An assessment of between-recti distance and divarication in patients with and without abdominal aortic aneurysm

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ABSTRACT

INTRODUCTION The study assessed whether there is a greater incidence of divarication of the recti and whether between-recti distance is greater in patients with abdominal aortic aneurysm (AAA).

PATIENTS AND METHODS The study consisted of two parts: a radiological and a clinical assessment. All patients with a confirmed AAA on computerised tomography were included and compared with patients in whom AAA was excluded with imaging. Between-recti distance was measured using a computerised image viewer and clinical divarication was assessed by a surgical registrar or consultant.

RESULTS In the radiological part of the study, 108 patients with AAA were compared with 84 with colorectal cancer. Median between-recti distance was 38 mm (range, 25–59 mm) in the AAA group and 27 mm (range, 20–44.5 mm) in the non-AAA group ($P = 0.006$). AAA diameter did not correlate with between-recti distance. The clinical study included 50 patients (25 AAA). The groups were well matched, with only a greater incidence of diabetes in the AAA group (20% vs 0%; $P = 0.018$). AAA patients were more likely to have clinically detected divarication of the recti (76% vs 36%; $P = 0.004$).

CONCLUSIONS Patients with AAA have greater radiological and clinical evidence of divarication. It is suggested that patients with divarication be screened for AAA.

KEYWORDS

Aortic aneurysm, abdominal – Divarication recti – Adult – Human

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An association between abdominal aortic aneurysms (AAAs) and inguinal hernias has long been established.^{1,2} Studies have demonstrated an increased risk of AAA in patients with inguinal hernias and a higher prevalence of inguinal hernias in patients with abdominal aortic aneurysms compared with patients with peripheral arterial occlusive disease or coronary atherosclerosis. These findings have been postulated to be as a result of systemic fibre degeneration or increased blood proteolytic activity in smokers.³ In addition, patients with AAAs are known to have a significantly higher incidence of abdominal wall hernias when compared with groups with aorto-iliac occlusive disease.^{4–6} A higher risk of developing postoperative incisional hernias following aortic reconstruction has been shown when compared with patients with arterial occlusive disease.^{7–11} One study, however, has suggested that this might be lowered by the use of a transverse incision over a vertical one.¹²

Divarication of the recti is a separation between the left and right rectus abdominis muscles, leaving the central

abdominal wall devoid of support, allowing protrusion of the abdominal contents.¹⁴ The aim of this study was to establish if there is a greater incidence of clinical divarication of the recti in patients with AAA compared with those without and whether there exists a significant difference in the radiological between-recti distance between the two groups.

Patients and Methods

The study was conducted in two cohorts: radiological and clinical. In both cohorts, patients with a diagnosis of AAA were compared with those patients without AAA. All data were collected prospectively.

Clinical study

INCLUSION CRITERIA

The non-AAA cohort were recruited from patients seen in the out-patient department or from the surgical wards in

Figure 1 Measurement of between-recti distance.

whom abdominal imaging (either CT or ultrasound) had been performed with clear documentation of the absence of an aortic aneurysm.

The AAA cohort was recruited from patients being admitted for elective repair of AAA as well as those patients known to the vascular surgical department with an aneurysm size greater than 5.5 cm but deemed unfit for surgery.

EXCLUSION CRITERIA

All patients having prior abdominal surgery were excluded from this part of the study.

DATA COLLECTION

The presence of divarication was determined in sex-matched patients by the same general surgical registrar and consultant and comparison amongst those with and without AAA was made. Two clinicians, who were blinded to each other's assessment, assessed all patients to ensure accuracy of data collection. The observer was unaware as to whether an aneurysm was present before establishing the diagnosis of divarication.

The presence of divarication was confirmed by the patient raising their head when lying flat on an examination couch.

Radiological study

INCLUSION CRITERIA

The non-AAA cohort were recruited from those patients being admitted for colorectal cancer surgery since these patients routinely undergo pre-operative computerised tomography of the chest, abdomen and pelvis and AAA can, therefore, be excluded radiologically. In addition, patients known to be undergoing pre-operative staging scans during the study period were recruited to the radiological arm of the study.

