

Endovascular aortic repair: the experience of two tertiary institutions in Singapore

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ABSTRACT

Introduction: Endovascular aortic repair (EVAR) has gained prominence as a means of treating aortic disease, with lower perioperative morbidity and mortality compared to open surgery. This article aimed to describe the experience of two tertiary hospitals in a Southeast Asian population.

Methods: A retrospective review of 100 consecutive patients undergoing EVAR in two hospitals in Singapore was conducted. This included patients undergoing elective as well as emergency repair.

Results: The mean duration of follow-up was 31.8 months. The mean aneurysm size was 6.3 cm and the mean length of stay was 12.1 days. 64 percent of the patients were of American Society of Anesthesiologists class III or above. The deployment success was 98 percent. Major complications (acute myocardial infarction, pneumonia, cerebrovascular accidents, renal failure, colonic infarction and spinal cord infarction) occurred in 18 patients. Perioperative mortality occurred in six percent of cases. The endoleak rate was 28 percent. Both patients with colonic infarction had a single patent internal iliac artery post-procedure, and end-stage renal failure.

Conclusion: Our results are comparable to published experiences in aortic stenting. Our population possibly had a higher incidence of short common iliac arteries. Revascularisation of internal iliac arteries should be considered for patients with end-stage renal failure and a single patent internal iliac artery.

Keywords: aorta, aortic aneurysm, aortic stent, endovascular aortic repair

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INTRODUCTION

Since Juan Parodi described the deployment of a home-made aortic endograft in 1991, endovascular aortic repair (EVAR) has developed and gained acceptance as an effective alternative to open repair. The main advantages of this procedure occur in the perioperative period, where EVAR has been shown to result in lower morbidity and mortality rates, compared to open repair. The EVAR Trial 1 showed better quality of life between one and three months after repair⁽¹⁾ compared to open repair. Unfortunately, the procedure is associated with higher costs, higher re-intervention rates, and currently lacks long-term durability data. Much of the published experience with these endovascular devices has been from the European, American and Australian populations. Several articles from China illustrate a Chinese perspective to this method of management.⁽²⁻⁴⁾ An article from Hawaii, USA showed that Asian patients have a higher incidence of adverse access-related and disease-related complications compared to a non-Asian population, at least partially contributed by small external iliac arteries.⁽⁵⁾ We review the experience of a Southeast Asian population of two tertiary hospitals in Singapore.

METHODS

A retrospective review was conducted of all aortic endoluminal grafts placed in two tertiary institutions in Singapore from October 1, 1998 to June 30, 2006. Information was extracted from computerised databases. Data was collected on the patient's age, comorbidities, American Society of Anesthesiologists (ASA) classification, anatomy of aortic disease, total intensive care unit (ICU) and hospital stay, complications (including endoleaks) and perioperative mortality.

RESULTS

A total of 100 patients underwent EVAR in the study period (Table I). 83 were male and 17 female. The mean duration of follow-up was 31.8 months. The mean age was 71 (range 21–86) years. 91 endografts were placed for aneurysmal disease, seven for aortic dissection and two for

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Table I. Patient demographics.

Demographics	No. of patients*
Mean (range) age (years)	71 (21–86)
Gender	
Male	83
Female	17
Diabetes mellitus	14
Hypertension	79
Ischaemic heart disease	37
Hyperlipidaemia	36
Respiratory disease	19
Renal impairment	16
Smokers	20
ASA	
I	2
II	34
III	51
IV	12
V	1
Mean length of stay (days)	12.1

*unless otherwise indicated

aortic ulcers. Of the patients with aneurysmal disease, 66 had infrarenal aneurysms, 22 had thoracic aneurysms and three had both thoracic and infrarenal aneurysms (Table II). All the patients underwent computed tomography (CT) angiography. 37 patients, in addition, underwent aortography. 83 patients were ethnic Chinese, 14 were Malay, one was Indian and two were Eurasian. The mean aneurysm size was 6.3 (range 4.3–12.0) cm. Three of the thoracic grafts were placed for pseudoaneurysms, and four for saccular aneurysms.

The mean length of stay was 12.1 days, where the mean length of stay for emergency cases was 17.2 days and that for elective cases was 10.6 days. However, two elective patients had extended hospitalisations of 98 days and 140 days, respectively. Excluding these two patients, the mean length of stay for the elective patients was 7.9 days. 75% of the patients stayed six days or more. All the patients were admitted at least one day before the procedure. Mean ICU stay was 1.6 days. 60 patients did not require ICU stay, 20 patients stayed one day, ten patients stayed two days, and ten patients stayed three days or more. Major complications (n = 26) occurred in 18 patients (Table III). In addition, ten patients developed groin haematoma, none of which required any intervention.

Deployment success was achieved in 98 patients. One failure was a patient with a ruptured descending thoracic aortic pseudoaneurysm. While attempting emergency repair, he was found to have a small left external iliac artery that did not allow passage of the device. He underwent laparotomy, open control of the abdominal aorta, and stent insertion and deployment through the infrarenal aorta. The deployment with this attempt was successful. The other

Table II. Imaging and disease demographics.

Demographics	No. of patients
Imaging	
CT angiography	63
CT angiography and aortography	37
Disease Type	
Aneurysms	91
Dissections	7
Ulcers	2
Location of disease	
Infrarenal	68
Thoracic	29
More than one location	3
Mean (range) size of aneurysms (cm)	6.3 (4.2–12)
Operation	
Elective	79
Emergency	21

patient presented with back pain and was found to have a descending thoracic aneurysm as well as an infrarenal aortic aneurysm. Elective stenting was attempted, but failed also because of small access vessels. He went on to have a thoracotomy and open repair of the thoracic aneurysm. The infrarenal aneurysm was not treated. He developed multiple complications and died ten days after surgery.

