Open Abdominal Aortic Aneurysm Repair in the Era of Endovascular Repair

P-A Leake, TN Hamilton-Johnson, M Harry, GM Gordon-Strachan, JM Plummer, MS Newnham

ABSTRACT

Objectives: The development of minimally invasive techniques for abdominal aortic aneurysm (AAA) repair and the establishment of specialized centres have resulted in improved patient outcomes. This study examines open AAA repair at a non-specialized centre where advanced techniques are not practised.

Methods: We conducted a retrospective analysis on a cohort of 83 patients presenting for AAA repair to a non-specialized hospital, the University Hospital of the West Indies (UHWI). The end points assessed included operative (30-day) mortality, postoperative complications, duration of operation, blood loss, intensive care unit (ICU) stay and overall hospital stay.

Results: The overall operative mortality was 9.4% (23% for ruptured aneurysms and 5% for unruptured aneurysms). Mean operating time, blood loss, ICU stay and hospital stay were 326 ± 98 minutes, 2420 ± 1397 mls, 3 ± 5 days and 9 ± 5 days, respectively with no significant differences noted between ruptured and unruptured aneurysms. Mean aneurysm diameter was 6.13 ± 1.59 cm.

Conclusion: Mortality rates for open aneurysm repair at the UHWI are consistent with findings in the current literature. Open AAA repair remains a safe treatment option in this environment. Continued improvements need to be made with respect to minimizing blood loss and operation duration, particularly in repairs of unruptured aneurysms.

Keywords: Abdominal, aneurysm, aorta, repair

Reparación Abierta de la Aorta Abdominal en la Era de la Reparación Endovascular

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RESUMEN

Objetivos: El desarrollo de técnicas mínimamente invasivas para la reparación del aneurisma aórtico abdominal (AAA) y el establecimiento de centros especializados para esos fines, han traído consigo el mejoramiento de los resultados clínicos de los pacientes. Este estudio examina reparaciones del tipo AAA en un centro no especializado, en el que no se practican técnicas avanzadas.

Métodos: Se llevó a cabo un análisis retrospectivo en una cohorte de 83 pacientes que acudieron para reparación de AAA a un hospital no especializado – el Hospital Universitario de West Indies (UHWI). Los aspectos finales evaluados incluyeron la mortalidad operatoria (30 días), las complicaciones postoperatorias, la duración de la operación, la pérdida de sangre, la estadía en la unidad de cuidados intensivos, y la estadía general en el hospital.

Resultados: La mortalidad operatoria general fue 9.4% (23% para los aneurismas rotos y 5% para los aneurismas no rotos). El tiempo promedio de operación, la pérdida de sangre, la estadía en la UCI y la estadía hospitalaria fueron 326 ± 98 minutos, 2420 ± 1397 mls, 3 ± 5 días y 9 ± 5 días respectivamente, sin que se observen diferencias significativas entre aneurismas rotos y no rotos. El diámetro promedio de las aneurismas fue 6.13 ± 1.59 cm.

Conclusión: Las tasas de mortalidad para la reparación abierta de aneurismas en el UHWI concuerdan con los hallazgos en la literatura corriente. Se necesita continuar los esfuerzos por lograr
INTRODUCTION

Abdominal aortic aneurysm (AAA) repair is a major surgical procedure with potential significant morbidity and mortality. It has been suggested that AAA repairs performed by specialized surgeons and in institutions of high volume have better outcomes (1). The advent of endovascular repair (EVAR) has also resulted in improved short-term outcomes (2). At this point, specialized centres are not available in the Caribbean and EVAR is not readily accessible. For these reasons, open aneurysmorrhaphy performed by general surgeons remains the mainstay of treatment for AAAs in the Caribbean.

Operative mortality rates for ruptured AAAs remain high (48%) despite improvements in prehospital and emergency room care (3). The early identification, close surveillance and early management of patients with unruptured AAAs have resulted in reduced operative mortality rates of 5.5% in asymptomatic patients (4) and up to 19% for symptomatic cases (5). Despite significant improvement in 30-day operative mortality [1.2% (6); 1.8% (7)] and some benefits conferred to patients not fit for open repair (8), long-term results for EVAR suggest greater morbidity and cost (7). As such, open repair remains a durable treatment option.

Reasonable outcomes for AAA repair can still be achieved by general surgeons at non-specialized centres. Thirty-day mortality rates for elective AAA repairs, in this setting, have been quoted at 5% (9) and 7.75% (10). The University Hospital of the West Indies (UHWI) is a tertiary level centre in a developing country. We hypothesize that open repair remains a safe treatment option for patients with AAA in our region.

SUBJECTS AND METHODS

Following approval by The University of the West Indies Ethics Committee, a retrospective analysis of all patients presenting for elective or emergency AAA surgery at the UHWI during the period January 1990 to December 2008 was conducted. Records were identified using the operative database and the coded patient files from the medical records department. Patients diagnosed with thoraco-abdominal aortic aneurysms were excluded. For the purposes of comparison, the cohort was divided into ruptured and unruptured cases. Pre-existing coronary artery disease, defined as angina pectoris, previous myocardial infarction or electrocardiogram (ECG) evidence of ischaemia, was documented in 16 cases. Hypertension (systolic greater than 140 mmHg and/or diastolic greater than 100 mmHg) was seen in 57 cases. Pulmonary disease and prior transient ischaemic attack/stroke were noted in 11 and 7 patients respectively.

