

## Open Abdominal Aortic Aneurysm Repair: Detection of Delayed Aneurysmal Complications

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### Abstract

**Purpose:** Up to 65% of open abdominal aortic aneurysm (AAA) repairs develop para-anastomotic pseudoaneurysms; 14% of these requiring surgery. A further 30% may develop metachronous common iliac artery (CIA) aneurysms with up to 15% being surgically significant. Conventional management is to perform a surveillance scan 5 years post-operatively, yet many of these patients are lost to follow-up. This study evaluates the incidence of such aneurysms in our community and will determine appropriate follow-up practice.

**Methodology:** Patients having undergone open AAA repair at Eastern Health at least 5-years prior to the study date were identified. Deceased patients and those requiring high level nursing care were excluded. Eligible cases were reviewed in clinic and offered CT evaluation where there was no recent scan available.

**Results:** 171 operations were identified between 2003- 2008. 90 (53%) patients were confirmed as deceased; with a further 45 (26%) unable to be contacted. Of the 36 eligible patients, 18 (50%) agreed to participate in clinical assessment with only 9 subsequently attending a review clinic; one of whom passed away prior to scanning. 5(56%) were found to have developed a para-anastomotic aneurysm and 2 (22%) had CIA aneurysms.

**Conclusions:** Despite the limited response rate, the incidence of both para-anastomotic pseudoaneurysms and CIA aneurysms in our experience is significant to warrant closer surveillance. Routine follow-up with imaging should be considered for the detection of delayed aneurysm development.

**Keywords:** Abdominal aortic aneurysm; Follow-up; Surveillance; Pseudo aneurysm

### Introduction

Abdominal aortic aneurysm (AAA) is a relatively common vascular condition that affects the aortic wall [1]. With risk increasing in direct proportion to age, the incidence and prevalence of AAAs is set to rise. Up to 65% of open AAA repairs develop para-anastomotic pseudoaneurysms; 14% of these requiring surgery. A further 30% may develop metachronous common iliac artery (CIA) aneurysms with up to 15% being surgically significant [2]. Patients surgically treated with open aneurysm repair have a risk of delayed development of metachronous peripheral aneurysms and paraanastomotic pseudoaneurysms.

Conventional management is to perform a surveillance scan 5 years post-operatively, yet many of these patients are lost to follow-up. This study evaluates the incidence of such aneurysms in our community and will determine appropriate follow-up practice following open aneurysm repair.

Prior studies have used follow-up ultrasound and computed tomography (CT) scanning for investigation of metachronous aneurysms in patients having undergone AAA repair. Hallett et al. performed a combination of such imaging on 140 patients to discover a proximal aortic false aneurysm prevalence of 1% over a 36-year period [3]. Based in Toronto, Kalman et al. solely utilised CT scanning to determine the prevalence of late arterial dilatations at an average of 8.5 years post AAA repair of unruptured aneurysms. Of 94 patients that underwent CT scanning, 64.9% had aneurysmal dilatation (>3 cm) and the abnormality was considered significant for surgical repair in 13.8%. 39 patients underwent initial repair with a tube graft of which 12 (30.8%) had iliac aneurysms and 6 (15.4%) of these were considered surgically significant [2]. Although the majority of aneurysmal dilatations were not considered surgically significant, it is evident that late follow-up CT

scans are useful in establishing further aneurysmal abnormalities. The authors recommend routine CT scanning at 5 years post AAA repair.

Including true and pseudoaneurysms, there is a wide incidence range of between less than 1% and up to 30% at 15-year post-op review [4-6]. Based in Italy, Locati et al. reviewed 2183 patients with prosthetic grafts inserted over 15 years for both AAA and occlusive disease [7]. 24 of these patients were treated for paraanastomotic aneurysms, at an average interval of 7.7 years post primary graft insertion. Pseudoaneurysms were detected in 19 cases with 47% proceeding to rupture. CT scanning was performed in all but 4 symptomatic patients whom proceeded directly to theatre. It is not clearly elucidated whether the asymptomatic patients were scanned during routine follow-up or for another reason. The authors suggest the incidence of paraanastomotic aneurysms increases proportionately with postoperative time and as such a screening program would be beneficial in this population.

