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Annals of Cardiovascular Diseases

Review Article

Proper Management of Ruptured Abdominal Aortic Aneurysm

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Submitted: 14 December 2017

Accepted: 27 January 2018

Published: 30 January 2018

Abstract

Background: Ruptured abdominal aortic aneurysm (RAAA) remains a challenging problem and one of the most fatal surgical emergencies, with an overall mortality of 90%. The best method for predicting RAAA has traditionally been AAA maximal diameter of more than 5,5cm.

Methods: PubMed, Scopus and Google Scholar databases were systematically searched according to the recommendations of the PRISMA statement from July 1987 until February 2017 for administrative dataset registries reporting outcomes after RAAA.

Results and conclusions: Recent reports show that the treatment of RAAA is still combined with high mortality and high perioperative morbidity. There is increasing evidence that Ruptured Endovascular Aortic Repair (REVAR) is able to decrease the mortality of RAAA repair with fewer complications. Use of an endovascular approach appears to reduce 30-day mortality by 10% to 20%.

INTRODUCTION

Ruptured abdominal aortic aneurysm (AAA) is one of the most fatal surgical emergencies, with an overall mortality rate of 90% and often unknown to the patient until the day of the rupture. Abdominal Aortic Aneurysm rupture is defined as bleeding outside the adventitia of a dilated aortic wall.

Ruptured Abdominal Aortic Aneurysm (RAAA) is the 10th leading cause of death in men older than 65 years in the United States [1]. Population statistics from the United States demonstrate that aortic aneurysms account for 15,810 deaths per year with 83.5% of these deaths occurring in patients older than 65 years and 93% in those older than 55 [2].

Free rupture into the peritoneal cavity has a worse prognosis because the rapid, large-volume blood loss overwhelms the ability of retroperitoneal cavity to provide tamponade and thereby reduce the rate and volume of blood loss [3].

The best method for predicting RAAA has traditionally been AAA diameter. The 5.5 cm diameter threshold for repair in men is supported by two randomized trials, the ADAM and the UKSAT trials [4,5]. Female sex has also been found to be an independent risk factor for rupture, and a 5cm threshold for repair in women has been suggested [6].

DIAGNOSTIC EVALUATION

RAAA is characterized by the classic triad of severe abdominal or back pain, hypotension, and a palpable pulsatile abdominal mass. A history of a syncopal episode may indicate the first sign of blood extravasation into abdominal cavity [7].

Differentiation between symptomatic and ruptured is critical. Symptomatic AAAs is those that have become painful and tender or have provoked peripheral embolization. Symptomatic AAAs is not associated with hypotension and the prognosis is better than that of RAAA but worse than after elective repair [8].

Ultrasound can accurately identify an AAA and frequently takes less than 5 minutes [9]. It can be used in the emergency department to rapidly evaluate aortic diameter in those with a suspicion of RAAA [10].

The most accurate method of diagnosing RAAA is CT, which also provides important information of other abnormalities and conditions in surrounding tissue. Evidence of retroperitoneal blood, when used as the "gold standard" to diagnose RAAA on CT, was found to be 77% sensitive and 100% specific in a retrospective series [11].

Although studies show that on average there is sufficient time between arrival at the emergency department and death from

RAAA for performance of CT, both the U.K. RAAA randomized trial and the Amsterdam Acute Aneurysm trial identified patients too unstable for CT scanning who required immediate transfer to the operating room [12,13].

CONTAINED RUPTURE

Several reports in the literature have described abdominal aortic aneurysms associated with retroperitoneal hemorrhage in patients who are hemodynamically stable. The duration and severity of symptoms, and the hemodynamic status of the patient, are used to differentiate acute from chronic rupture [14].

Differentiation of contained rupture from frank rupture of abdominal aortic aneurysms is vital in selecting proper treatment. Stable patients may benefit from preoperative assessment-management and decreased mortality rates.

INITIAL MANAGEMENT

Permissive hypotension at a systolic pressure of 70 to 80mm Hg and the avoidance of aggressive resuscitation to pressures higher than 100 mm Hg has been recommended to stabilize the initial rupture due to tamponade [15].

Furthermore animal studies have documented reduced survival in models of arterial injury when resuscitation occurs before control of haemorrhage [15]. At present there is no evidence that resuscitation is better with blood than with crystalloids.

In the operating room, central venous catheter, insertion of an arterial line, and placement of a Foley catheter can be done simultaneously. The patient is prepared and draped awake before anesthesia is induced because relaxation of the abdominal muscles reduces the tamponade effect and will increase bleeding through thrombous dislodgement.

ENDOVASCULAR AORTIC REPAIR (EVAR)

Currently, open surgical repair is reserved for those who are anatomically unsuitable for EVAR, for environments where EVAR is not available, or when EVAR fails to seal the AAA. The proportion of RAAAs suitable for EVAR is variable but has been calculated at between 47% and 67% based on two recent meta-analyses [17,18].

