Chapter 1

Abdominal Aortic Aneurysm

What is the mortality and morbidity associated with ruptured abdominal aortic aneurysm?

A ruptured abdominal aortic aneurysm (AAA) is one of the most commonly fatal surgical emergencies with only approximately 50% of patients reaching hospital alive; of those who do reach the hospital, up to 50% die before having surgery, and a further 50% do not survive surgical repair.

What are the risk factors for AAA?

Risk factors for AAA include:

1 Male gender
2 Age >65 years
3 Smoking
4 Hypertension
5 Myocardial and/or cerebrovascular disease
6 Genetic/familial disposition (e.g. inherited connective tissue disorders such as Marfans and Ehlers-Danlos)

How does a ruptured AAA present?

The majority of AAAs will rupture into the retroperitoneal cavity, resulting in the classical triad of:

– Pain (typically severe and usually located in the back)
– Signs of circulatory compromise (often the patient is shocked)
– Pulsatile abdominal mass

However, patients may present with atypical symptoms and signs that can lead to misdiagnosis including:

– Back pain (may mimic renal colic)
– +/– radiation to the legs (mimicking sciatica)
– Chronic severe back pain (contained rupture)
– Transient lower limb paralysis

Massive gastrointestinal (GI) haemorrhage raises the suspicion of an aortoenteric fistula (usually in the context of a previous AAA graft that has eroded into the GI tract).

How would you treat a patient with AAA rupture?

Ruptured AAA is a surgical emergency and transfer for definitive surgical management should not be delayed by unnecessary investigations or procedures. Management should follow an ABCDE approach, and abnormalities should be treated as they are found.

1 Resuscitation
   - Two large bore peripheral intravenous (IV) cannulae, attached to giving sets with hand pumps or rapid infusion systems
   - Crossmatch ≥6 units of blood and activate massive transfusion protocol as necessary
   - Target systolic blood pressure (SBP) ~90 mmHg to maintain end organ perfusion
   - Provide titrated analgesia (e.g. fentanyl or morphine)
2 Investigations
   - Full blood count (FBC), urea and electrolytes (U+Es), coagulation profile, venous gas
   - Electrocardiogram (ECG, massive MI is a differential diagnosis)
   - Imaging as necessary (see below)
3 Transfer to the operating theatre for definitive treatment

Both open and endovascular approaches are currently used to repair ruptured AAA. There is some evidence to suggest that perioperative (30-day) outcomes for endovascular aneurysm repair (EVAR) following ruptured AAA may be better than for open AAA repair; however, significant differences in mortality rates have not definitively been demonstrated and studies are ongoing.

Contained rupture still requires urgent repair, but less acutely than an uncontained rupture.

What imaging may be used and what are the advantages and disadvantages of each?

Imaging should *never* delay potentially lifesaving abdominal surgery when such surgery is immediately available and the diagnosis is strongly suspected. Table 1.1 describes advantages and disadvantages of each modality.

Table 1.1 Imaging modalities used to characterise aortic aneurysms

Imaging modality	Advantages	Disadvantages
CT	Best investigation if diagnosis is uncertain Detailed analysis of the extent of aneurysmal disease Can confirm and localise the site of rupture Evaluate aortic wall morphology and extra-aortic structures	Haemodynamic stability required for transfer Can result in a delay to surgery Nephrotoxicity of the contrast media
Ultrasound	Can be rapidly performed at the bedside (i.e. suitable for unstable patients) Can detect aneurysm and free fluid Simple Economical	Imperfect sensitivity (~95%)
MRI	Highly specific and sensitive Lack of nephrotoxicity of the contrast media Tissue characterisation using pulsed sequences	Long scanning time – not appropriate in AAA rupture Higher cost Inferior spatial resolution

CT – computed tomography; MRI – magnetic resonance imaging

What complications can arise following emergency surgery for AAA rupture?

A number of complications can occur following emergency AAA repair as highlighted in Table 1.2.

How can you prognosticate in ruptured AAA?