The literature today distinguishes a link between abdominal aortic aneurysms (AAAs) and femoral and popliteal artery aneurysms. Untreated peripheral aneurysms are limb threatening due to their capability to rupture or cause embolism [8]. Two retrospective studies from the University of Michigan have illustrated a 3.2% to 3.9%

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incidence of peripheral aneurysms in patients diagnosed with AAAs [9,10]. Diwan et al. conducted a prospective study on 313 consecutive patients with AAAs diagnosed from 1995 to 1998 in order to establish the true incidence of femoral and popliteal artery aneurysms in this population [11]. Of the 313 patients, 36 (12%) were diagnosed with a total of 51 femoral and popliteal aneurysms; all of which were male. A further 25 patients (8%) were found to have 26 distinct focal dilatations that were insufficient to meet the aneurysm criteria of the study. As evidenced by their use of Doppler ultrasound, the authors set out to specifically evaluate the incidence of femoral and popliteal artery aneurysms in this population. Patients with peripheral artery pseudoaneurysms, also at risk of rupture if left untreated, were excluded from this study. The study establishes the incidence of peripheral aneurysms, allowing future scope for follow-up of the significance of their findings.

A review of the relevant literature finds mention of metachronous aneurysms following abdominal aortic aneurysm repair, yet there is a scarcity of direct studies investigating this. Evident in the inherent risks of untreated metachronous and paraanastomotic aneurysms, multiple publications invite future study in this area. As such, there is indeed scope for follow-up of patients in our specific population to establish a surveillance program to benefit patient outcomes.

## Methods

Patients having undergone open AAA repair at Eastern Health at least 5-years prior to the study date were identified. Data was available from the Melbourne Vascular Surgery Audit (MVSA) of a total of 171 procedures performed in between 2003-2008.

Among the 171 patients were 137 males and 34 females, ranging in age from 53 to 92 years (mean age,  $74 \pm 8$ ). Of the total cases 81 were referred from outpatients or private rooms, 61 admitted via the emergency department, 23 transferred from other hospitals, 4 referred by another inpatient unit and two cases were not recorded as to source of referral. 65 were emergency operations and 90 cases elective, with a further 16 recorded as semi-urgent.

Due to prospective patient review with radiology, formal ethics approval was gained from the Eastern Health Ethics Committee.

Patient records were investigated to establish mortality and morbidity status of all cases where possible. Those confirmed as deceased or requiring high level nursing care were excluded from the study. All other patients were mailed documentation, inviting participation in the study. Eligible and willing patients were reviewed in clinic and offered CT evaluation where there was no recent scan available.

## Results

171 operations were identified between 2003- 2008. 90 (53%) patients were confirmed as deceased; with a further 45 (26%) unable to be contacted. A total of 36 responses were received from 93 (54%) letters sent out inviting patients to participate in the study. 9 patients attended a review clinic, one of whom passed away prior to scanning. The eight patients reviewed were seen between 6-10 years (mean, 8 years) since their surgery. Five (63%) were found to have developed a para-anastomotic aneurysm and a further 3 (25%) CIA aneurysms (defined as  $>1.8$  cm) were detected in two patients (Table 1).

The average abdominal aortic aneurysm diameter was  $4.0 \pm 1.1$  cm (range, 3.0 to 5.8 cm) and the average common iliac artery diameter was  $2.3 \pm 0.5$  cm (range, 1.8 to 2.8 cm). One patient had a unilateral

CIA aneurysm and another patient had bilateral CIA aneurysms. Of the five cases with para-anastomotic aneurysms, one had a metachronous ascending aortic aneurysm (Table 2).