In stable patients, standard EVAR is performed although an aortouniiliac device followed by a femorofemoral crossover graft may achieve more rapid control of intrabdominal hemorrhage and is therefore preferred for unstable patients.

Exclusion criteria for REVAR include neck length less than 1 cm, neck diameter greater than 32 mm, angulation greater than 60 degrees, common iliac diameter greater than 20 mm or less than 6 mm, and inability to preserve at least one internal iliac artery.

Use of an endovascular approach appears to reduce 30-day mortality by 10% to 20%.

Postoperative complications include renal failure, arterial ischemia, wound infection, and abdominal compartment syndrome related to the hematoma. The incidence of renal dysfunction has been reported to be 28% in one series, with only two patients requiring hemofiltration and none requiring permanent dialysis [19].

OPEN REPAIR (OR)

Most surgeons prefer a transperitoneal, midline incision because it affords wide exposure to the abdominal aorta and allows rapid supraceliac control if necessary [20].

After clamping of the supraceliac aorta, the clamp may be repositioned to the infrarenal aortic neck if possible, to reperfuse the viscera and kidneys. Supraceliac clamping should be as brief as possible.

Distal control can be achieved with clamps on the iliac arteries or occasionally the distal aorta. When substantial hematoma is present, however, distal dissection can be difficult and care must be taken because associated with iliac vein injury can increase mortality.

Aortic repair should be accomplished rapidly with a tube graft if possible. Tube grafts have been reported to have better outcomes than bifurcated grafts in older series. Their use will lead to the shortest operation and the least overall systemic physiologic insult.

Primary abdominal closure has been the most common approach. However, in 25% to 30% of patients the abdomen cannot be closed without significant tension secondary to swollen bowel, excessive tissue edema, or massive retroperitoneal hematoma [21].

A bladder pressure in excess of 30 cm H_2O or 25 mm Hg is diagnostic of abdominal compartment syndrome that is caused by increased intraperitoneal pressure and results in hypoventilation, decreased venous return, hypoxemia, increased intracranial pressure, and renal failure.

Although delayed closure after RAAA repair has been reported since 1991, it has recently been suggested as a means of reducing the development of subsequent organ failure in both trauma and ruptured AAA patients [22].

OPEN VERSUS EVAR FOR RAAA

There is increasing evidence that REVAR is able to decrease the mortality of RAAA repair with fewer complications (bleeding, renal, and respiratory), shorter hospital stays, and more patients being able to return home rather than going to institutional care after the procedure.23

Analysis of mortality rates of REVAR cases between 2000 and 2003 noted a significant reduction in the mortality of RAAA patients treated by EVAR (31.85 versus 50.8%; $P < .001$) [12].

In Swedish national population-based study, there was no difference in mortality outcome after RAAA repair among centers with a primary EVAR approach when compared with a primary OR strategy [24].

Powel et al. in the IMPROVE randomised trial after studying 613 patients, presented a 30-day mortality rate of 32% for EVAR versus 35% for open repair group [25].

One large individual patient meta analysis across three European trials concluded that there is no early survival benefit

for an endovascular strategy or EVAR following ruptured AAA, although there is a very weak indication in favour of EVAR at 90 days for patients with ruptured AAA, who are eligible for both treatments [26].

Finally another large meta-analysis that included 2783 patients, with 14 245 person and median 5,5 years of follow-up, confirmed the early survival advantage in the EVAR group but over 5 years patients of marginal fitness had no early survival advantage from EVAR compared with open repair [27].

DISCUSSION

Substantial progress had been made in recent years in understanding the different types of RAAA and progression has been made in diagnosis and management of this devastating disease.

Prompt detection of abdominal aortic aneurysm rupture is critical because survival is improved by emergent surgery. Identification of impending or contained rupture is equally important because these patients are at risk for frank rupture but can generally benefit from a more thorough preoperative assessment, followed by urgent surgery.

The concept of permissive hypotension has been successfully applied in the routine clinical management of multiple trauma and the applicability to the treatment of RAAA has been well demonstrated.

Currently, open surgical repair is reserved for those who are anatomically unsuitable for EVAR.

Although patients treated with EVAR had lower short term mortality compared with those undergoing open repair, this is likely to be an effect of case selection and does not result in an overall difference in RAAA mortality based on primary treatment strategy of centers.

Short-term survival benefits of EVAR versus open repair of intact abdominal aortic aneurysms have been shown in randomised trials, but this early survival benefit is lost after a few years.

Ruptured abdominal aortic aneurysm thus remains a challenging problem. Future studies will show whether endovascular treatment with stent prostheses improves outcomes.

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Cite this article

Stamatatos I, Metaxas E, Georgoudi S, Theodorou M, Milou EE, et al. (2018) Proper Management of Ruptured Abdominal Aortic Aneurysm. Ann Cardiovasc Dis 3(1): 1020.