndrome, or another connective tissue disorder. Ask about a history of syphilis and cocaine use.

A full peripheral arterial examination should be performed, as the absence of distal pulses is a poor prognostic factor that indicates extensive disease. There may be a difference in the recorded blood pressure between the right and left arms and a slow radial pulse. The patient may present with neurological symptoms (paraplegia) or stroke. There may be abdominal pain or tenderness (visceral ischemia) or flank tenderness (renal ischemia), and there may be oliguria or anuria. An electrocardiogram (ECG) will be done to exclude a coronary event and is usually normal.

Principles of Acute Management

The first step is to suspect the diagnosis. Analgesia is essential, as is the swift pharmacological control of blood pressure which often requires consultation with a cardiologist. Management of aortic dissection is dependent on the classification, and although many classification systems exist, the Stanford classification is by far the easiest to remember. Dissections proximal to the left subclavian artery are termed Stanford type A and distal to the left subclavian, Stanford type B.

Type A aortic dissection requires *URGENT* cardiothoracic referral as the mortality rate from an untreated type A dissection is 1%/h (from acute aortic regurgitation and/or rupture, pericardial tamponade, and coronary ischemia). Type B dissection can be further classified into uncomplicated or complicated (associated with limb, visceral, spinal, or renal ischemia).

High flow oxygen should be administered, and intravenous access established with large bore cannulas. ECG should be performed and blood tests, including full blood count, urea and electrolytes, coagulation screen, and cross match. Liver function tests and amylase may provide clues to mesenteric perfusion, and an arterial blood gas is helpful. Creatine kinase (CK) is often helpful in complicated type B cases.

Tight blood pressure control is required. Intravenous beta-blockers are usually the first line of choice. Glyceryl trinitrate (GTN) infusions may be used but can cause headache if used for a prolonged period. Analgesia is also required, in the form of a patient-controlled analgesia (PCA).

Computerised tomographic angiography (CTA) should be performed urgently, and then a management plan worked out accordingly. Type A dissections require urgent aortic root replacement by a cardiothoracic surgeon. The majority of type B dissections can be managed conservatively, with tight blood pressure control and analgesia.

Complicated type B dissections, however, will require intervention. If the patient presents with single limb ischemia, then femoro-femoral cross-over bypass grafting may be indicated. If there is renal or mesenteric ischaemia paralysis, or even an aortic rupture, then the treatment of choice is endovascular stent grafting. Sometimes, a short covered stent can be placed over the intimal tear to close it and fenestrations created more distally to restore flow to the true lumen.

Discussion

Aortic dissection can occur in hypertensives and in patients with a family history. It is associated with Marfan's disease and bicuspid aortic valves. Sometimes, there are no predisposing factors known. There may be limb, gut, or renal ischemia depending on the extension of the dissection flap, all of which are poor prognostic factors.

This patient's prognosis is very poor, but fortunately many patients do very well with simple conservative measures for type B dissection. For most patients, the pain settles over a few days. If pain persists, they are thought to be at risk of rupture and endovascular intervention is indicated. Imaging is repeated usually after a fortnight to determine whether there has been expansion of the false lumen, which would be another indication to intervene. After 2 weeks, the dissection is termed "chronic." About 30% of patients with chronic dissection undergo aneurysmal change and so serial CTs are

recommended (usually on an annual basis). The aorta remodels more effectively in the acute period rather than once the dissection is well established, and as there is no certain means of predicting which patients will develop late expansion, there are trials underway to determine whether all patients might benefit from endovascular stent grafting in the acute period.

Clinical Case Scenario 3: Acutely Ischaemic Limb

Case Presentation

A 53-year-old man comes into the accident and emergency department with a cold, white, numb foot. This came on very suddenly a couple of hours ago. He has never experienced any problems in the leg before. He is a smoker and hypertensive and suffers from the odd episode of palpitations but is otherwise well.