All patients reviewed with imaging were male, of which all had hypertension and were a current or ex-smoker. Renal impairment and diabetes mellitus were not significant factors in the development of new aneurysms.

## Discussion

Open surgical repair (OSR) has always been the gold standard in AAA management. Yet, with the continual development of endovascular aneurysm repair (EVAR), there is an impending paradigm shift [12]. In the typically comorbid AAA patient, OSR is generally deemed a single definitive procedure, with minimal post-operative follow-up once immediate survival is established. EVAR, with its inherent risks of endoleak, rather mandates a much closer follow-up protocol that involves repeated radiation exposure and renal toxicity with contrast scanning. Standardised follow-up protocols recommend a contrast-enhanced CT scan to be done at 1, 6 and 12 months post-operatively and then annually thereafter [13]. Conversely, open surgical repair often mandates only a post-operative review; with the subsequent 5-year scan often not performed.

As shown by our study, 5-year follow-up is often missed and thus secondary complications cannot be addressed. 63% of cases developing para-anastomotic aneurysms suggest there is indeed a risk of propagating aneurysmal disease following surgical AAA repair. Essentially a precursor to para-anastomotic aneurysm (PAA) formation, a retrospective cohort study by Sonesson et al. found there was a significant dilatation of both the infrarenal aortic neck and the juxtarenal aorta following open aortic procedures [14]. Although small, this tendency indeed reflects the natural history of aneurysmal disease.

The literature suggests PAAA are of greater prevalence amongst ruptured AAA repairs rather than elective procedures [15]. In our study only one case was subsequent to an emergency AAA repair, yet with our small sample size, this is not representative of the greater population.

Scientific data suggests clear genetic and epidemiological associations between an aneurysmal aorta and peripheral aneurysmal disease [16]. As such a common pathological basis for the development of metachronous aneurysms may be inferred. An exploratory study performed in the Netherlands noted a significant correspondence in proinflammatory transcription factors and activation proteases between AAA and peripheral arterial aneurysms [17].

Open repair has historically been the favoured approach in managing aortic aneurysms in patients aged 65 years and younger.

Characteristic	Study (N=8)
Female	0
Male	8 (100%)
Diabetes mellitus	1 (12.5%)
Renal impairment (eGFR<50)	2 (25%)
Hypertension	8 (100%)
Ischaemic Heart Disease	5 (62.5%)
Hypercholesterolemia	7 (87.5%)
Smoking (ex or current)	8 (100%)
Airways disease	4 (50%)

Table 1: Characteristic studies of different diseases.

Demographic	EM / EL	D.O.S	Post-op (Years)	Co-morbidities							Outcome
				DM	eGFR	Resp	Htn	IHD	Smoker	Chol	
HB 84M	Elective	12/2007	6	N	42	COAD	Y	Y	Ex	Y	3.7cm AAA
DG 80M	Elective	12/2005	8	N	73	COAD	Y	N	Ex	Y	5.8cm AAA 2.2cm L CIAA
NB 78M	Elective	09/2004	9	N	59	Asthma	Y	Y	Ex	Y	Nil aneurysm
JF 69M	Elective	10/2003	10	Y	59	N	Y	N	Ex	N	3.0cm AAA
MP 65M	Elective	11/2005	8	N	90	N	Y	Y	Ex	Y	2.8cm R CIAA 1.8cm L CIAA
RJ 80M	Emergency	04/2005	8	N	33	COAD	Y	Y	Y	Y	4.4cm AAA
GP 76M	Elective	12/2005	8	N	55	N	Y	Y	Ex	Y	Nil aneurysm
JS 80M	Elective	12/2006	7	N	53	N	Y	N	Ex	Y	3.3cm AAA

**Table 2:** Demographic studies.

With uncertainties regarding long-term graft durability, risk of late graft rupture and surveillance associated radiation exposure; endovascular repair is generally discouraged in younger patients [18-20]. Nonetheless, a single-centre study on elective AAA repairs by Altaf et al. found similar reintervention rates in open (13%) compared to endovascular (11%) procedures at a median follow-up interval of 77 months [20]. On the contrary, a retrospective review of ruptured aneurysms in another United States hospital noted a much higher re-intervention rate following EVAR than open repair (10.9% vs 1.5%) [21]. It is worth noting that this study population was solely on ruptured aneurysms, with a higher average age at initial intervention and median follow-up interval of only 36 months.