The AAA cohort were recruited as for the clinical study.

EXCLUSION CRITERIA

All patients having prior abdominal surgery were excluded from this part of the study.

DATA COLLECTION

Computed tomography images were assessed using a computerised image viewer (Fig. 1) and the distance between the recti muscles measured using one of the viewer's in-built tools. The greatest of three separate measurements was used. Two clinicians took measurements from the scans independently; where disparity arose, a third, independent, clinician took a further set of measurements and the values were averaged.

STATISTICAL ANALYSIS

Statistical analysis was conducted using the Mann-Whitney U-test to compare continuous variables and Pearson's chi squared test to compare nominal outcomes. The Spearman correlation was used to assess whether an association between aneurysm diameter and radiological between-recti distance existed. Median values and 25th to 75th centiles are presented. All *P*-values less than 0.05 were considered statistically significant. Statistical analysis was performed using Statistical Package for the Social Sciences v15 (SPSS Inc., Chicago, IL, USA).

Results

Radiological study

In the radiological arm, there were 108 patients (96 men) with AAA and 84 patients (47 men) in the control group. Patients with aneurysms were significantly older than those without (median 75 years [range, 70–78 years] vs median 70.5 [range, 63.25–78 years]; *P* = 0.014). In the AAA cohort, the median between-recti distance was 38 mm (range, 25–59 mm) versus 27 mm (range, 20–44.5 mm) in the non-AAA group (*P* = 0.006; Table 1). The diameter of the aneurysm bore no correlation to the between-recti distance (Spearman correlation -0.11 ; *P* = 0.910).

Clinical study

The clinical group consisted of 50 sex-matched patients (25 patients with aneurysms versus 25 without). The median ages were 76 and 69 years (*P* = 0.165; AAA vs non-AAA) and median body mass index (BMI) of 27.5 kg/m² versus 24.7 kg/m² (*P* = 0.097), respectively. The groups were well matched for co-morbidities, with only the incidence of diabetes being greater in the AAA group (20% vs 0%; *P* = 0.018).

Patients with an aneurysm were significantly more likely to have clinically detected divarication of the recti than

Table 1 Summary of results

	Control group	AAA group	P-value ^a
Radiological	<i>n</i> = 84	<i>n</i> = 108	
Male gender	47 (56.0%)	96 (88.9%)	< 0.001
Median age (25th – 75th)	70.5 (63.3–78)	75 (70–78)	0.014^b
Between recti distance (mm)	27 (20–44.5)	38 (25–59)	0.006^b
Clinical	<i>n</i> = 25	<i>n</i> = 25	
Male gender	24 (96%)	24 (96%)	1.000
Median age (25th – 75th)	69 (62–77)	76 (68–78)	0.165 ^b
BMI	24.7 (20.7–28)	27.5 (23.8–28.8)	0.097 ^b
Divarication	9 (36%)	19 (76%)	0.004^b

^aPearson's chi squared test; ^bMann–Whitney U-test.

P-values in bold denote statistical significance.

those in whom an AAA had been excluded (76% vs 36%; $P = 0.004$; Table 1).

Discussion

This analysis shows that the prevalence of divarication of the recti is approximately twice as high in patients with abdominal aortic aneurysms than in those without. Moreover, the between-recti distance was significantly greater in aneurysmal patients compared to patients with colorectal cancer. Although patients with AAAs had a higher median BMI, the BMI for both patient groups falls within the 'overweight' criteria.