The majority of AAAs (92.8%) were infrarenal. The mean diameter based on ultrasound or computed tomography

<table>
<thead>
<tr>
<th>Age range</th>
<th>Percentage of patients (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40–49</td>
<td>1.2 (1)</td>
</tr>
<tr>
<td>50–59</td>
<td>7.2 (6)</td>
</tr>
<tr>
<td>60–69</td>
<td>31.3 (26)</td>
</tr>
<tr>
<td>70–79</td>
<td>39.8 (33)</td>
</tr>
<tr>
<td>80–89</td>
<td>19.3 (16)</td>
</tr>
<tr>
<td>90–99</td>
<td>1.2 (1)</td>
</tr>
</tbody>
</table>

Table 1: Distribution of patients with abdominal aortic aneurysm, by age

with a male predominance of 2.1 to 1. Sixty-four per cent of patients were symptomatic on presentation. Abdominal pain was the commonest presenting symptom (67.9%), followed by back pain (30.2%). Symptoms for ruptured and unruptured AAAs were similar (Table 2). Pre-existing coronary artery disease, defined as angina pectoris, previous myocardial infarction or electrocardiogram (ECG) evidence of ischaemia, was documented in 16 cases. Hypertension (systolic greater than 140 mmHg and/or diastolic greater than 100 mmHg) was seen in 57 cases. Pulmonary disease and prior transient ischaemic attack/stroke were noted in 11 and 7 patients respectively.

The majority of AAAs (92.8%) were infrarenal. The mean diameter based on ultrasound or computed tomography

Palabras claves: abdominal, aneurisma, aorta, reparación
operations were performed twice as frequently as emergency operations. Mean operating time was 326 ± 98 minutes (range: 135 – 600 minutes) with a mean aortic clamp time of 119 ± 48 minutes (range: 41 – 246 minutes). Mean blood loss was 2420 ± 1397 mls. Patients were admitted to the intensive care unit (ICU) for an average of 3 ± 5 days with an overall average hospital stay of 9 ± 5 days.

T-test analysis showed no difference between ruptured and unruptured AAAs with respect to duration of procedure, aortic clamp time, blood loss or length of ICU stay (Table 4).

### Table 4: Comparison of ruptured and unruptured aneurysms with respect to outcome measures

<table>
<thead>
<tr>
<th></th>
<th>Ruptured or unruptured</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss (mls)</td>
<td>Ruptured</td>
<td>2400.00</td>
<td>1492.202</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unruptured</td>
<td>2419.33</td>
<td>1392.539</td>
<td>0.965</td>
</tr>
<tr>
<td>Duration (mins)</td>
<td>Ruptured</td>
<td>329.69</td>
<td>100.041</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unruptured</td>
<td>331.06</td>
<td>94.681</td>
<td>0.963</td>
</tr>
<tr>
<td>Aortic clamp time (mins)</td>
<td>Ruptured</td>
<td>114.69</td>
<td>52.927</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unruptured</td>
<td>120.57</td>
<td>45.946</td>
<td>0.715</td>
</tr>
<tr>
<td>ICU stay (days)</td>
<td>Ruptured</td>
<td>1.93</td>
<td>1.438</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unruptured</td>
<td>3.79</td>
<td>5.788</td>
<td>0.228</td>
</tr>
</tbody>
</table>

There were too few deaths to establish an association between operative factors, patient characteristics and mortality. Overall hospital mortality (death prior to discharge or within 30 days of the operation) was 9.4% for the cohort of resected cases. In the 13 cases of confirmed rupture, mortality for resection was 23% (3 cases). Resection of unruptured AAAs, whether operated on electively or as an emergency for suspected rupture, carried a mortality of 5%. The causes of death involved exsanguination in three cases (postoperatively in two), and cardiac arrest in the remaining two cases. Thirty per cent of patients had some form of postoperative complication (Table 5). Only one patient developed a graft-specific complication, that of graft occlusion requiring re-anastomosis and embolectomy.

The retroperitoneal approach to the aneurysmorrhaphy was used in five cases. The remainder were approached transabdominally. Fifty-seven per cent of patients undergoing elective surgery had epidural-based anaesthesia. Intra-operative blood transfusions were required in 45 (83.3%) patients at a mean volume of 890 millilitres (mls). Autologous blood transfusion was used in 12 cases.

### DISCUSSION

With the developments of EVAR (11) and laparoscopic AAA repair (12), the use of open AAA repair at specialized centres is likely to lessen significantly. Still, it remains the mainstay of treatment in non-specialized centres (10). With the push for regionalization of certain procedures to centres of high volume (13), validation of acceptable outcome measures at these non-specialized centres becomes necessary. This is particularly relevant in the Caribbean where regionalization is not imminent.

