Early management of ruptured abdominal aortic aneurysm: a practical guide

Introduction

An abdominal aortic aneurysm is a permanent localized dilatation which most commonly affects the infrarenal segment of the abdominal aorta. Rupture, the most common and most fatal complication of abdominal aortic aneurysm, is an acute vascular emergency that requires an immediate life-saving operation which has a high mortality rate. Approximately 30–50% of patients with ruptured abdominal aortic aneurysm die before they reach the hospital, and 30–40% of those who reach the hospital alive die without surgical intervention (Bengtsson and Bergqvist, 1993). With an average mortality rate of 45% among patients who undergo emergency repair of ruptured abdominal aortic aneurysm, the overall mortality rate is estimated at 80–90%.

Because most patients with abdominal aortic aneurysm are asymptomatic until the aneurysm ruptures and because of the almost unparalleled emergency nature of ruptured abdominal aortic aneurysm, rapid diagnosis and prompt surgical treatment of this emergency is essential. This article provides a practical guide to the early management of patients with ruptured abdominal aortic aneurysm.

Diagnosis

The diagnosis of ruptured abdominal aortic aneurysm requires a high level of suspicion because the earlier the diagnosis is made and the treatment provided, the better the patient's chances of survival. Often, the hospital is notified by the ambulance or the GP that a 'ruptured aneurysm' is being transferred to the emergency department. Occasionally, a patient who is known to have an aneurysm develops symptoms suggestive of rupture, making the diagnosis much more straightforward, as described later. Regardless, once a ruptured aneurysm is suspected, senior review and surgical consultation should be immediately sought as these patients are critical and any delay in their management could prove costly. As in trauma and other acute emergencies, time is of the essence; taking a concise history, performing a focused physical examination, providing careful resuscitation and arranging for urgent diagnostic tests are all important aspects of care that should occur swiftly and in concert.

Mr Ahmed N Assar *is Postdoctoral Research Fellow in the Division of Vascular Surgery, Stanford University, Stanford, CA 94305, USA*

Clinical picture

Patients with ruptured abdominal aortic aneurysm are usually over 55 years of age, smokers and may have a family history of aortic aneurysms (Lederle et al, 2000). To understand the presentation of ruptured abdominal aortic aneurysm, one should know the sites of aneurysm rupture (*Table 1*). Most commonly, an abdominal aortic aneurysm ruptures into the retroperitoneal space, resulting in bleeding which is initially contained for a few hours as result of hypotension, coagulation and retroperitoneal tissue resistance. This is the window of time during which the patient is transferred to the hospital, diagnosed and treated.

A patient with a ruptured aneurysm typically presents with sudden severe back pain, with or without abdominal pain, and a brief period of syncope at the onset of pain. Upon arrival at the hospital, the patient is usually hypotensive but alert and conscious. Abdominal examination, particularly in a thin patient, often reveals a tender pulsatile epigastric mass which may not be palpable in an obese or distended patient, or in a patient with severe hypovolaemic shock (Brewster et al, 2003). The classic triad of back pain, hypotension and pulsatile mass is present in only 25–50% of patients (Marston et al, 1992).

Occasionally, a patient presents with back pain without syncope or hypotension and is found to have an aortic aneurysm. This is known as a symptomatic, unruptured aneurysm (Marston et al, 1992). Although a patient presenting like this is initially haemodynamically stable, it is imperative to treat this patient with the same urgency and request immediate surgical consultation as one would do with a haemodynamically unstable ruptured aneurysm patient. A symptomatic unruptured aneurysm is expanding and is considered in a pre-rupture state, so it could rupture at any moment without warning. In addition, one can never be sure of the aneurysm status until a computed tomography (CT) scan is done. Therefore, immediate diagnosis and prompt surgical treatment are necessary in such a patient. Abdominal pain alone, without back pain, is unusual and necessitates ruling out other causes of acute abdomen. *Table 2* outlines the differential diagnosis of ruptured abdominal aortic aneurysm.

A number of rare and often misleading symptoms have been attributed to ruptured abdominal aortic aneurysm. There are several reports of patients who initially presented with unrelated symptoms and who were later found to have ruptured aneurysms (*Table 3*). The majority of these unusual symptoms begin hours or even

Table 1. Abdominal aortic aneurysm: sites of rupture, common presentations and incidence

Site of rupture	Presentation	Incidence
Retroperitoneal	Triad of back pain ± abdominal pain, hypotension, pulsatile mass	Most common (~80%)
Intraperitoneal	Abdominal or back pain, universally fatal at onset	Less common (~20%)
Aortocaval fistula	Triad of abdominal or back pain, pulsatile mass, continuous bruit	Rare
Aortoduodenal fistula	Upper gastrointestinal haemorrhage	Rare

days after an episode of intense back pain which is initially ignored. After rupture, the expanding retroperitoneal haematoma compresses the surrounding structures producing these symptoms. Rarely, a patient may present with aneurysmal erosion into the inferior vena cava (aortocaval fistula) or the duodenum (aortoduodenal fistula) (*Table 1*). These cases are difficult to diagnose before surgery and are associated with high mortality rates.