In spite of the paucity of literature on the matter, the current findings concur with the evidence available. A recent study has demonstrated a 4-fold higher prevalence of divarication in older men with AAAs compared to a similar group with peripheral arterial disease.¹⁵ Given the high morbidity and mortality associated with AAAs, coupled with their subtle and often absent symptomology, the findings presented here might further validate the justification in screening high-risk patients with divarication, namely older men with a history of smoking. There is now reliable evidence on the benefits of screening for AAAs with a reduction in aneurysm-related mortality, on the proviso, however, that programmes target high-risk groups.^{16,17} Under the circumstances, perhaps the presence of divarication, particularly with the concurrence of a hernia in an older man, should encourage the use of ultrasound to exclude an abdominal aortic aneurysm in these high-risk groups. There is little evidence currently, however, to suggest that the presence of divarication alone, in otherwise healthy individuals, merits a screening ultrasound.

Further questions arise as to why both hernias and divarication are more commonly observed in patients with AAAs. These conditions are thought to originate in part from connective tissue disorders and the associations may represent a systemic phenomenon of tissue weakness. Marfan's, Ehlers–Danlos syndrome (Type IV) and systemic lupus erythematosus are all well documented systemic disorders affecting vascular and other tissues.^{18–20} There is further evidence, particularly with groin hernias, that these are a result of systemic or local disorders of collagen metabolism.^{21,22} Smoking, as mentioned above, is thought to increase proteolytic activity in conjunction with other molecular factors that lend themselves to weakening of tissues, with subsequent hernia formation.

The link between divarication and herniae is not known, but it is worth considering whether the presence of an established weakened linea alba (divarication of the recti) is a risk factor in the formation of an incisional hernia following midline laparotomy for aortic reconstruction. There is no literature available on the subject, but one might postulate that an incision through compromised linea alba, in a patient with recognised tissue weakness (through the presence of divarication and AAA) would be at high risk of subsequent incisional hernia.

As previously described, patients who have abdominal aortic aneurysm repairs are well known to be at high risk of such conditions compared to patients with aorto-iliac occlusive disease. Incisional hernias presenting following surgery may be problematic causing pain, concern with cosmesis or presenting with incarceration or strangulation. Often, secondary repair may be technically demanding and frequently involving high-risk patients. The use of

a prophylactic polypropylene mesh inserted in the pre-peritoneal space has been demonstrated in studies to be an effective, safe and simple method of decreasing the incidence of incisional hernias following aneurysm repair.^{25,24}

It may be appropriate, therefore, to consider mesh closure of the abdomen in patients undergoing repair of an AAA who have clinical evidence of divarication prior to the operation.

Conclusions

There appears to be a link between the presence of divarication and abdominal aortic aneurysms, although further studies such as a retrospective review of 'screen detected AAAs' would be required to authenticate the present findings. Patients with cardiovascular risk factors and divarication of the recti should be offered an ultrasound assessment of the aorta in those areas where population screening is not being undertaken.