The present study shows the mean diameter of AAA presenting for repair to be 6.13 ± 1.59 cm. Almost 16% of the cohort refused surgery. For those who had AAA repair, overall operative mortality rate was 9.4%, mortality rate for ruptured aneurysms was 23% and that for unruptured aneurysms was 5%.

A study similar to the present one was conducted by Branday et al in 1983 at the UHWI (14). It evaluated 101 patients over an 18-year period (1965–1982). Though the methodology differed, comparison of the outcomes showed considerable improvements in overall mortality rates [9.4% vs 25% (14)] and mortality rates for unruptured [5% vs 16% (14)] and ruptured AAAs [23% vs 53% (14)]. The present study was unable to link mortality to patient and aneurysm factors due to the low number of deaths. Symptomatology remained similar with abdominal pain and back pain being the predominant complaints in both articles. This study shows a trend towards operating on smaller aneurysms, the use of epidural anaesthesia, the retroperitoneal approach to AAA repair and the use of autologous blood transfusion.

The literature on AAA repair in the community is limited. Studies show mortality rates for elective repair in non-specialized centres ranging from 5.1% (15) to 7.75%
In addition, while obtaining informed consent for resection in our series (15.7% of cohort). A similar finding under F surgery represented the majority of cases of non-Ethnic and cultural beliefs may contribute to this refusal of poor surgical risk and the presence of a stable aneurysm as the predominant reasons for non-resection (29). Refusal to present for AAA repair did not undergo resection. This is a relevant concern at our institution. Further improvements in operative mortality may come with the creation of dedicated teams of surgeons, anaesthetists and intensivists. As EVAR is unlikely to be introduced at UHWI in the near future and most patients unlikely to afford care in overseas specialized centres, it is incumbent that attention be directed to the optimization of the above factors to further reduce morbidity and mortality.

Unlike elective AAA repair, mortality rates for ruptured AAAs remain consistently high despite improvements in prehospital emergency care, surgical technique and postoperative management of complications. The mortality rate of 23% in the present study appears to be lower than other documented rates (20, 21). This has to be interpreted cautiously, however, in the face of low patient numbers. A meta-analysis of 50 years of ruptured AAA repair noted that though mortality rates have reduced over time, the overall operative mortality rate still remains high at 48% (3). Factors out of the control of the surgeon such as excess blood loss and blood administration, excess fluid administration and intra-operative cardiac arrest have been implicated in these poor outcomes (22–24). It has been suggested that the use of EVAR for ruptured AAAs can lead to reduction in mortality rates (25), with reports quoting figures of 8% (26) to 22.2% (27). Though this technique shows promise, it must be seen with caution until stronger supportive evidence is established (28).

Thirty-five per cent of patients in the present study presenting for AAA repair did not undergo resection. This proportion is high compared to other series that suggested poor surgical risk and the presence of a stable aneurysm as the predominant reasons for non-resection (29). Refusal to undergo surgery represented the majority of cases of non-resection in our series (15.7% of cohort). A similar finding was noted in a Chinese series published by Wei et al (30). Ethnic and cultural beliefs may contribute to this refusal of care. In addition, while obtaining informed consent for surgery, the discussion with patients about the previously published high mortality rates (14) may have led to fear and further contributed to refusal of care.

Blood loss during an AAA repair (14, 31, 32), operative time (14, 32) and aortic clamp time (14, 32, 33) are factors contributing to early mortality after AAA repair. Though our analysis was unable to determine predictors of mortality, no difference was found between ruptured and unruptured AAAs with respect to these factors. Overall results are more consistent with the literature on ruptured (21, 32) rather than unruptured AAAs. Bearing in mind the recognized association between these factors and mortality, continued efforts to improve them in the elective/semi-elective setting must be made. This includes continued multidisciplinary care, improvements in comorbidity optimization and infrastructure development (ICU beds, nursing staff, monitoring equipment).

Clear areas of evolution were demonstrated with the use of epidural anaesthesia and autologous blood transfusion. The use of epidural anaesthesia/analgesia is a component of ‘fast track’ AAA repair and contributes to a reduction in postoperative ventilation, morbidity and overall hospital stay (34). Autologous blood transfusion [acute normovolaemic haemodilution (ANH) and intra-operative red cell salvage (IBS)] is noted to reduce adverse outcomes such as systemic inflammatory response syndrome (SIRS) and infectious complications related to AAA repair (35). It also reduces the requirements for allogeneic blood transfusion (36, 37) which benefits circumstances of allogeneic blood shortages (38). This is a problem often faced in developing countries.

The present study shows that AAA repair can be performed with reasonable outcomes in regions lacking specialized vascular centres or minimally invasive vascular techniques. The results of the study must be taken into context, however. The power of the study is limited by its retrospective nature and the amount of data available for analysis. This may limit the generalizability of the results. Further prospective evaluation of open AAA repair in this setting would be useful in supporting the results of this study while following the progress in the use of supportive adjuncts such as epidural anaesthesia and autologous blood transfusion. In addition, with the lack of availability of and access to EVAR, the future development of specialized teams will undoubtedly continue to improve the care administered.

REFERENCES