Despite 171 procedures having been completed during our study period; ultimately reviewing a mere 9 patients is quite a poor return. 93 letters were sent out with a total of 36 (39%) responses. Indeed, the morbidity and mortality associated with both the disease and procedure leads to an inherently poor response rate amongst this population. Yet, a health related survey sent out to patients up to 8.5 years post-ruptured AAA repair in Quebec, Canada had a 75% completion rate [22]. Further, Khan et al. had an 89% response rate in their questionnaire establishing patients' perspective of functional outcome following elective AAA repair [23]. Nonetheless, divergent to our correspondence these two studies utilised simple surveys a patient could complete at their own leisure. As our study required patient's to physically attend up to two clinic appointments with the likelihood of a repeat CT scan, voluntary inclusion indeed presents a more arduous endeavour than a mere survey. Future studies may potentially be streamlined by scheduling a scan, when required, on the same day as the clinic appointment.

Of the nine patients reviewed in our study, 2 cases (22%) developed CIAAs; one unilateral and one bilateral. With a range from 1.8-2.2 cm, all of these were asymptomatic and only detected with our repeat imaging. Iliac artery aneurysms are noted to be the most common aneurysm after AAA, with CIAA the most frequent of these [24]. The majority of iliac artery aneurysms develop in patients with AAA. A CT angiographic study from the UK suggests 20% of patients with AAA have CIAA [25]. Rather, with an incidence of 0.03-2% in autopsy series', isolated iliac artery aneurysms are exceeding uncommon [26-28]. A series published by Huang et al. found 86% of patients with CIAA having existing AAA and 65% with contralateral CIAA [29]. Thus, it indeed seems prudent to schedule follow-up imaging post AAA repair to monitor for peripheral arterial aneurysms.

Common practice regarding threshold for repair is 3cm due to likelihood of becoming symptomatic and increased risk of rupture [27, 30-32]. Similar to AAA, ruptured CIAA carries high mortality rates. Further, concurrent AAA rupture will indeed complicate management.

As with AAA surgery, open repair has long been the gold standard for management of iliac aneurysms until the recent development of an endoluminal approach [33-37]. Patel et al. found no difference in primary patency rates between open and endovascular repair of isolated iliac artery aneurysms over 12 years [38]. With a median follow-up of 36 months, Fossaseca et al. describe primary and secondary patency rates of 95% and 100% respectively of endovascularly treated iliac aneurysms [39]. Similarly, Boules et al. note a primary patency rate of 95% at 2 years post endovascular repair of iliac artery aneurysms [40]. Thus, endoluminal repair provides a safe, minimally invasive option for CIAA repair with favourable anatomy without compressive symptoms.

We acknowledge that the study is inherently limited by a significant loss to follow-up and therefore small sample size. Future studies may involve longer, prospective follow-up practices and could consider investigating rates of subsequent rupture and reintervention.

## Conclusion

Despite our small sample size, we found a high proportion of para-anastomotic and metachronous aneurysms following open AAA repair. Indeed, our study results suggest that closer radiological monitoring be considered for open AAA repair. Not as frequent as per EVAR, yet we suggest that at least a 5-year post-operative scan be completed. Further, with studies showing similar re-intervention rates in the elective setting between the two approaches, it may perhaps be wise to consider EVAR as the primary intervention in the younger patient.

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