

The Outcome of Abdominal Aortic Aneurysm Repair in Northern Malaysia

M N Lakhwani *, K C B Yeoh **, B H Gooi**, S K Lim*

* Penang Adventist Hospital, Penang, **Penang Hospital, Penang

Summary

A prospective study of all infrarenal abdominal aortic aneurysm (AAA) repairs both as electives and emergencies in Penang between January 1997 to December 2000 is presented. The objectives of the study were to determine the age, gender, racial distribution of the patients, the incidence, and risk factors and to summarize treatments undertaken and discuss the outcome. Among the races, the Malays were the most common presenting with infrarenal AAA. The mean age of patients operated was 68.5 years. Males were more commonly affected compared to females (12:1). Most infrarenal AAA repairs were performed as emergency operations, 33 cases (61.1%) compared to electives, 21 cases (38.9%). Total survival was 70.3% (elective 85.7%; emergency 57.6%). Mortality rate was 31.5% and the primary reason is the lack of operating time available for urgent operation and for treatment of concurrent disease states. Mycotic aneurysm with its triad of abdominal pain, fever and abdominal mass resulted in a significantly higher mortality (46.6%). Ninety six percent of the infrarenal AAA had transverse diameter greater than 6cm. Morphologically 90.7% were fusiform AAA rather than saccular aneurysm (9.3%). Pulmonary complications (35.2%) were more common than cardiac complications (11.1%) possibly related to the urgent nature of the operation, smoking or history of pulmonary tuberculosis. Bleeding (14.8%) was the most common cause of mortality in ruptured mycotic infrarenal AAA.

The Outcome of Abdominal Aortic Aneurysm Repair in Northern Malaysia

Abdominal aortic aneurysm (AAA) is an important vascular disease, which is much neglected in Northern Malaysia. This stems from the difficulty in diagnosis and the lack of awareness by the general practitioners, physicians and surgeons alike. The age-old adage, "What the mind does not know, the eyes does not see," holds true for AAA.

Throughout the world, AAAs are amongst the most frequently encountered disease by vascular

surgeons, in most cases constituting at least 10% of their operative experience¹. An alarming fact is that the incidence of AAA has increased fourfold over the last thirty years, occurring in 3% of those over the age of 50, more frequently in males than females, with the ratios of 3:1 to 8:1 having been reported. With increasing life expectancy and an aging population, it is reasonable to anticipate a corresponding increase in the incidence of AAAs in the future².

The improved outcome of elective aortic aneurysm surgery is the result of several factors.

This article was accepted: 16 January 2003

Corresponding Author: M N Lakhwani, Penang Adventist Hospital, Penang

Abandonment of complete aneurysm resection in favour of endoaneurysmorrhaphy was largely responsible for the decrease in mortality observed in the 1960s^{3,4}. The development of improved prosthetic materials and other refinements in operative technique were also important. Additionally, better anaesthetic and postoperative management have also contributed to this. Non-invasive diagnostic techniques have led to the earlier diagnosis and earlier treatment of aneurysms. Lastly, improved preoperative detection and treatment of significant coronary heart disease and other concurrent diseases have increased the safety of aneurysm surgery.

A prospective study of all AAA repair performed both as elective and emergency procedures in both Hospital Pulau Pinang and Penang Adventist Hospital was analyzed and its results discussed.

Materials and Methods

This was a prospective study performed between January 1997 to December 2000. All infrarenal AAAs operated at Penang Hospital and Penang Adventist Hospital were included in the study. The objectives of the study were to determine the age, gender, racial distribution of the patients, incidence, risk factors and to summarize treatments undertaken and discuss the outcome. All information on personal data, clinical presentation, intercurrent illnesses, investigations, management including operative findings, complications and progress were recorded on a standard protocol at discharge.

All emergency and elective operations performed by the author were recorded and tabulated. Patients with infrarenal AAAs who refused surgery or were not operated upon were excluded from the study. Infrarenal AAAs operated were from the states of Penang, Perlis and Perak. Referrals were from medical officers from district hospitals,

various private hospitals and disciplines within Penang Hospital and Penang Adventist Hospital.

