Best evidence topic - Aortic and aneurysmal

Endovascular versus open surgical repair for blunt thoracic aortic injury

James Barnard a, *, Julia Humphreys b, Mohamad N. Bittara

aLancashire Cardiac Centre, Victoria Hospital, Whitney Heys Road, Blackpool, FY3 8NR, UK
bDepartment of Vascular Surgery, Wythenshawe Hospital, Southmoor Road, Manchester, M23 9LT, UK

Received 7 November 2008; received in revised form 21 March 2009; accepted 20 April 2009

Summary

A best evidence topic in vascular surgery was written according to a structured protocol. The question addressed was whether patients with acute traumatic thoracic aortic injury have a better outcome with endovascular or open surgical repair. Altogether, 283 papers were found using the reported search, of which five represented the best evidence to answer the clinical question. The author, journal, date and country of publication, patient group studied, study type, relevant outcomes, results, and study weaknesses of these papers are tabulated. We concluded that the peri-procedural mortality rate for patients with traumatic thoracic blunt aortic injury is lower for patients treated with an endovascular stent graft when compared to the open technique. This important benefit is at the cost of a high procedure complication rate, requirement for long-term surveillance of the stent and uncertain medium and longer-term outcome.

© 2009 Published by European Association for Cardio-Thoracic Surgery. All rights reserved.

Keywords: Evidence-based medicine; Vascular surgery; Blunt thoracic aortic injury; Endovascular repair; Open repair

1. Introduction

A best evidence topic was constructed according to a structured protocol. This protocol is fully described in the ICVTS [1].

2. Three-part question

In [patients with blunt thoracic aortic injury] is [endovascular repair or open surgical repair] superior in reducing [mortality].

3. Clinical scenario

You are about to perform surgery on a 37-year-old man with an acute thoracic aortic dissection. He was admitted through the Accident and Emergency Department following a road traffic collision where he sustained a deceleration injury from a velocity of 45 mph. A chest X-ray showed a widened mediastinum and left-sided haemothorax and a CT of the thorax, abdomen and pelvis reveals an acute traumatic aortic transections immediately distal to the left subclavian artery.

You plan your surgery and think about the best method of repairing the aortic injury. One surgeon tells you that open repair is the tried and tested method for this type of injury in younger, low-risk trauma patients. A second surgeon tells you that an endovascular approach is just as effective, with less risk of complications. You decide to look up the evidence.

4. Search strategy


5. Search outcome

Using the above search, 283 papers were identified for screening. Relevant papers numbered 77 of which 50 were rejected on the basis of small sample size. Four meta-analyses of retrospective non-randomized studies were identified and one prospective non-randomized large multicentre study which was not included in the meta-analyses. These five papers represented the best available evidence and are presented in full (Table 1).

6. Comment

Experience with endovascular stent grafts in blunt traumatic injuries of the aorta is still very early. The review of the literature that we have performed has identified only one large prospective study – describing outcome in endovascular stenting for blunt aortic injury and no randomized controlled trials. There is also a lack of information in the literature regarding medium and long-term outcomes. This
### Table 1: Table of best evidence clinical papers

<table>
<thead>
<tr>
<th>Author, date, journal and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xenos et al., (2009), Eur J Cardiothorac Surg, USA, [12]</td>
<td>22 retrospective cohort studies from 2003 to 2007 were included. 501 patients were treated with open repair and they were compared with 358 patients treated with endograft repair. Blunt thoracic aortic injury was the pathology in 68% of the patients</td>
<td>Meta-analysis of non-randomized, retrospective studies (level III)</td>
<td>Mortality</td>
<td>OR, 0.46, (95% CI, 0.26–0.78; P = 0.005)</td>
<td>All studies were non-randomized and retrospective</td>
</tr>
<tr>
<td>Hoffer et al., (2008), J Vasc Interv Radiol, USA, [6]</td>
<td>19 retrospective cohort studies comparing the outcomes of 262 endograft repairs and 376 open surgical repairs were identified. Pooled analysis of 667 endovascular repair survivors from 50 reports</td>
<td>Meta-analysis of non-randomized, retrospective studies (level III)</td>
<td>Mortality</td>
<td>OR, 0.43 (95% CI, 0.26–0.70; P = 0.001)</td>
<td>All studies were non-randomized and retrospective</td>
</tr>
<tr>
<td>Xenos et al., (2008), J Vasc Surg, USA, [11]</td>
<td>17 retrospective cohort studies comparing the outcomes of 220 endograft repairs and 389 open repairs</td>
<td>Meta-analysis of non-randomized, retrospective studies (level III)</td>
<td>30-day Mortality</td>
<td>OR, 0.44, (95% CI, 0.25–0.78; P = 0.005)</td>
<td>All studies were non-randomized and retrospective</td>
</tr>
<tr>
<td>Tang et al., (2008), J Vasc Surg, USA, [13]</td>
<td>Analysis of 33 articles reporting 699 procedures patients with traumatic aortic transections (TTAT) in which 370 patients were treated with endovascular repairs (endoTTAT) and 329 patients were managed with open repair (openTTAT)</td>
<td>Meta-analysis of non-randomized, retrospective studies (level III)</td>
<td>Mortality</td>
<td>7.6% endoTTAT, 15.2% open TTAT, P = 0.0076</td>
<td>All studies were non-randomized and retrospective</td>
</tr>
<tr>
<td>Demetriades et al., (2008), J Trauma, Injury, Infection and Critical Care, USA, [9]</td>
<td>193 patients</td>
<td>Prospective, non-randomized multicentre (level III)</td>
<td>Mortality</td>
<td>Open n = 16 (23.5%) Endovascular n = 9 (7.2%) P = 0.001</td>
<td>Non-randomized. No long-term follow-up. Multicentre study with poorer results by low volume centres</td>
</tr>
</tbody>
</table>