Key Features of History and Examination

A patient with an acutely ischemic limb will report symptoms that have typically come on within hours but less than 2 weeks (which would make it a critically ischemic limb). They may have risk factors for atherosclerosis (smoking, hypertension, diabetes, male gender, family history, hypercholesterolemia). They may have an arrhythmia and may or may not be anticoagulated with warfarin. Think about the silent MI as a source of embolus, particularly in a diabetic. They may have a history of previous vascular surgery and have a bypass graft or stent graft that has acutely occluded.

The presence or absence of pulses on the other side is a useful clue for determining etiology. Presence of pulses might indicate an embolus, absent pulses might indicate preexisting arterial disease, and a very prominent popliteal pulse might point the finger at an aneurysm. Check for an aortic aneurysm as an embolic source.

Classically, the patient presents with a limb that is painful, and perishingly cold, and may have parasthesia and paralysis. It is pale

and pulseless on examination. Parasthesia and paralysis are signs that the leg is imminently threatened and may not be viable more than 6 h after onset of symptoms in the case of an acute embolism in a leg with previously normal vasculature. If there is preexisting peripheral vascular disease, collaterals may have developed, which means that the leg may remain viable for longer. The foot may not be pale, but may be mottled or dusky. The capillary refill time is of useful significance in a dusky leg. If delayed (if it takes longer to refill than it does to say “capillary refill”), this would indicate ischemia. Calf or anterior compartment tenderness is also a disturbing sign and would indicate muscle under threat. Fixed mottling (that does not blanch with pressure) and paralysis usually mean an unsalvageable limb.

Principles of Acute Management

The important points here are to accurately identify a limb at need of urgent intervention. There may only be a small time frame when the limb might be salvageable. The patient may have had a recent coronary event, and if the event was embolic, be at risk of further embolization (stroke, mesenteric ischemia).

The patient will need rapid assessment and appropriate referral. Analgesia is important, and the patient will usually require intravenous opiates. Bloods should be sent for full blood count, urea and electrolytes (prior to intravenous contrast), coagulation screen (baseline), group and save, and troponin (if recent onset chest pain or they are diabetic). ECG should be performed to determine whether the patient is in sinus rhythm and to exclude a myocardial infarction. If in atrial fibrillation, they will need rate controlling.

Anticoagulate with intravenous heparin as the patient may have had an embolus, and they may need urgent arteriography or surgery. Give a 5,000 unit bolus intravenously and then start an infusion. If available, an urgent CT angiogram or arterial duplex by a skilled vascular technician is invaluable and may be all the imaging that is required prior to surgery.

If no imaging is available, the limb is white, and the patient appears to have had a very acute embolic event, it may be appropriate to take the patient straight to the operating theater

at this point, without additional imaging, and perform an angiogram “on-table” if necessary. A femoral embolectomy may be performed easily in an unwell patient under local anesthetic.

If there is diagnostic uncertainty and there are no runoff vessels on the duplex scan, and there is thought that thrombolysis might be indicated, or that the patient might benefit from radiological intervention, an arteriogram may be performed.

Discussion

An acutely ischemic limb may be a result of trauma, embolus, in situ arterial thrombosis, or a thrombosed popliteal aneurysm. It can often be very difficult to identify an acutely ischemic limb. The key is to identify the limb at risk from the limb that is unsalvageable, as trying to reperfuse a nonviable limb is extremely hazardous for the patient. Prompt decisions are necessary. The patient may be very unwell following a recent coronary event. Always consider whether fasciotomies may be necessary.

The majority of embolic events come from a cardiac source and an echocardiogram should be performed, although this may be normal. It may be necessary to image the aorta with CT to look for an alternative source of embolization (aneurysm, ulcer, atheroma).

If the patient presents with a popliteal aneurysm, they will need to be screened for abdominal aortic aneurysm and the popliteal on the other side as these frequently coexist.

Clinical Case Scenario 4: Transient Ischemic Attack

Case Presentation

A 65-year-old man is brought in by his family after developing weakness of his right arm and slurring of his speech. He describes a similar episode 2 weeks previously that resolved over an hour. On further questioning, he describes transient visual loss that affected his left eye. These symptoms improve over the course of the day.