As mentioned above, the classic triad of ruptured abdominal aortic aneurysm is not present in all patients, so it is not surprising that misdiagnosis of ruptured abdominal aortic aneurysm occurs in up to 30% of patients (Marston et al, 1992).

Permissive hypotension

Resuscitation of a patient with ruptured abdominal aortic aneurysm usually follows the Advanced Trauma Life Support (ATLS) guidelines with a notable exception; fluid resuscitation. Aggressive fluid resuscitation has traditionally been part and parcel of managing patients with haemorrhagic shock. However, several animal studies challenged this concept by introducing permissive hypotension (Mapstone et al, 2003). Permissive hypotension, also known as hypotensive resuscitation, means fluid resuscitation to below-normal blood pressure with the aim of achieving the minimum pressure necessary for organ perfusion until definitive control of bleeding is achieved (Roberts et al, 2006).

In trauma patients, blood pressure elevation worsens bleeding and increases mortality (Dries, 1996) because excessive fluids interfere with the coagulation cascade, dilute clotting factors and may mechanically disrupt blood clots (Roberts et al, 2006). A literature review documented the efficacy of permissive hypotension over normotensive resuscitation in patients with ruptured abdominal aortic aneurysm (Roberts et al, 2006).

Although a single target blood pressure suitable for all patients is difficult to define, Crawford (1991) suggested that a target resuscitation systolic blood pressure should be 50–70 mmHg. Today, most physicians agree that resuscitation should aim at a systolic blood pressure above 80 mmHg but below 100 mmHg. Colloids are generally preferable to crystalloids because of the smaller volume necessary to rapidly expand the plasma using the former. Thus, careful fluid resuscitation and frequent blood pressure monitoring are imperative when resuscitating a patient with ruptured abdominal aortic aneurysm.

Imaging

Contrast-enhanced abdominal CT scan is the imaging modality of choice in patients with suspected ruptured abdominal aortic aneurysm (*Figure 1a*). However, an emergency department-led abdominal ultrasound scan is also sensitive and specific in detecting aortic aneurysms (Dent et al, 2007). Ultrasound scans are used to detect abdominal aortic aneurysm in the emergency department because of their speed, reduced cost and quick learning curve. Another benefit of ultrasound might be the limited availability of out-of-hours CT scans in some hospitals and concerns over the transfer of a haemodynamically unstable patient to the radiology suite.

Nevertheless, Lloyd et al (2004) looked at the feasibility of a preoperative CT scan in patient with ruptured abdominal aortic aneurysm and showed that, in patients who were unfit for surgery and treated conservatively, the median time from hospital admission to death from a ruptured aneurysm was 10 hours. This is more than enough time to obtain a CT scan en route to theatre, particularly when a protocol for the management of ruptured abdominal aortic aneurysm is in place. Practically speaking, however, the request of a diagnostic contrast CT scan is probably still partly dictated in most hospitals by the availability of out-of-hours radiology and vascular services and the seniority of the requesting doctor rather than the patient's clinical presentation including his or her haemodynamic state.

Even so, when a patient with a ruptured abdominal aortic aneurysm arrives at the hospital, there are usually three possibilities. First, a patient presents with the classic triad of pain, hypotension and a pulsatile mass; second, a patient who is known to

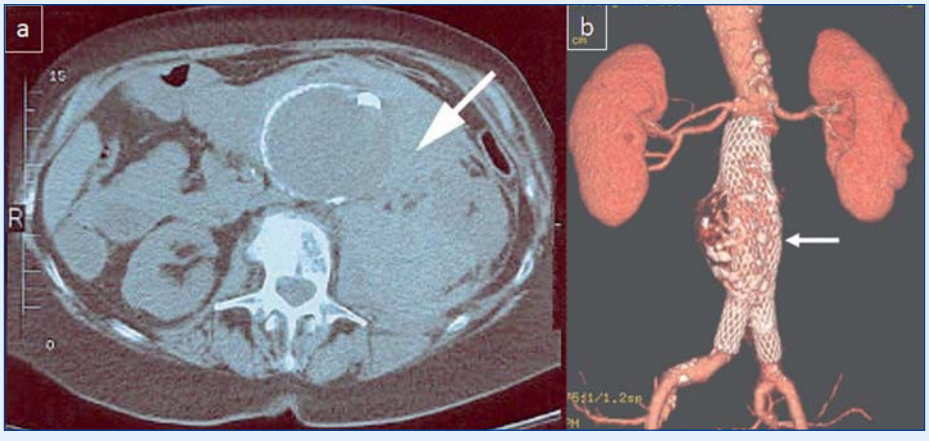
Table 2. Differential diagnosis of ruptured abdominal aortic aneurysm

