

SHORT REPORT

Ascending Aortic Diameter after Dissection Does Not Reflect Size before Dissection

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Introduction: Current guidelines for prophylactic resection of ascending aortic aneurysms are based on post-dissection aortic diameter. However, this may not reflect the diameter prior to dissection.

Report: Pre- and post-dissection aortic diameters were compared in 34 patients with available computerised tomography scans. The median time interval between these scans was 536 days (interquartile range 354 – 1237).

Discussion: There was a statistically significant difference in diameters from the sinotubular junction to the proximal abdominal aorta, the largest was in the ascending aorta with a mean of 7.6 mm (standard deviation 4.5). This suggests that the ascending aortic diameter is a poor predictor of dissection in most patients.

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INTRODUCTION

Acute ascending aortic dissection (AAD) is relatively uncommon, with a reported incidence of 2 – 3.5/100 000 per year,¹ but due to its high mortality much effort is made to prevent the disease. However, a satisfactory risk calculator is yet to be developed and decisions are mainly based on size.

Patients with enlarged ascending aortas (> 40 mm in diameter) are regularly seen in outpatient clinics, and referred for surgery once the aortic diameter exceeds 50 – 60 mm.¹ Although three small studies have demonstrated that aortic diameters may increase acutely after dissection,²⁻⁴ current guidelines for prophylactic resection rely on data derived from patients with AAD.^{1,5,6}

The aim of this study was to compare aortic diameters prior to dissection with post-dissection diameters in identified cases of AAD having computed tomography (CT) scans before and after dissection.

REPORT

CT scans of patients with AAD submitted to Odense University Hospital from 1 January 2009 to 1 March 2018 were reviewed. Patients who had also had a thoracic CT scan prior to the dissection were included.

The CT scans were analysed by one observer (Q.S.) using Siemens syngo.via[®] image analysis platform (Siemens Healthcare A/S, Erlangen, Germany).

Aortic diameter was measured at the sinotubular junction, where the left coronary artery originates; the tubular ascending aorta, the most dilated part of the tubular ascending aorta; the distal ascending aorta, proximal to the origin of the brachiocephalic trunk; the aortic arch, between the left common carotid and left subclavian arteries; the proximal descending aorta, the narrowest point of the proximal descending aorta; the distal descending aorta, at the transverse level of the tubular ascending aorta; and the proximal abdominal aorta, proximal to the origin of the coeliac trunk. Supra-aortic vessel diameters were measured at their point of origin. All measurements were internal and perpendicular to the long axis of the respective vessel.

Additionally, the pre-dissection diameter of the tubular ascending aorta was modelled for every patient using the pre-dissection scan, the time (in days) between the pre- and post-dissection scans and the “normal” mean aortic expansion. The mean annual aortic expansion was derived from as yet unpublished data from the DANCAVAS project,⁷ in which 615 patients underwent two consecutive CT scans of the tubular ascending aorta. This revealed a mean annual expansion of 0.16 mm/year.

Thus, the equation used was as follows: expected pre-AAD diameter (mm) = observed pre-AAD tubular ascending aortic diameter (mm) + (0.16 × days between scans/365 days).

Of 167 patients presenting with CT confirmed AAD, 34 had undergone thoracic CT scanning prior to dissection. Of

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Table 1. Comparison of pre-acute ascending dissection (AAD) diameters, with post-AAD diameters, according to anatomical location. Expected tubular ascending aortic diameter was derived by calculating the expected aortic diameter prior to dissection, taking into consideration the “normal” annual aortic growth, and time in days between the pre- and post-dissection scans.

Variable	Pre-dissection – mm	Post-dissection – mm	Difference between pre- and post-dissection scans – mm	p value
Sinotubular junction	42.2±6.8	49.7±10.1	7.5±6.7	<.01
Tubular ascending aorta	43.9±7.3	51.5±8.7	7.6±4.5	<.01
Expected tubular ascending aorta	44.3±7.3	51.5±8.7	7.3±4.6	<.01
Distal ascending aorta	39.4±5.5	42.0±5.7	2.9±4.2	<.01
Arch	30.1±4.2	31.4±3.8	1.4±2.6	<.01
Proximal descending aorta	27.5±3.7	29.6±3.7	2.1±2.9	<.01
Distal descending aorta	29.0±4.0	32.4±5.7	3.3±3.3	<.01
Proximal abdominal	27.1±3.8	29.3±4.4	2.2±3.0	<.01
Brachiocephalic trunk	14.9±2.6	16.7±3.0	1.9±1.9	<.01
Left common carotid artery	9.4±2.0	9.9±2.0	0.4±1.3	0.06
Left subclavian artery	12.4±2.7	12.8±2.4	0.3±1.6	0.27