Key Features of History and Examination

Emboli originating from the internal carotid artery cause ischemic changes in the territory of the middle cerebral artery or ophthalmic artery. These manifest as symptoms including contralateral limb weakness or sensory disturbance. Ipsilateral monocular blindness (amaurosis fugax, typically described as a “curtain obstructing vision in one eye”) is a result of emboli in the ophthalmic artery and is usually transient. Slurring of the speech may be present with left hemispheric TIA or stroke (95% of right-handed and 70% of left-handed people have their speech center located in the left cerebral hemisphere). A transient ischemic attack by definition fully resolves within 24 h. The patient will have one or more for atherosclerosis risk factors. On neurological examination, there may be weakness of the upper or lower limbs or both. The patient may be hyperreflexic with an upgoing plantar response on the affected side. Sensory inattention may be present together with dysarthria or dysphasia. A carotid bruit is sometimes, but not always, present, and its presence or absence is not helpful (it may be absent with a severe stenosis of the internal carotid artery or may be present and associated with a mild stenosis or actually be emanating from the external carotid artery). There may be stigmata of related cardiovascular disease (i.e., sternotomy incision from previous CABG, absent foot pulses, aneurysmal disease).

Principles of Acute Management

Although often referred to the internal medical team, surgeons should be adept at the investigation and management of patients with transient ischemic attacks. Prompt management of transient ischemic attacks can prevent stroke in approximately 43% of patients within 7 days of the index event. All patients should have bloods including glucose and inflammatory markers (the latter may point to an arteritic process), and ECG should be performed to exclude cardiac ischemia or arrhythmia or occult cardiac pathology. A CT scan of the brain may be performed if there is clinical suspicion of a

hemorrhagic stroke (accounting for 20% of all strokes). Antiplatelet therapy should be commenced in all patients unless contraindicated.

Duplex ultrasonography is the investigation of choice in assessment of carotid disease. It is a low cost, noninvasive investigation; however, it is not readily available out of hours. In such cases, CT or magnetic resonance angiography of the carotid arteries may be performed. There is good evidence that CEA (combined with medical therapy) is superior to best medical therapy when the degree of ICA stenosis is greater than 70%. Surgery should be scheduled on the next available elective operating list and certainly within 7 days of the index TIA in uncomplicated cases. If the patient is not receiving clopidogrel, they should receive a 75 mg stat dose the evening before surgery, as this has been shown to reduce the incidence of perioperative embolization. Patients with subthreshold stenosis (<70%) should be managed with best medical therapy. Any cases that are not clear cut should be discussed at a multidisciplinary team meeting, as should all operative cases if logistically practical.

Patients admitted with a stroke in evolution, progressive hemiplegia, or crescendo TIAs should be considered for emergency CEA. Patients admitted with these conditions should be anticoagulated with unfractionated heparin prior to surgery. Patients thrombolized for stroke as a result of thrombotic occlusion of the ICA may have an underlying stenosis unmasked by thrombolysis. Such patients should also be treated in the same manner and have an early CEA.

Discussion

In this modern era, it is not unusual for specialist vascular surgical teams to be involved in the management of transient ischemic attack. CEA is no longer a "cold" elective case, and health services worldwide are employing a more aggressive approach to its management. Increasingly CEA is being performed out of hours and at weekends. The modern surgeon working in a vascular unit should be adept at performing

neurological examination, and the threshold for operating should be lowered if there is any suggestion of ongoing neurological deterioration. In cases of TIA related to atherosclerotic disease, the benefits of CEA are greatest in the first 24 h. Patients should be given antiplatelet medication (aspirin, dipyridamole, clopidogrel) if they are not already receiving this, and some patients will require intravenous unfractionated heparin prior to expedited surgery.

Clinical Case Scenario 5: Extensive or Proximal DVT

Case Presentation

A 35-year-old pianist presents with a history of a swollen, purple right arm a day after doing some DIY. He gives no significant past medical history.