Elective operations were carried out if the aneurysms were symptomatic or their transverse diameter were greater than 5cm. Emergency AAA repairs (leaking or ruptured) were performed regardless of the size of the aneurysm or the presence of concurrent disease(s). Exception to this policy include the patient with a very limited life expectancy or a severely limited quality of life for which life saving therapy of any nature would be withheld (e.g. a patient with advanced incurable cancer).

Among specific investigations carried out included VDRL, TPHA, blood cultures, lipid profile, ultrasonography, computerized tomography and angiogram (occasionally) for the infrarenal aorta.

Results

Epidemiology

The racial distribution of all patient who had infrarenal AAA repaired during the 5 years are seen in Table I. Infrarenal AAA was most commonly seen among the Malays. Elective surgery was the most frequent operations performed in the Malays (14/33) while emergency operations were more common among the Chinese (10/17) and Indians (4/4) (Table I).

The mean age of patients operated was 68.5 years. The age group most commonly affected were those between 70-79 years, followed by those in the 60-69 years (Table II).

Most infrarenal AAA repairs were performed as emergency procedures, 33 cases (61.1%) compared to electives, 21 cases (38.9%). While the total survival was approximately 70.3%, elective surgeries as expected fared better compared to emergency surgeries (Table III).

Table I: Racial distribution of patients with infrarenal abdominal aortic aneurysm

Race	Total N (%)	Male N (%)	Female N (%)	Elective N (%)	Emergency N (%)
Malay	33 (61.1)	29 (53.7)	4 (7.4)	14 (25.9)	19 (35.2)
Chinese	17 (31.5)	17 (31.5)	0	7 (12.9)	10 (18.5)
Indian	4 (7.4)	4 (7.4)	0	0	4 (7.4)
Total	54	50	4	21	33

Table II: Frequency of age-group with infrarenal abdominal aortic aneurysm repair

Age-group (years)	Numbers (%)
< 50	1 (1.9)
50-59	5 (9.3)
60-69	20 (37.0)
70-79	24 (44.4)
80-89	4 (7.4)

Table III: Survival and mortality

Type of surgery	Number N (%)	Survival N (%)	Mortality N (%)
Elective	21 (38.9)	18 (85.7)	3 (14.3)
Emergency	33 (61.1)	19 (51.6)	14 (42.4)
Total	54 (100)	38 (70.3)	17 (31.4)

P < 0.01

Mycotic Aneurysms

Mycotic infrarenal abdominal aortic aneurysms (infective aneurysms) most commonly presented as emergencies with fever and abdominal pain. There were 10 patients (7 Malays, 2 Chinese, 1 Indian) with syphilitic aneurysms and constituted 18.5% of the total number of AAA. Eight cases survived and two cases died due to uncontrolled bleeding at the operation (Table V). Syphilitic infrarenal AAAs were unique in that they had smooth surface, were thin-walled and ruptured easily if handled carelessly especially at cross-clamping. All these syphilitic cases presented as ruptured aneurysms except for 4 cases, which were operated electively.

Morphology

The transverse diameter measurement of all aneurysms were greater than 6 cm except for two cases, which had aneurysm sizes of 3 to 5cm. The

most common infrarenal AAAs morphologically were the fusiform type (49/54) compared to the saccular variety. Only one of the syphilitic patients had a saccular aneurysm. All other nine syphilitic cases had fusiform aneurysm. Of the latter, 3 needed aorto-biiliac grafts while the others straight grafts (Table VI).

Juxtarenal infrarenal AAAs 8/54 (14.8%) constituted a significant proportion and presented mainly as emergencies 6/54 (11.1%). Aneurysms extending up to the common iliac artery, 8/54 (14.8%) were the commonest while those extending up to the external iliac artery and femoral artery were less common, constituting 3/54 each (5.6%) respectively (Table VI).

Most ruptures of the infrarenal AAA, greater than 90% as in this study, occurred posteriorly into the retro peritoneum. Anterior ruptures were uncommon and seen only in 3 cases.

Risk factors

The risk factors associated with infrarenal AAA repairs were smoking, in decreasing order of importance hypertension, ischaemic heart disease, chronic obstructive airway disease, syphilis, diabetes mellitus and renal disease (Table IV). These diseases were discovered during the preoperative or postoperative work-ups both for the elective or emergency surgeries respectively. Ninety four percent of patients with AAA smoked between 10 to 60 cigarettes per day. Hypertension was diagnosed for the first time on admission in most of the emergency cases. Underlying chronic obstructive airway disease, syphilis, peptic ulcer disease, hyperlipidemia were the other diseases often detected on admission for the first time.