(Continued on next page)
is of some concern as when stents have been used to treat elective abdominal aortic aneurysm disease at four years after randomisation all-cause mortality was similar between open repair and endovascular repair [2]. While it must be emphasised that this is a very different pathology in a much older age group, valid issues exist regarding device durability, device migration and potentially device occlusion.

Malapposition of endografts to the inferior curve of the distal aortic arch is a potential consequence of the application of currently available endografts to the relatively young healthy aortas encountered in the young trauma population and malapposition may lead to device collapse or a functional co-arctation [3]. Endovascular stent graft collapse requiring a further stenting procedure is an acknowledged complication with angulation of the stent described to occur between the left subclavian artery and the aorta. There is also an acknowledged problem with sizing of the devices and subsequent device failure as well as problems with occlusion of the left subclavian and even the left common carotid vessels. A recent review of the issue of placing a thoracic aortic stent over the left subclavian artery describes a 10% incidence of ischaemia or other symptoms attributable to poor blood flow, a 2.6% incidence of stroke, 1.6% incidence of paraplegia/papaparesis and a 1.2% incidence of endoleak [4]. With regard to the sizing of devices, the society of thoracic surgeons endovascular surgery task force have emphasised the importance of not oversizing devices by over 20% due to their ability to fold on themselves and obstruct the aorta [5]. The exact type of device used is also an issue in thoracic endovascular aortic repair of blunt aortic injury as none of the currently available devices are specifically designed for this cohort of relatively younger patients, nor are they approved for use by the United States Food and Drug Administration for this role [6].

The use of endoluminally delivered stents eliminates the need for thoracotomy and single-lung ventilation and the ensuing pulmonary complications that occur with this approach. The decreased requirement for tracheostomy observed in patients treated with endoaortic stenting [7] possibly demonstrates that this group have a decreased need for mechanical ventilation as compared with patients undergoing conventional surgical repair, however, several studies have not seen a statistically significant difference in respiratory complications [3, 8–10].

Demetriades et al., in the single prospective study that we have reported [9], have described 25 patients (20%) in the endovascular repair group who developed 32 device related complications. The most common complication was endoleak (18 cases, 14.4%). This complication rate was higher than was picked up in the systematic review of retrospective studies performed by Hoffer et al. [6] and possibly emphasises the importance of prospective data collection as much as the variation in complication rates between institutions.

The absence of prospective randomized trials raises anxieties regarding selection bias in the published series. There is a strong possibility that endovascular repair was considered for a particular subset of patients and, in addition, would have been based on the availability of the technique. In addition, where historical surgical controls have been used for comparison with the endovascular technique it is likely that improvements in the baseline standard of acute trauma care and critical care facilities would again have introduced a bias. The meta-analyses that we have reported [6, 11–13] have all sourced the same sample of retrospective studies, give or take a few studies depending on publication dates or study size selection criteria. Disappointingly there is no prospective, randomized, controlled trial comparing the endovascular and open techniques, and it is unlikely that such a trial would now fail to be approved on ethical grounds, given the apparent survival advantage with endovascular stenting.

Most surgeons select stent grafts for traumatic aortic rupture irrespective of associated injuries, injury severity, and age. Stent grafts are associated with significantly lower mortality [6, 11–13] and fewer blood transfusions, but there is a considerable risk of serious device related complications and these complications may occur in the short, medium or longer-term. There is a major and urgent need for improvement of the available endovascular devices that are available and for a reduction in procedure related complications. In addition, it is desirable that medium and longer-term follow-up for these endovascular procedures are reported in the future.

7. Clinical bottom line

The peri-procedural mortality rate for patients with blunt aortic injury is lower for patients treated with an endovascular stent graft when compared to the open technique.
This important benefit is at the cost of a high post-procedure complication rate, requirement for long-term surveillance of the stent and uncertain medium and longer-term outcome.

**References**