Emergency surgery for ruptured AAA is associated with a high mortality. The Acute Physiology and Chronic Health Evaluation (APACHE) II and Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (POSSUM) scoring widely used in other settings do not accurately predict outcome in ruptured AAA, hence specific tools for this purpose exist. The Hardman index for ruptured AAA was published in 1996 and consists of five preoperative variables with a range of possible scores from 0–5 (Table 1.3). Recent studies have predicted a mortality of 80% with Hardman index scores ≥2.

The Glasgow Aneurysm Score is also used in predicting outcome after both elective and emergency aneurysm surgery (Table 1.4). A value of 84 indicates a predicted mortality of 65%.

Table 1.2 Complications following emergency surgery for ruptured AAA

	Early complications	Late complications
Graft-related	Massive transfusion Distal embolisation (trash foot) Aortic branch involvement resulting in ischaemia i.e. pancreatitis, AKI Endoleak	Infection Graft occlusion Aorto-enteric fistula Anastomotic pseudoaneurysm
Non-graft related	Renal failure Myocardial infarction Paraplegia Hepatic dysfunction HAP/VAP ARDS Abdominal compartment syndrome Ileus	Prolonged respiratory wean Small bowel obstruction Sexual dysfunction Incisional herniae DVT/PE

AKI – acute kidney injury; HAP – hospital-acquired pneumonia; VAP – ventilator-associated pneumonia; ARDS – Acute Respiratory Distress Syndrome; DVT – deep vein thrombosis; PE – pulmonary embolus

Table 1.3 The Hardman index for predicting immediate outcome after surgery for ruptured AAA

Variable	Points
Age >76	1
Serum creatinine >190 μmol/l	1
Haemoglobin <90 g/l	1
Myocardial ischaemia on ECG	1
A history of loss of consciousness after arrival to hospital	1

Table 1.4 Glasgow Aneurysm Score for predicting immediate outcome after surgery for ruptured AAA

Variable	Points
Age of patient	= age in years
Shock	17
Myocardial disease	7
Cerebrovascular disease (all grades of stroke including TIA)	10
Renal disease (urea >20 μmol/l and/or creatinine >150 μmol/l)	14

TIA – transient ischaemic attack

Age is an important independent risk factor for post-operative mortality after AAA rupture as highlighted by both systems.

What interventions may help reduce the mortality from ruptured AAA?

1 Abdominal ultrasound screening
  Elective repair should be undertaken in:
    i Male with AAA >5.5 cm
    ii Female with AAA >5 cm
    iii Rapid growth >1 cm/year
2 Advances in endovascular techniques
3 National audit
4 Vascular teamwork with standardisation of care pathways and treatments

What are the indications for spinal drain insertion?

Indications for spinal drain insertion in patients undergoing aneurysm repair include:

1 To reduce cerebrospinal fluid (CSF) pressure following complex abdominal EVARs where patients are considered to be at particular risk of spinal cord ischaemia
2 Rescue therapy for delayed paraplegia postoperatively.

Other indications for CSF drainage:

1 Reduce intracranial pressure (ICP), e.g. pre-, intra-, or post-neurosurgery
2 Monitor CSF chemistry, cytology, and physiology
3 Provide temporary CSF drainage in patients with infected cerebrospinal fluid shunts

How do lumbar spinal drains work?

Spinal drainage of CSF can be used to prevent or treat spinal cord ischaemia. The physiological basis for lumbar CSF drainage is that spinal cord perfusion pressure is a function of the mean arterial pressure (MAP) minus the lumbar CSF pressure.

Cord perfusion pressure = MAP – CSF pressure

Draining CSF by percutaneous insertion of a catheter into the subarachnoid space between lumbar spinal processes has the potential to increase spinal cord perfusion pressure by decreasing the CSF pressure.

What are the contraindications to spinal drain insertion?

Absolute contraindications are:

1 Patients receiving anticoagulants
2 Bleeding diathesis

Lumbar drainage is *not recommended* in the following (use for external drainage and monitoring is at the discretion of the physician):

1 Non-communicating hydrocephalus
2 Presence of large intracranial mass lesions, e.g. tumours, haematomas or cysts
3 Infection in the surrounding area, i.e. skin, subcutaneous tissue, bone and epidural space

Further Reading

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