Renal or ureteric colic
Musculoskeletal pain (low back pain)
Acute pancreatitis
Biliary tract disease
Perforated duodenal or gastric ulcer
Acute mesenteric ischaemia
Acute aortic dissection
Inferior myocardial infarction

Table 3. Unusual symptoms of ruptured abdominal aortic aneurysm

Loin pain suggestive of renal colic
Groin pain
Chronic back pain (weeks or months) as a result of a chronically contained rupture
Lower limb neuropathy or deep vein thrombosis
Inguinoscrotal mass mimicking a strangulated hernia
Testicular pain or ecchymosis

Figure 1. a. Abdominal computed tomography scan showing a large retroperitoneal haematoma (arrow) resulting from a ruptured abdominal aortic aneurysm. b. Endovascular stent-graft repair (arrow) of an abdominal aortic aneurysm in a different patient.



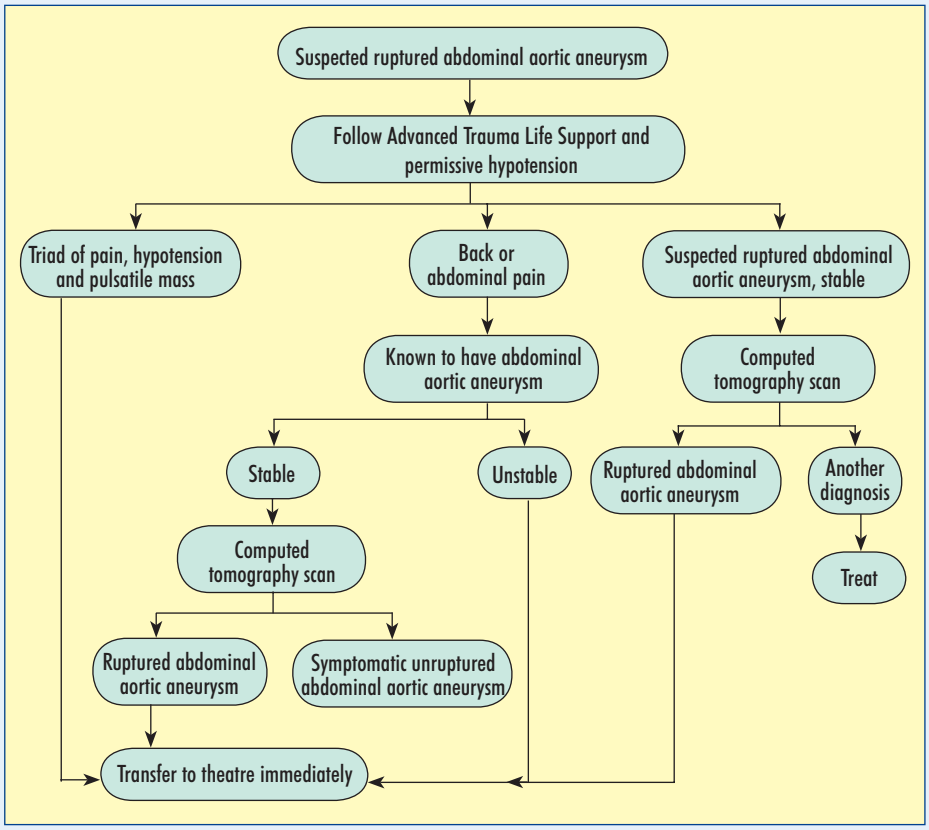


Figure 2. Algorithm for the early management of patients with ruptured abdominal aortic aneurysms.

have an aortic aneurysm presents with pain with or without syncope and hypotension and, third, a stable patient, regardless of the presentation, is suspected of having a ruptured aneurysm. *Figure 2* outlines the early management of ruptured abdominal aortic aneurysm exemplified by these three scenarios. In the first two scenarios the patient is usually transferred to theatre immediately without a preoperative CT scan. If the latter patient presents with pain but is stable, a CT scan is indicated (*Figure 2*).