Key Features of History and Examination

Deep venous thrombosis is common and about 50% will have no symptoms or signs. Proximal or very extensive deep venous thromboses, may benefit from intervention to prevent post-thrombotic syndrome. The patient may give no significant history, but may, with upper limb deep venous thrombosis, report heavy lifting or repetitive activity (such as rowing, painting, horse riding) in the preceding days (Paget-Schroetter syndrome), and they may be particularly muscular. They may give a family history of thrombophilia, or report previous deep vein thromboses or recurrent miscarriages. A careful history must also include other risk factors for deep venous thrombosis (obesity, travel, injury, immobility, oral contraceptive pill, smoking), and the possibility of an underlying malignancy must be considered. The thrombosis of course may be secondary to central venous catheterization. The patient may present with a

swollen arm or leg. The swelling will generally affect the whole limb. This may be associated with pain, but it may not be particularly painful. There are signs of venous congestion, with blue or purple discolouration, and increased capillary refill time. The limb may feel cool from the edema, which may make pulses difficult to palpate, and the discoloration may fool the unwary into thinking this might be an ischemic limb. The rapid capillary refill is the clue here. The classic description of phlegmasia cerula dolens is of a swollen discolored limb, but the presentation may be more subtle. In very severe cases, there may be associated arterial spasm (phlegmasia alba dolens) and the limb does appear ischemic. There may be dilated superficial veins.

Principles of Acute Management

The first step is to prevent thrombus propagation or pulmonary embolization, and so the patients needs to be anticoagulated. This is usually with a therapeutic dose of low-molecular-weight heparin, but intravenous heparin may be appropriate if the patient is being considered for thrombolysis. A venous duplex scan is the most sensitive and specific test, but a CT scan with venous phase contrast may be used if duplex is unavailable. Bloods should be sent for D dimers and clotting screen, to screen for an underlying malignancy (FBC, U&E, LFTs, bone profile, CRP, tumor markers) and a thrombophilia screen (protein C, protein S, antithrombin III, activated protein C resistance), prior to commencing anticoagulation.

The limb should be elevated and compression applied, whether this be a full length compression stocking or a intermittent pneumatic compression device.

A decision is then made as to whether the patient will benefit from thrombolysis. Proximal deep venous thromboses have a significant (25–40%) risk of developing into post-thrombotic syndrome. This can mean a permanently swollen limb, and in the case of the lower limb, skin changes and venous ulceration. These sequelae can take years to develop.

For this reason, older patients, who are more likely to have a stroke from thrombolysis, and are more likely to have an underlying malignancy, are not usually offered thrombolysis. Thrombolysis is more likely to be offered in the dominant arm, in a younger person, and with a hobby or occupation that requires precise movements (such as a musician). Recent surgery, active peptic ulceration, or other bleeding diatheses are contraindication for thrombolysis and must be determined in the history.

Thought needs to be given to whether there is an underlying anatomical cause for the thrombosis, such as thoracic outlet syndrome, and chest and cervical spine X-rays are recommended for upper limb thromboses, to look for a cervical rib. At a later stage, an MRI scan is recommended, but this is not part of the acute management.

Once thrombolysis has been successfully achieved, further imaging is required to identify and treat any underlying anatomical abnormality, be it a cervical rib or band or compression from the iliac artery (May-Thurner lesion).

Discussion

One may not think of deep venous thrombosis as a vascular emergency, as it is usually managed by physicians. Certainly, the most dangerous complication of DVT is pulmonary embolism. However, patients with axillary/subclavian venous thromboses or even extensive iliofemoral deep vein thromboses may suffer significant morbidity from post-thrombotic syndrome and may well benefit from emergency thrombolysis, which explains why they are included in this category.

The key thing to consider here is that about 25% of patients will be diagnosed with a malignancy within 12 months of presenting with an upper limb DVT. It is very important, therefore, to take a careful history and examination.

This particular patient, who is a professional musician, would benefit from thrombolysis, even if the symptoms were relatively minor.

Five Key Learning Points

1. Think of the diagnosis of a ruptured aortic aneurysm. Remember, not all presentations are typical. Resuscitate with blood.
2. Aortic dissection requires tight blood pressure control, analgesia, and rapid imaging, as urgent intervention may be required.
3. An acutely ischemic leg may be secondary to an embolism, an acute thrombosis, or a thrombosed aneurysm.
4. Crescendo TIAs should be considered a surgical emergency.
5. Consider whether a patient with proximal DVT may benefit from thrombolysis.

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