Mycotic infrarenal abdominal aortic aneurysms most commonly presented as emergencies with fever and abdominal pain. There were 10 patients (7 Malays, 2 Chinese, 1 Indian) with syphilitic aneurysms and constituted 18.5% of the total number of AAA. Eight cases survived and two cases died due to uncontrolled bleeding at the operation (Table V). Syphilitic infrarenal AAAs were unique in that they had smooth surface, were thin-walled and ruptured easily if handled carelessly especially at cross-clamping. All these syphilitic cases presented as ruptured aneurysms except for 4 cases, which were operated electively.

On the other hand, non-syphilitic mycotic abdominal aortic aneurysms constituted 9.3% of

the cases (5/54) and were more deadly and all succumbed to death during the operation mainly from uncontrolled septicaemia and bleeding (Table V). Among the organisms cultured from this group were salmonella species, staphylococcus aureus and klebsiella pneumonia.

Hypertension was present in 66.7% of the patients with mycotic aneurysms; 5 of the 10 cases of the syphilitic and all the 5 non-syphilitic mycotic aneurysms. Ischaemic heart disease was evident in 8/15 (53.3%) of the mycotic aneurysms; 6 cases in the syphilitic and 2 in the non-syphilitic mycotic aneurysms. Diabetes mellitus was present in 7/15 (46.7%) cases; 4 cases in the syphilitic and 3 in the non-syphilitic group.

Surgery

Aortic graft replacement was accomplished with a straight tube dacron graft of the infrarenal aorta in 37/54 (68.5%) of the patients in whom the iliac arteries were not involved. Anastomoses to the iliac, external iliac or femoral arteries, with an inverted Y-shaped dacron graft were necessary in 14/54 (25.9%) of the patients, because of aneurysm involvement of the iliac or external iliac arteries (Table VI). Extension of the graft to the femoral level was indicated for severe concomitant iliac occlusive disease or rarely because of technical difficulties anticipated with the deep pelvic anastomoses. Iliac anastomoses were preferred because of higher infection rate and pseudoaneurysm formation associated with femoral anastomoses.

Table IV: Intercurrent illness most frequently associated with infrarenal abdominal aortic aneurysm patients

Intercurrent Illness	Number (%)
Smoking	51 (94.4)
Hypertension	30 (55.5)
Ischaemic heart disease	19 (35.1)
Chronic obstructive airway disease	14 (25.0)
Syphilis	10 (18.5)
Diabetes mellitus	9 (16.5)
Renal impairment	6 (11.1)
Peptic ulcer disease	5 (9.3)
Cerebrovascular disease	3 (5.6)

Table V: Types of mycotic aneurysms

Type	Syphilis N (%)	Others N (%)
Number	10	5
Survival	8 (80)	0
Death	2 (20)	50 (100)

Table VI : Morphological types of infrarenal abdominal aortic aneurysms

Type	Number
Fusiform	49/54
Saccular	5/54
Infrarenal aortic aneurysm	37/54
Common iliac artery aneurysm	1/54
External iliac artery aneurysm	1/54
Juxtarenal	8/54
Extended aneurysm	14/54
- Aortobiiliac	8/14
- Aortobiexternal iliac	3/14
- Aortofemoral	3/14

Outcome

The most important complications postoperatively were pulmonary and cardiac related complications, wound infection and bleeding in both the elective and emergency surgeries (Table VII). Among the commonest pulmonary complications were pneumonia and acute respiratory distress syndrome. Resolution was complete almost always with antibiotics and physiotherapy except for two cases (Table VIII).

The other complication of significance was bleeding (Table VII) which occurred in about 13% (7/54). Most of these were due to ruptured mycotic aneurysm and patients died from exsanguinations on the operating table during emergency surgery (Table VIII). Two bleeding cases in elective surgeries (Table VII) had a completely opposite outcome. A case of bleeding from a splenic tear due to retraction that necessitated relaparotomy survived but in another case, bleeding from a left common iliac vein injury from a technical misadventure caused the death of the patient. (Table VIII).

