Medical Elective Report

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AIMS & OBJECTIVES

The aim of this elective project was to assess the differences in aortic morphology between Caucasians and Asians in a comparison of AAA patients from Inverness and Singapore.

The project was carried out in Raigmore Hospital in Inverness and the National University Hospital in Singapore. The full report will be published in due course and the following short report is a summary of the reasoning behind the project with an explanation of the findings.

The objectives included:

To collect aortic diameter measurements at fixed reference points for both cohorts

Compare the data and establish whether differences exist

Apply the findings to current guidelines in managing Abdominal Aortic Aneurysm disease

Make recommendations for further research and/or improved practice.

Introduction

Abdominal Aortic Aneurysm (AAA) is a form of vascular disease, which is defined as an abnormal dilatation of the abdominal aorta. AAA can develop as people become older and occurrence of such disease has been shown to be associated with risk factors such as increasing age, male gender, smoking and family history. The prevalence of AAAs in the UK has been found to be around 4-5% in the 65-plus age range. The disease is less common in females (7.6% in men, 1.3% in women) and a lower prevalence is also seen in Asians from the Indian subcontinent and in those of Afro-Caribbean origin.

The natural history of AAA disease usually involves progressive dilatation throughout the older patient's life. As the aneurysm becomes larger, the risk of rupture increases. Rupture poses significant risk of death from sudden intra-abdominal bleeding and resulting haemodynamic shock.

There is significant variability in practice throughout the world regarding the initial management of AAAs but it is widely agreed that with increasing size there is an eventual need for surgical intervention. The criteria for intervention is dependent on a host of factors such as surgeon clinical judgment, estimated risk of rupture and whether surgically challenging anatomy exists. Patient suitability for intervention is dependent on factors such as age, pre-existing morbidity and importantly, the patient's wishes to go ahead with a procedure which itself poses risk.

Aneurysm size alone has been shown to be the best indicator of risk of rupture with rapid expansion rate and the presence of symptoms both being poor prognostic factors. Trials amongst Caucasian males have shown that surveillance of aneurysms up to 5.5cm is safe. In the four randomized controlled trials that have been carried out, screening has been shown to reduce AAA related deaths in men. These trials were all carried out on populations, which were predominantly of Caucasian ethnicity.

Screening programmes are now in place in the UK, which invite all male patients over the age of 65 for ultrasound assessment of their abdominal aortas. If an aneurysm is detected, it is assessed for size, with a diameter of 5.5cm or more being the criteria for referral to a vascular surgeon for repair. Any patient with an aneurysm smaller than this is offered continued surveillance. There appears to be a lack of evidence to support screening in females with only one randomized controlled trial having being conducted that included women. In addition, the trials which led to the implementation of screening in the UK have not provided any guidance regarding patient ethnicity. This may be seen as a weakness of these guidelines when we consider the ethnically diverse population seen in the UK.

Two trials in the UK have found AAA disease to be rare in Asians originating from the Indian subcontinent, however evidence regarding Eastern and South Eastern Asians is limited. The difficulty with this is that when non-Europeans present with AAA disease there is a lack of evidence regarding optimal management. There is still a lack of evidence providing clearly defined

intervention policies for females or for smaller patients in general e.g. Eastern Asians.

Although females are less likely than men to develop AAA disease, it has been shown that their risk of rupture is 3-4 times more likely during the surveillance period. It has also been shown that AAAs in females tend to rupture at diameters that are on average 0.5cm smaller than in those for men. It is difficult to prove the reasons for this however it is tempting to speculate that this may be influenced by the fact females have smaller normal aortic diameters than males. It is also interesting to consider whether this may be linked to the female sex's shorter height. Evidence remains very limited regarding the aortic diameters at which females should receive surgical repair. It has been suggested that smaller thresholds be adopted (5.2cm) due to females having smaller normal aortic diameters.

In further considering the fact that female aneurysms rupture earlier one may consider whether smaller patients in general may be included in the higher risk group. The evidence and trials carried out regarding AAA disease have been largely involving taller populations, therefore it is interesting to consider how applicable this is to smaller groups e.g. Eastern Asians.

For any dilatation of the abdominal aorta to be considered aneurysmal, the most widely accepted a diagnostic criterion requires that an abdominal aortic diameter be 3.0cm or more (In the AP or Lateral planes). This has been found to be around two standard deviations above the mean for European men and women. The weakness in this definition is that aneurysm size alone is reported with no reference being made to the 'normal' abdominal aorta. No consideration

is given to the extent of aortic distension relative to the previously healthy aorta. For example, consider two patients both having aneurysms measuring 5.5cm. Patient A's normal aorta measures 2cm, and patient B's normal aorta measures 2.5cm. Clearly, patient A's aneurysm is proportionally larger relative to the original aortic diameter than when compared to patient B (5.5:2 vs. 5.5:3) (Figure 1). At present, both these patients would be treated at 5.5cm with no consideration given to their different aortic morphology.