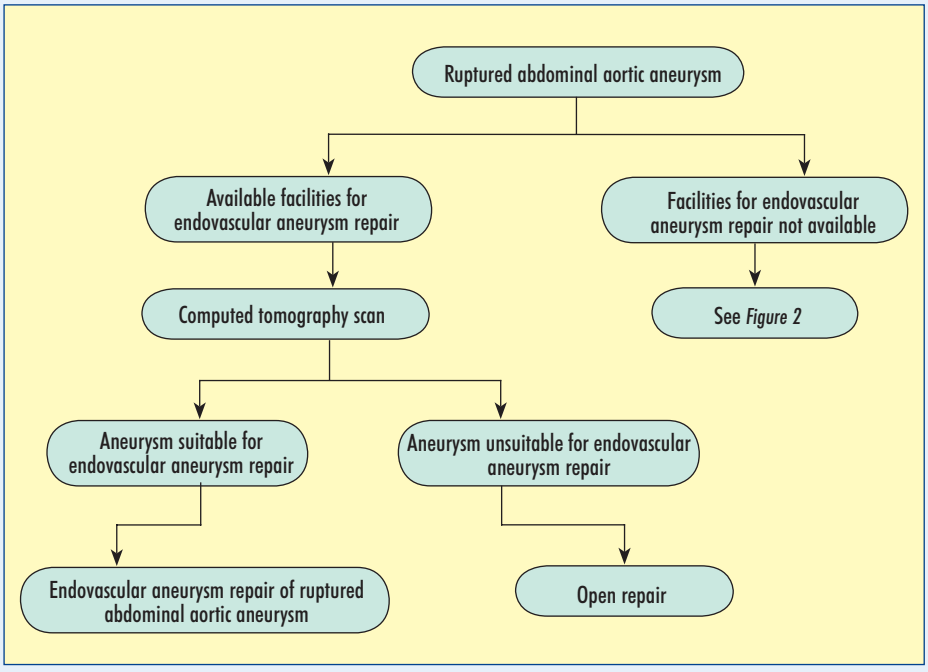
Endovascular aneurysm repair

Modern vascular surgery has undergone a metamorphosis in recent years with the advent of endovascular surgical techniques that provided new insights into the management of aortic aneurysms. Endovascular aneurysm repair (EVAR) is the preferred method of elective repair of infrarenal abdominal aortic aneurysm in patients with suitable aneurysm morphology (*Figure 1b*). Two randomized controlled trials demonstrated a three-fold reduction in perioperative mortality in endovascular aneurysm repair patients compared to traditional open surgery (Greenhalgh et al, 2004; Prinssen et al, 2004). Despite the current lack of similar level I evidence, endovascular repair of ruptured abdominal aortic aneurysm has been shown to be technically feasible with early promising results (Mastracci et al, 2008). Endovascular repair of ruptured abdominal aortic aneurysm may provide a future paradigm shift in the management of this fatal vascular emergency.

The enthusiasm for endovascular repair of ruptured abdominal aortic aneurysms is palpable; a Dutch multicentre trial comparing conventional repair *vs* endovascular repair of ruptured abdominal aortic aneurysm is expected to be completed in 2010. In the UK, a similar multicentre randomized controlled trial, primarily looking at the 30-day mortality, is expected to start in 2009.

With the availability of equipment, training and most importantly scientific evidence, patients with ruptured abdominal aortic aneurysm may benefit from endovascular repair on a wider scale in future. In light of this, a suggested algorithm for the management of ruptured abdominal aortic aneurysm where facilities for endovascular aneurysm repair are available is shown in *Figure 3*. Note that a preoperative CT scan to assess the aneurysm's anatomical suitability for endovascular aneurysm repair is mandatory before this procedure is performed. Although not shown in *Figure 3*, some authorities suggest assessing the aneurysm's anatomy in theatre using on-table angiography; however, this may lead to endovascular therapy in an

Figure 3. Management of patients with ruptured abdominal aortic aneurysm where facilities for endovascular repair are available.



unsuitable patient, as it may not reveal some unfavourable anatomic characteristics of the infrarenal aortic neck.

Conclusions

Ruptured abdominal aortic aneurysm is an acute vascular emergency with an extremely high mortality rate. A high level of suspicion based on understanding the modes of presentation of ruptured abdominal aortic aneurysm is important for rapid diagnosis and successful early management of this condition. Despite the lack of prospective studies, there is accumulating evidence in favour of permissive hypotension in patients with ruptured abdominal aortic aneurysm. Conventional open repair is the gold standard of care; however, results from randomized trials may extend the benefits of endovascular repair to patients with ruptured abdominal aortic aneurysm in the near future. **BJHM**

Figure 1a *is reproduced from Sakalihasan et al (2005), by kind permission of Elsevier. The author wishes to thank Dr Oscar J Abilez, research fellow at Stanford University, for providing valuable advice.*
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KEY POINTS

- Ruptured abdominal aortic aneurysm is an acute vascular emergency with an extremely high mortality rate.
- A high level of suspicion is essential for early diagnosis and prompt surgical treatment.
- The classic triad of pain, hypotension and a pulsatile mass is not universally present in all patients.
- Computed tomography scan is the investigation of choice.
- Endovascular techniques have shown promising early results and may positively impact the high operative mortality rate associated with open surgery.