Wound infection usually developed while the patients were still in the wards and almost always responded to antibiotics. There were two cases of Methicillin Resistant Staphylococcus Aureus (MRSA) wound infections in the emergency cases, that needed treatment with vancomycin, fusidic acid and rifampicin.

Cardiac complications in the form of supraventricular tachycardia were commonly encountered postoperatively both in the intensive care unit and wards. Invariably, rapid atrial fibrillation needed immediate treatment.

Other complications of importance included renal impairment, spinal cord ischaemia and stroke encountered following emergency aneurysm repairs. Fortunately, all recovered except for one patient who progressed to chronic renal failure and required prolonged dialysis for almost 3 years.

Septicaemia was an important cause of mortality especially in the ruptured AAA repairs (Table VIII). The resulting multisystem organ failure especially renal failure were always lethal invariably leading to death.

Table VII: Incidence of postoperative complications after infrarenal abdominal aortic aneurysm surgery

Complications	Incidence	
	Elective (%)	Emergency (%)
Pulmonary	5 (9.3)	14 (25.9)
- Pneumonia	3	10
- Acute Resp. Distress Synd.	2	4
Wound infection	3 (5.5)	6 (11.1)
Bleeding	2 (3.7)	5 (9.3)
Cardiac	2 (3.7)	4 (7.4)
- Myocardial infarction	1	2
- Supraventricular tachycardia	2	2
Deteriorating renal function	0	2
Leg ischaemia	1 (1.9)	3 (5.6)
Stroke (transient)	0	2 (3.7)
Spinal cord ischaemia (transient)	0	2 (3.7)
Deep vein thrombosis	0	1 (1.9)
Graft thrombosis	1 (1.9)	0

Table VIII: Causes of mortality in elective and emergency infrarenal abdominal aortic aneurysm repair

Causes	Elective (%)	Ruptured (%)
Haemorrhage	1	7
Renal / Multisystem organ failure	1	3
Cardiac - AMI	1	2
Pulmonary - ARDS	0	2

Discussion

Epidemiology

Malays were the most common ethnic group presenting with AAA in this study. The incidence of AAA varies with the population and tends to be highest in those with a high incidence of atherosclerotic lesions⁵. Due to higher predisposition to vascular disease from atherosclerosis, Malays tend to outnumber the Chinese in acquiring AAA^{6,7}. Indians tend to be under-represented although their incidence of atherosclerotic disease is the highest^{6,7}.

This series has a very high ratio of male to female of 12.5:1. Other studies show that affected men

outnumbered women by approximately 4:1^{8,9}. The high incidence of AAA in males in Malaysia may perhaps be explained by the higher percentage of males who smoke compared to females.

Most infrarenal AAA in this study, were diagnosed above the age of 60 years but less than 80 years; 81.4% of all aneurysms fell within this age group. This is similar to other studies where the risk of rupture rises dramatically with increasing age^{8,9}.

Most emergency or ruptured AAA presented with acute symptoms such as hypotension, abdominal pain or fever. Diagnosis was often missed at the initial consultation. Usually it was not until ultrasonography or computerized tomography

were performed that ruptured or leaking infrarenal AAAs were diagnosed. Often this is delayed. Hence, the high mortality rate of 42.4 % (14/33) in the emergency ruptured infrarenal AAAs. This figure was much higher than most other studies, which quote an average of about 13.3 to 26%^{10,11,12} (average 18%). The primary factor in the high mortality, as in other studies, is the lack of time available for careful evaluation and management of concurrent disease states before emergency operation¹¹. Other possible contributing causes of high mortality include mycotic nature of infrarenal AAAs, multiple intercurrent diseases, lack of intensive care beds and poor transportation systems between the hospitals.

In contrast, the 30-day mortality rate of 14.3% in electively treated patients was comparable to most other studies, ranging from 0 to 21%¹².

As with other major vascular procedures, the experience of the operating surgeon is an important factor in reducing perioperative morbidity and mortality¹³, and the type of hospital does not appear to be crucial¹⁴. However, careful preoperative evaluation and adept postoperative management are as important as surgical skills in reducing morbidity and mortality.