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References

- Lehnert B, Wadoud F. High coincidence of inguinal hernias and abdominal aortic aneurysms. *Ann Vasc Surg* 1992; **6**: 134–7.
- Pleumeekers HJ, De Gruijl A, Hofman A, Van Beek AJ, Hoes AW. Prevalence of aortic aneurysm in men with a history of inguinal hernia repair. *Br J Surg* 1999; **86**: 1155–8.
- Cannon DJ, Casteel L, Read RC. Abdominal aortic aneurysm, Leriche's syndrome, inguinal herniation, and smoking. *Arch Surg* 1984; **119**: 387–9.
- Adye B, Luna G. Incidence of abdominal wall hernia in aortic surgery. *Am J Surg* 1998; **175**: 400–2.
- Hall KA, Peters B, Smyth SH, Warneke JA, Rappaport WD, Putnam CW *et al*. Abdominal wall hernias in patients with abdominal aortic aneurysmal versus aortoiliac occlusive disease. *Am J Surg* 1995; **170**: 572–5, discussion 5–6.
- Papadimitriou D, Pitoulas G, Papaziogas B, Koutsias S, Vretzakis G, Argiriadou H *et al*. Incidence of abdominal wall hernias in patients undergoing aortic surgery for aneurysm or occlusive disease. *Vasa* 2002; **31**: 111–4.
- Holland AJ, Castleden WM, Norman PE, Stacey MC. Incisional hernias are more common in aneurysmal arterial disease. *Eur J Vasc Endovasc Surg* 1996; **12**: 196–200.
- Liapis CD, Dimitroulis DA, Kakisis JD, Nikolaou AN, Skandalakis P, Daskalopoulos M *et al*. Incidence of incisional hernias in patients operated on for aneurysm or occlusive disease. *Am Surg* 2004; **70**: 550–2.
- Raffetto JD, Cheung Y, Fisher JB, Cantelmo NL, Watkins MT, Lamorte WW *et al*. Incision and abdominal wall hernias in patients with aneurysm or occlusive aortic disease. *J Vasc Surg* 2003; **37**: 1150–4.
- Stevick CA, Long JB, Jamasbi B, Nash M. Ventral hernia following abdominal aortic reconstruction. *Am Surg* 1988; **54**: 287–9.
- Takagi H, Sugimoto M, Kato T, Matsuno Y, Umemoto T. Postoperative incision hernia in patients with abdominal aortic aneurysm and aortoiliac occlusive disease: a systematic review. *Eur J Vasc Endovasc Surg* 2007; **33**: 177–81.
- Fassiadis N, Roidl M, Hennig M, South LM, Andrews SM. Randomized clinical trial of vertical or transverse laparotomy for abdominal aortic aneurysm repair. *Br J Surg* 2005; **92**: 1208–11.
- (deleted at proof)
- O'Reilly D. Diastasis recti. 2007
<<http://www.nlm.nih.gov/MEDLINEPLUS/ency/article/001602.htm>>.
- McPhail I. Abdominal aortic aneurysms and diastasis recti. *Angiology* 2009; **59**: 736–9.
- Ashton HA, Buxton MJ, Day NE, Kim LG, Marteau TM, Scott RA *et al*. The Multicentre Aneurysm Screening Study (MASS) into the effect of abdominal aortic aneurysm screening on mortality in men: a randomised controlled trial. *Lancet* 2002; **360**: 1531–9.
- Norman PE, Jamrozik K, Lawrence-Brown MM, Le MT, Spencer CA, Tuohy RJ *et al*. Population based randomised controlled trial on impact of screening on mortality from abdominal aortic aneurysm. *BMJ* 2004; **329**: 1259.
- Oderich GS, Panneton JM, Bower TC, Lindor NM, Cherry KJ, Noel AA *et al*. The spectrum, management and clinical outcome of Ehlers–Danlos syndrome type IV: a 30-year experience. *J Vasc Surg* 2005; **42**: 98–106.
- Ohara N, Miyata T, Kurata A, Oshiro H, Sato O, Shigematsu H. Ten years' experience of aortic aneurysm associated with systemic lupus erythematosus. *Eur J Vasc Endovasc Surg* 2000; **19**: 288–93.
- Thomas GP, Purkayastha S, Athanasiou T, Darzi A. General surgical manifestations of Marfan's syndrome. *Br J Hosp Med (Lond)* 2008; **69**: 270–4.
- Ozdogan M, Yildiz F, Gurer A, Orhun S, Kulacoglu H, Aydin R. Changes in collagen and elastic fiber contents of the skin, rectus sheath, transversalis fascia and peritoneum in primary inguinal hernia patients. *Bratisl Lek Listy* 2006; **107**: 235–8.
- Pans A, Albert A, Lapiere CM, Nusgens B. Biochemical study of collagen in adult groin hernias. *J Surg Res* 2001; **95**: 107–13.
- O'Hare JL, Ward J, Earnshaw JJ. Late results of mesh wound closure after elective open aortic aneurysm repair. *Eur J Vasc Endovasc Surg* 2007; **33**: 412–3.
- Rogers M, McCarthy R, Earnshaw JJ. Prevention of incisional hernia after aortic aneurysm repair. *Eur J Vasc Endovasc Surg* 2003; **26**: 519–22.