Data are presented as mean (± standard deviation).

these, 27 also had paired abdominal CT scans. The median time interval between scans was 536 days (interquartile range [IQR] 354 – 1 237), median age was 69 years (IQR 65 – 75), 19 (56%) were males, 22 (65%) received medication for hypertension and 14 (41%) had aortic valve pathology.

Of the pre-AAD scans, thirteen were angiographically augmented, seventeen were augmented with intravenous

contrast, while four were not. Thirty of the post-AAD scans were angiographically augmented, three were augmented with intravenous contrast and one was not augmented. Eleven patients (32.3%) presented with dissections limited to the ascending aorta (DeBakey type II), while the rest had extended dissections (DeBakey type I).

There was a significant difference between unadjusted pre- and post-AAD diameters from the sinotubular junction to

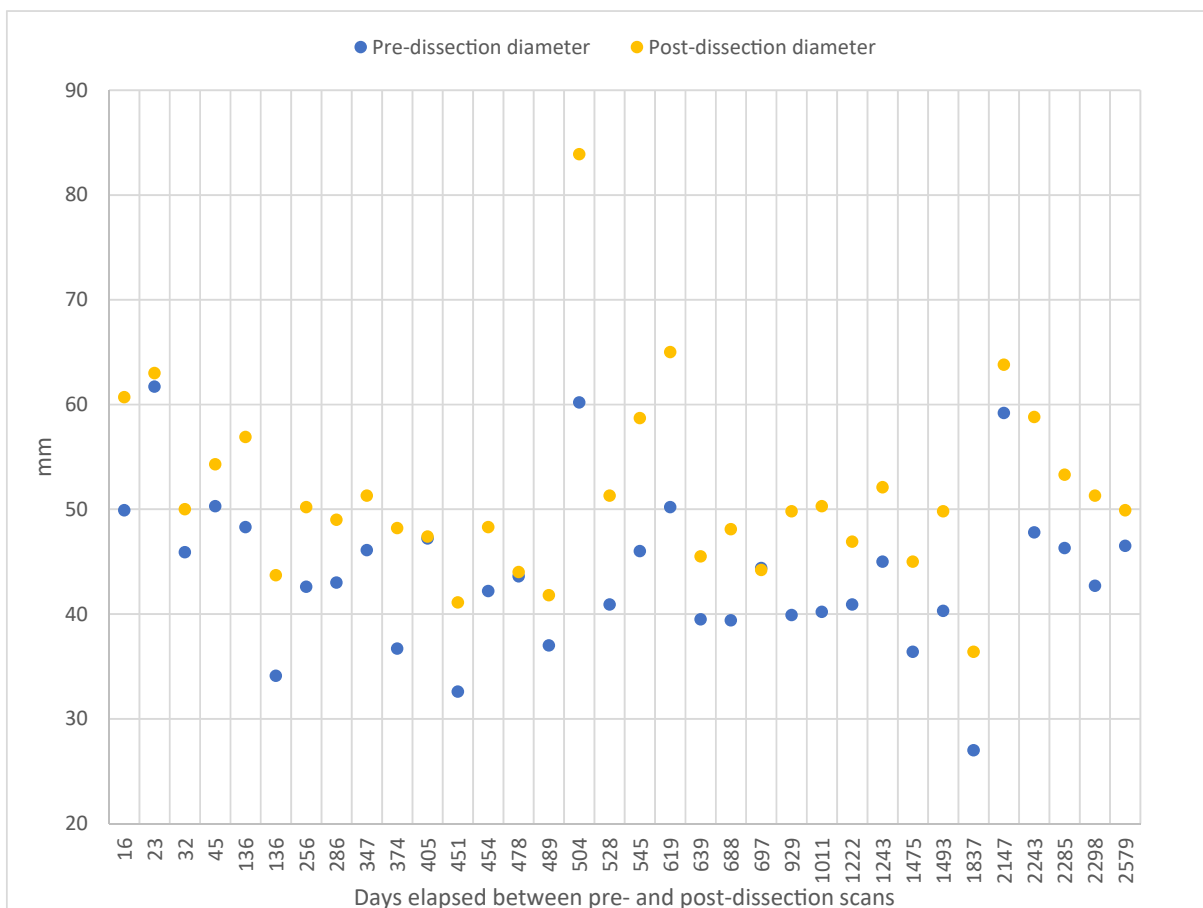


Figure 1. This figure shows tubular ascending aortic diameters in each individual case of the study sample. Illustrated are; pre- and post-ascending aortic dissection (AAD) diameter. The values of the x axis show the time elapsed between pre- and post-AAD scans in days for each individual patient. The markers overlap in three cases where the pre- and post-AAD diameter is almost identical.

the proximal abdominal aorta, as well as the brachiocephalic trunk (Table 1). The greatest mean difference was observed in the tubular ascending aorta, 7.6 mm (standard deviation [SD] 4.5). Using the adjusted pre-AAD diameter, the mean difference in the tubular ascending aorta was 7.3 mm (SD 4.6).

The degree of change in the tubular ascending aortic diameter ranged from 0 to 23.7 mm, as illustrated in Fig. 1. The small sample size hindered *ad hoc* statistical analysis to explain this range, and *ad hoc* review of the baseline data did not reveal any explaining patterns.

When adjusting for “normal” annual aortic expansion of the tubular ascending aorta, the calculated expected pre-AAD diameter was 44.3 mm (SD 7.3). Thus, the pre-AAD diameter was estimated to be below 60 mm in 91% of patients and below 50 mm in 85%. Additionally, the post-AAD diameter was estimated to be below 60 mm in 85% of patients and below 50 mm in 50%.

DISCUSSION

The main finding of this study is that the pre-dissection diameter of the ascending aorta was below the threshold value for prophylactic surgery in most included patients.