Risk factors

Of the risk factors, smoking (94.4%) and hypertension (55.5%) were extremely important and the majority of the patients were not aware of the association of these factors leading to infrarenal AAA and subsequent complications. While diabetes mellitus did not appear important in elective surgery mortality, 77.8% (7/9) of diabetics were in the emergency group with mycotic aneurysms and may have been an important contributor to their death.

Mycotic Aneurysms

Mycotic aneurysms can be lethal¹⁵. The risk factors for the development of salmonella arteritis include an age of greater than 50 years; pre-existing

coronary atherosclerosis (presumably a reflection of co-existing atherosclerosis elsewhere) or valvular heart disease as evidence of infection before hospitalization¹⁶. Most of the patients with mycotic infrarenal AAA in this study possessed these risk factors. Mycotic abdominal aortic aneurysms although is developed countries rare is not uncommon in a developing country like Malaysia where infective conditions are still endemic.

The diagnosis of mycotic infrarenal AAAs should be suggested by the triad of back pain, unexplained fever and a pulsating abdominal mass¹⁷. Over 50% of patients with mycotic AAAs will have these clinical triad^{18,19}. Mycotic aneurysms develop in patients with atherosclerosis who acquire bacteraemia. Even a transient bacteraemia may allow bacteria to lodge onto a roughened intimal surface. This focus of infection then weakens and destroy the aortic wall and aneurysmal formation ensues. Early diagnosis and surgical treatment of salmonella mycotic aneurysms is imperative as up to 40% of patients may die of sepsis or rupture before surgery²⁰. Computerized tomographic scanning with intravenous contrast or by angiography can reveal early signs of infection of the aorta including air in the aortic wall, periaortic nodularity, change in the size of the aorta and a saccular aneurysms. Air in the aortic wall is pathognomonic of an infected aorta but is non-specific for salmonella infection²¹. Some of these features were present in our patients. Whether in-situ or extra-anatomic bypass grafting is advisable for salmonella mycotic infrarenal AAAs remain controversial although a higher success rate has been reported for the latter. In the former, prosthetic graft infection remains a frightening complication due to the insertion of prosthetic material in a field contaminated by virulent and destructive bacteria¹⁵. In our patients, all the emergency repairs had in-lay dacron grafts (straight or bifurcated) despite the fact they may have been mycotic during the operations.

The successful treatment of the mycotic aneurysms generally involves a high degree of suspicion,

early diagnosis, adequate combination of early chemotherapy for hypertension, septicaemia and diabetes mellitus with prompt surgical intervention.

Though rare in developed countries, aneurysms resulting from tertiary syphilis (luetic aneurysms) are almost always supradiaphragmatic there. In our patients syphilitic infrarenal AAA constituted 18.5% of the total AAA and only one had associated supradiaphragmatic arch aneurysm discovered following an emergency repair of the ruptured infrarenal AAA. The prognosis of syphilitic infrarenal AAA appeared better than the other types of infections with 80% surviving surgery (Table V). Treatment for these aneurysms was completed with a course of benzathine penicillin. Fusiform aneurysms (Table V) were more common in the syphilitic infrarenal AAA than the saccular variety accounting for 90% of the cases.

Morphology

Juxtarenal aneurysms (Table VI) are indicative of a more serious and difficult infrarenal AAA than normally encountered because of the absent neck resulting in difficult proximal control. Perhaps in these aneurysms suprarenal aortic control is

useful before any aneurysm repair facilitating anastomotic repair without excessive blood loss.

Outcome

Contrary to most other studies,^{12,22} morbidity from pulmonary problems constituted more (35.2%) of postoperative complications compared to cardiac problems 11.1% (Table VII). However mortality from myocardial infarction was comparable to other studies. The rate of cardio respiratory complications following emergency infrarenal AAA repair in the study was almost double that in elective surgery. The high rate of pulmonary complications, like acute respiratory distress syndrome (ARDS) and pneumonia, was probably due to the emergency nature of the surgery, smoking and history of pulmonary tuberculosis. The high rate of ARDS could also be due to a combination of massive transfusion and respiratory infection.

In conclusion, infrarenal AAA is a grave disease to operate in an emergency setting due to its high morbidity and mortality. The mycotic nature of the aneurysm secondary to salmonella, staphylococcal or klebsiella species infection also cannot be taken lightly due to its high mortality rate. Early diagnosis is still the most important in improving the outcome.