The 30-day mortality was 6%. Of these six patients, three were emergency procedures and three were elective, giving a mortality rate of 3.8% for elective procedures and 14.3% for emergency procedures. Of the three elective patients who died perioperatively, one was ASA III and two were ASA IV. One patient had stenting of thoracic aortic dissection, which was complicated by a Type I endoleak. Endovascular treatment of the endoleak failed, and open repair was then performed. He developed pneumonia and renal failure, and died subsequently. The second patient was the renal transplant patient who had both thoracic and infrarenal aneurysms as described above. He was due to have both aneurysms repaired, but deployment of the thoracic graft failed. He developed renal failure and other complications, and died. The third patient had an uneventful stenting of the aortic aneurysm but developed acute myocardial infarction, pneumonia and a cerebrovascular accident post-procedure, leading to his death. Of the emergency cases, one patient had thoracic and infrarenal aneurysms repaired simultaneously, but developed spinal cord infarction and fever shortly after being discharged from the hospital. He deteriorated rapidly despite aggressive antibiotic therapy. The other two patients developed severe pneumonia post-procedure and died. All-cause mortality was 23 percent over the duration of the study.

Of the four patients who developed acute renal failure

Table III. Major complications encountered.

Major complications	No. of patients
Acute myocardial infarction	3
Pneumonia	11
Cerebrovascular accidents	5
Renal failure	4
Colonic infarction	2
Spinal cord infarction	1

post-procedure, two had underlying renal impairment. Also, two were perioperative mortalities. 12 out of 71 patients (16.9%) treated for infrarenal aortic disease required preoperative internal iliac artery embolisation. Out of these, five were for purely short common iliac arteries, and seven were for a combination of short and aneurysmal common iliac arteries. Two patients developed colonic infarction of the inferior mesenteric artery territory. Both patients had end-stage renal failure and a single patent internal iliac artery – one had preoperative embolisation of an internal iliac artery aneurysm and one had occlusion of an internal iliac artery post-EVAR, presumably due to plaque rupture or dissection. Both patients required colectomy, and died after prolonged ICU and hospital stay.

28 patients had endoleak (Table IV). Of the patients with Type I leak, six had re-intervention, one declined treatment and two were treated conservatively. Of the six patients who underwent treatment, three underwent stent placement and three underwent open surgery. Of the three patients who did not receive treatment, two died, one of pneumonia and one of septicaemia. The remaining patient is currently still under follow-up. Of the patients with Type II endoleak, nine (60%) were treated conservatively. Of those who underwent treatment, four had radiological embolisation performed and two underwent re-stenting. None had presented with rupture. Of the four patients with Type III endoleak, three underwent re-stenting and one patient declined further intervention. He was lost to follow-up. There were no patients with Type IV endoleak.

DISCUSSION

The use of EVAR in the management of aortic disease has gained widespread use due to its benefits in the early postoperative period. Since its inception 17 years ago, the devices in use have undergone numerous modifications, resulting in the currently-available devices. Where short-necked aneurysms were once considered beyond the realm of endovascular management, fenestrated aortic stents can be used to treat juxtarenal aneurysms. Much of the literature on aortic stenting has been based on

Table IV. Endoleaks.

Endoleaks	No. of patients
Type I	9
Type II	15
Type III	4
Total	28

European, Australian and American populations. There is a dearth of literature from Asian populations. We sought to describe our experience in such a population. Singapore has a multicultural society where ethnic Chinese make up the majority (about 75%) of the population, followed by ethnic Malays (14%) and Indians (9%). In our study population, 83% were Chinese, 14% were Malay, and 1% Indian. Feasibility of deployment in our population was not reflected in this review as it does not include patients considered for EVAR but deemed unsuitable due to difficult access vessels.

The 30-day mortality rate of 6% may be reflective of the high proportion of patients with ASA classes III and IV, as well as the inclusion of emergency cases. No patient with ASA class I died, and the only mortality with ASA class II was one who had emergency stenting of a thoracic as well as abdominal aortic aneurysm resulting in spinal cord infarction. Three of the six procedures were emergency cases. Caution should be exercised in patients with end-stage renal failure who have a single patent internal iliac artery. Both our patients with the above combination developed left-sided bowel infarction. These patients tend to have extensive calcific arterial disease and would probably require two patent internal iliac arteries to maintain adequate left colonic perfusion post-EVAR. A problem probably more common in Asian populations is the presence of a short common iliac artery. In our review, 16.9% of the patients treated for infrarenal aortic disease required preoperative internal iliac artery embolisation, either because of short common iliac arteries, or a combination of short and aneurysmal common iliac arteries. Also, both deployment failures were due to small access vessels.

Our endoleak rate of 28% is comparable to published data.⁽¹⁾ Type II endoleaks were the most common. Almost half of our patients with endoleaks were treated conservatively. The mean length of stay for elective procedures was 10.6 days. This is comparable to the EVAR cohort in the EVAR Trial 2, where the mean length of stay was 12 days.⁽⁶⁾ However, this group of patients was deemed unfit for open repair. The median length of stay in the EVAR Trial 1 was seven days, but this was for a fitter group of patients. Our heterogeneous group of

patients with a wide range of ASA scores would therefore be expected to have a mean length of stay between that of the EVAR Trials 1 and 2 groups.

In conclusion, this paper describes the results of EVAR of two tertiary hospitals in Singapore. Unique anatomical features like small access vessels and short common iliac arteries affected our selection of patients for EVAR. Revascularisation of internal iliac arteries should be considered for patients with end-stage renal failure, who develop occlusion of even one internal iliac artery perioperatively.

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