The largest expansion in diameter was found in the tubular ascending aorta. However, it must be kept in mind that one third of the patients did not dissect beyond this point. Although most patients had a change in tubular ascending diameter, a few had no or minimal change. In reviewing the data, no indicators of a possible explanation for the variation of expansion in diameter were found.

By reviewing the literature, three similar studies were found.^{2–4} Rylski *et al.*² included 27 patients with spontaneous AAD and 36 with retrograde type B dissections. Patients with pre-AAD scans older than two years were excluded. The largest increase was in the ascending aorta with a reported median difference of 12.8 mm. Mansour *et al.*⁴ included 29 patients with AAD. Annual growth, gender, and age were accounted for by multiple regressions. They report the largest increase in the ascending aorta, with a mean difference of 7.65 mm. Yamauchi *et al.*³ developed equations for estimating pre-AAD diameters based on 28 patients presenting with AAD. Patients with pre-AAD scans older than three years were excluded. They reported an increase in the middle ascending aorta from 40.6 mm to 47.0 mm, with an average increase of 15.8%. The range of aortic expansion following dissection was not uniform in these studies. Our results are in accordance with these studies.

This study is limited by its retrospective design causing risk of selection bias as only 34 of 167 had paired CT scans. Different scanning protocols cause a risk of information bias which may have skewed the results. An attempt to restrict further information bias was made by using only one observer. The risk of confounding is limited due to the paired design.

Although data are limited, these results suggest that the ascending aorta expands due to dissection, and accordingly that post-AAD diameters overestimate pre-AAD diameters

in most cases. This may suggest that the diameter of the ascending aorta is a poor predictor of AAD, and that maximum aortic diameter may play a less significant role as a trigger factor for dissection than previously expected.

CONFLICTS OF INTEREST

None.

FUNDING

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ETHICS STATEMENT

The project was approved by the Department of Patient Safety at the National Board of Health (3-3013-2124/1), and the data protection agency. In compliance with The Danish Code of Conduct, the data was securely stored in a RedCap database. There was no patient contact or intervention, consequently scientific ethical approval was not necessary.

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