References

1. Rutherford PB. Vascular Surgery, Philadelphia: W.B. Saunders Company, 1989.
2. Yusuf SW, Baker DM, Chuter TAM, Whitaker SC, Wenham PW, Hokinson BR. Transfemoral endoluminal repair of abdominal aortic aneurysm with bifurcated graft. *Lancet*. 1994; 344: 651-52.
3. Crawford ES, Saleh SA, Babb JW, et al. Infrarenal abdominal aortic aneurysm : Factors improving survival after operation over a 25 year period. *Ann Surg*. 1981; 193: 699.
4. Thompson JE, Hollier LH, Patman RD, et al. Surgical management of abdominal aortic aneurysms. Factors influencing mortality and morbidity - a 20-year experiences. *Ann Surg*. 1975; 181: 654.
5. Goldstone J. Abdominal aortic aneurysms. In Greenfield J, ed. *Surgery. Scientific Principles and*

ORIGINAL ARTICLE

- Practice. Philadelphia : JB Lippincott and Company, 1993; 1711-722.
6. Safiah MY, Margetts BM. Coronary heart disease mortality in Peninsular Malaysia. *Med. J. Malaysia.* 1995; 50: 194-96.
 7. Safiah MY, Margetts BM. Coronary heart disease in Peninsular Malaysia. *Med. J. Malaysia* (Letters to the editor) *Med. J. Malaysia* 1996; 51: 392-95.
 8. Darling RC, Messina CR, Brewster DC, et al. Autopsy study of unoperated abdominal aortic aneurysms. *Circulation.* 1977; 56: 161.
 9. Sterpetti AV, Cavallaro A, Cavallari N, et al. Factors influencing the rupture of abdominal aortic aneurysm. *Surg. Obstet. Gynaecol.* 1991; 173: 175.
 10. McCabe CJ, Coleman WS, Brewster DC. The advantage of early operation for abdominal aortic aneurysm. *Arch. Surg.* 1981; 116: 1025.
 11. Sullivan CA, Rohrer MJ, Cutler BS. Clinical management of the symptomatic but unruptured abdominal aortic aneurysm. *J. Vasc Surg.* 1990; 11: 799.
 12. Johnston KW, Scobie TK. Multicenter prospective study of nonruptured abdominal aortic aneurysms. Population and operative management. *J. Vasc. Surg.* 1988; 7: 69.
 13. Hertzner NR, Avellone JC, Farrell CJ, et al. The risk of vascular surgery in the metropolitan community. *J. Vasc. Surg.* 1984; 1: 13.
 14. Amundson S, Skjaerven R, Trippestad A, et al. Abdominal aortic aneurysms. Is there an association between surgical volume, surgical experience, hospital type and operative mortality? *Acta Chir. Scand.* 1990; 156: 323.
 15. Flamand F, Harris KA, DeRose G, Karam B, Jamieson WG. Arteritis due to salmonella with aneurysm formation : Two cases. *Am. J. Surg.* 1988; 155: 655.
 16. Cohen PS, O'Brien TF, Schoenbaum SC, Medeiros AA. The risk of endothelial infection in adults with salmonella bacteraemia. *Ann Intern. Med.* 1978; 89: 931.
 17. Medelowitz DS, Ramstedt R, Yao JST, et al. Abdominal aortic salmonellosis. *Surgery.* 1979; 85: 514.
 18. Bennet DE, Cherry JK. Bacterial infection of the aortic aneurysms. *Am. J. Surg.* 1967; 113: 321.
 19. Jarett F, darling RC, Mundth ED, et al. Experience with infected aneurysms of the abdominal aorta. *Arch Surg.* 1975; 110: 1281.
 20. Golledge CI, McGeachie DB. Mycotic aneurysms of the thoracic aorta caused by *Salmonella typhimurium*. *Med. J. Aust.* 1988; 149: 94.
 21. Oz Mc Brenner BT, Berda JA, et al. A ten-year experience with bacterial aortitis. *J. Vasc. Surg.* 1989; 10: 439.
 22. Diehl JT, Cali RF, Hertzner NR, et al. Complications of abdominal aortic reconstruction: An analysis of perioperative risk factors in 557 patients. *Ann. Surg.* 1983; 197: 49.