



ORIGINAL ARTICLE

Outcome and risk factor analysis of patients who underwent open infrarenal aortic aneurysm repair



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Received 24 January 2015; received in revised form 26 February 2015; accepted 2 March 2015
Available online 14 May 2015

KEYWORDS

abdominal aortic aneurysm;
abdominal aortic aneurysm repair;
long term survival;
reintervention

Summary *Introduction:* The aim of this study was to evaluate the short- and long-term outcomes in patients who underwent open infrarenal aortic aneurysm repair.

Methods: Consecutive patients who underwent open repair of infrarenal aortic aneurysms at our institution from July 1st 1990 to June 30th 2012 were reviewed from a prospective collected departmental database. Short-term outcomes included 30-day mortality and peri-operative complications. Independent risk factors to predict 30-day mortality were identified. Long-term survival and secondary interventions were also reported.

Results: Three hundred and eighty-three patients (317 males, median age 72 years with a range of 15–90 years) underwent open infrarenal aortic aneurysm repair during the period, of whom 266 (69.5%) were elective, 18 (4.7%) were urgent for symptomatic but nonruptured cases, and 99 (25.8%) were emergency procedures for ruptured aneurysms. Mean aneurysm size was 6.5 cm (ranging from 2.5 cm to 15 cm). All patients were followed up for at least 24 months with a mean follow up period 163 months. Overall 30-day mortality was 11.0% (36.4% for ruptured cases, 11.1% for symptomatic cases, and 1.5% for elective cases; $p < 0.001$). Preexisting renal disease and ruptured aneurysms were independent risk factors for 30-day mortality ($p = 0.001$ and $p = 0.006$ respectively). Systemic complications included 50 cardiac events, 52 respiratory events, six renal events, three cerebral vascular accidents, and one deep vein thrombosis/pulmonary embolism. Local complications included two anastomotic/graft hemorrhage, 10 distal thrombosis/embolisms, five bowel ischemias, one spinal cord ischemia, and 17 wound complications. The ruptured group presented survival rates of 53.5%, 50.5%, 47.5%, 42.3%, 38.0%, 21.9%, and 12.5% at 1 year, 2 years, 3 years, 4 years, 5 years, 10 years, and 15 years, respectively; while nonruptured survival rates were 91.5%,

Conflicts of interest: No conflicts of interest declared.

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<http://dx.doi.org/10.1016/j.asjsur.2015.03.009>

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88.0%, 83.7%, 78.3%, 73.0%, 43.0%, and 25.3%, respectively (log rank $p < 0.001$). For those who died 30 days after the operation, only six patients (1.8%) died from aneurysm related mortality. A total of three (0.9%) patients underwent late re-interventions, one for late aorto-enteric fistulae and two for anastomotic pseudoaneurysms.

Conclusion: In the current era of endovascular repair, open infrarenal aneurysm repair is effective and durable, and has very low secondary interventions rates.

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1. Introduction

Ever since Nicolai Volodos in 1986¹ and Juan Carlos Parodi in 1990² demonstrated the feasibility of aortic aneurysm exclusion with endografts, endovascular stent graft repair (EVAR) became the standard of care for infrarenal abdominal aortic aneurysms (AAA) at the end of past century. There was a resurgence of interest in open repair when long-term results from the EVAR1 trial,³ DREAM trial,⁴ OVER trial,⁵ and ACE⁶ trial were published recently. They all showed that the early mortality advantage of EVAR was lost at around 2 years of follow up, and re-intervention, long term complications, and cost were significantly higher in the EVAR group compared to the open repair group. This observation was reconfirmed using meta-analysis.⁷

We present the long-term outcomes of patients who underwent open infrarenal AAA repair in our department. This is the first paper reporting the long-term durability of open repairs in the Han Chinese population. Patients and clinicians can now be informed about the relative merits of open treatment versus endovascular treatment.

2. Methods

We reviewed all patients who received open repair of infrarenal aortic aneurysm at our institution, a tertiary referral center in Hong Kong for the period of July 1st 1990 to June 30th 2012. Data were subtracted from a prospective collected departmental database, supplemented by clinical notes and computer records. Only infrarenal aneurysms were included; while pararenal, suprarenal, and thoracoabdominal aneurysms were excluded.

Patients presented with ruptures, either suspected clinically or diagnosed using imaging. These patients were treated as surgical emergencies. Midline laparotomy and infrarenal clamps were the preferred approaches. Often a supraceliac clamp may be needed temporarily. Asymptomatic patients were offered repair when the aneurysm size reached 5.0 cm. Symptomatic patients included those with pain, infection, embolic phenomenon, and an aneurysm expansion rate >0.5 cm/6 mo. They were treated in an early elective basis. Incision was rooftop or midline with an infrarenal clamp. Tube or bifurcated grafts of woven Dacron or knitted Dacron were used.

Patients were nursed in intensive care units after their operations. After discharge, patients were regularly followed up in the outpatient clinic. Surveillance duplex or computer tomography (CT) scans were not routine.

During the same period of time, our center also performed endovascular stenting but these patients were not reported in the current study.

Patients' baseline characteristics and follow-up periods were reported. Short-term outcomes included perioperative morbidities and mortalities. Variables including age, sex, comorbidities, preoperative hemoglobin level, preoperative base excess, whether the aneurysm had ruptured or not, and American Society of Anesthesiologists (ASA) grades were used to predict the 30-day mortality using a binary logistic regression model. Long-term survival and secondary interventions were reported. Chi-square test was used to differentiate significant differences between categorical variables, while Student t test was used for continuous variables. Statistical analysis was calculated by SPSS version 22 (SPSS Inc., Chicago, IL, USA). A p value <0.05 was defined as significant.

Definitions of comorbidities were as follows. Cardiac history included stable angina, unstable angina, myocardial infarction, congestive heart failure, and arrhythmia. Pulmonary history included all patients with dyspnea or chest roentgenographic changes. Renal impairment was defined as serum creatinine level >120 $\mu\text{mol/L}$. Positive smoking history included all patients who had quit <10 years.

Thirty-day mortality was defined as death ≤ 30 days after index open repair. Late aneurysm-related mortality was defined as death >30 days after index operation and as a direct result of aneurysm rupture. Late re-intervention was defined as further intervention >30 days after the index operation. Graft related events were defined as those occurring as a direct consequence of prosthetic aortic replacement and consisted of graft thrombosis, pseudoaneurysm formation, graft infection, and graft-enteric fistula. Other aneurysms remote from the index operation, e.g., thoracic or iliac aneurysm, requiring further intervention were not counted and were reported separately.

3. Results

Three hundred and eighty-three patients underwent open infrarenal aortic aneurysm repair during the study period (Fig. 1). Three hundred and seventeen (82.8%) were males while 66 (17.2%) were female. The median age was 72 years ranging from 15 years to 90 years, of whom 266 (69.5%) were elective, 18 (4.7%) were urgent for symptomatic but nonruptured cases, and 99 (25.8%) were emergency procedures for ruptured aneurysms. Mean aneurysm size was 6.5 cm ranging from 2.5 cm to 15.0 cm. Other baseline

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