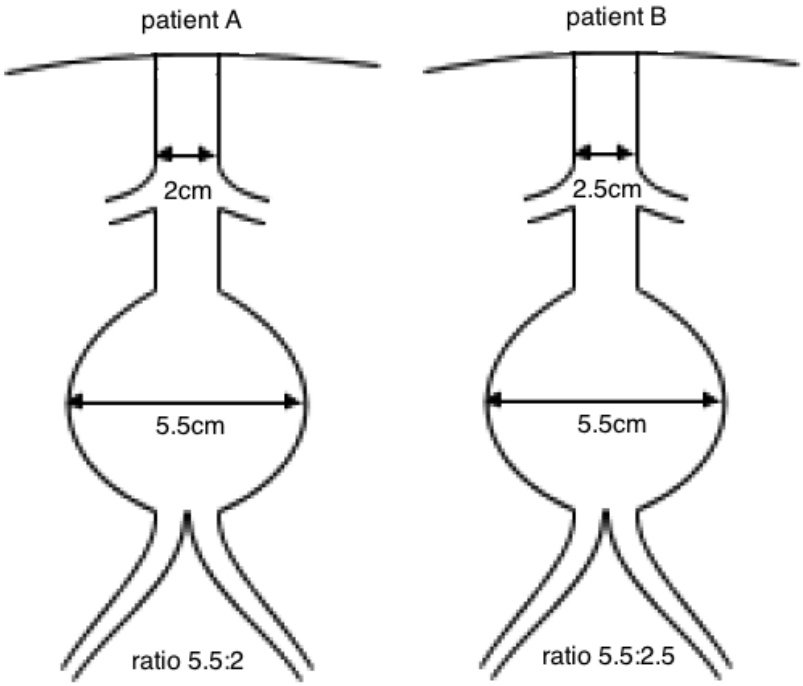

Figure 1. Aortas of different size with equally sized aneurysms. Aneurysm diameter to aortic diameter ratio shown.

Previous studies have considered the potential weakness in the current method of defining an aneurysm and it has been suggested that an aneurysm be defined as any dilatation, which is more than 1.5 times the size of the 'normal' aorta. This method in assessing AAAs has not been adopted by the trials that we base our current practice on. Current guidelines advising on the management of AAAs

continue to assess aneurysm diameter alone either in the risk assessment or in the monitoring phase of aneurysm treatment.

In using the more widely accepted definition of an aneurysm, i.e. the 3.0cm diameter criterion, it is tempting to speculate that for equally sized aneurysms in patients with different aortic diameters, a smaller patient with a smaller abdominal aorta may be at higher risk of aneurysm rupture than for a patient with a normal sized aorta. Examining this further using the law of Laplace, in the context of cardiovascular physiology, we can see that for any increase in vessel radius (r) a corresponding increase in wall tension (T) will result, provided that the intraluminal pressure (P) and wall thickness (w) remain unchanged.(35)

$$T=Pr/w$$

Applying the law of Laplace to our previous example of patient A and patient B, this would imply that patient A's aneurysm is under greater wall tension than patient B's. Studies have shown that AAA wall tension is a sensitive predictor of pending aneurysm rupture.

The current criteria for surgical intervention used for men in the UK follows a simple 5.5cm aneurysm diameter criterion for surgical intervention. There is no consideration given to normal aorta size or indeed, to the extent of aortic distention relative to the original aortic diameter. The purpose of this study is to investigate AAA patients' aortic diameters and to consider whether the current evidence for managing AAAs is valid for all.

RESULTS

The ethnic breakdown of the UK and Singapore cohorts can be seen below (Table 1), which shows the groups were closely matched for age.

Table 1. Patient Characteristics

	Inverness n (%)	Singapore n (%)
Number of patients	43	45
Male gender	43(100%)	41(91%)
Age years (mean ± SD)	73.8±5.0	74.4±7.4
Patient ethnicity		
Caucasian	43(100%)	1(2%)
Chinese	0	34(76%)
Malay	0	4(9%)
Indian	0	1(2%)
Other	0	5(11%)

AORTIC MEASUREMENTS

The following table gives a brief snapshot of the differences in diameters between Inverness and Singapore.

Aortic Diameters	Inverness Median	Singapore Median
Supra-renal aorta AP (mm)	28	26
Supra-renal aorta Lateral (mm)	29	25
Supra-renal aorta short axis (mm)	27	24

CONCLUSION

This study demonstrated that there is a statistically significant difference between Asian and European patients' aortic diameters. The findings show that Asian patients have smaller aortas. The implications of this may be that Asian patients' aneurysms may rupture earlier than Caucasians'. This brief report outlines a largely summarised version of the full report which will be submitted for publication in due course. This will include a full explanation of the methodology adopted and a detailed discussion of the results.