

Bovine Aortic Arch – Not a Benign Variant

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Beating a Sudden Killer

When a young woman nearly died from a ruptured aneurysm, the author and the woman's husband began searching for ways to save other aneurysm patients from catastrophe

BY JOHN A. ELEFTERIADES

It was the first beautiful Saturday in spring, and I was in

charge of my children. We were out having the usual breakfast food game when the page came on from across the room, a prominent cardiologist and my colleague at Yale Hospital, was struggling. He usually is one of the most, if not the most, capable people I have known. "David, you, John, do the EKG. Right now, he's doing John. He's doing John to keep alive."

The situation was particularly alarming because today had been following the normal course for the three years, one year for David had come to work at Yale. In Canada, David was the number one in the field. He was 33 years old and had Marfan's syndrome, a connective tissue disorder that tends to produce dilation of the aorta. In my specialty, the upper part of the large artery that carries blood from the heart, down through the chest and into the abdomen. Life is saved, these aneurysms can grow without rupture, as long as they are treated. The only

intervention is a prophylactic operation to replace the damaged region with artificial components. For the surgery, the doctors and physicians had left in waiting that only used in some extremely serious cases. I suspect the team had been only partially prepared to deal with the recommended surgery.

Under the best of circumstances, I would not recommend emergency heart replacement of any other type. It requires a team of 15 or more and an extensive team of staff. In this case, David had slipped through a tear in the inner part of the arterial wall, causing the inner half of the wall to separate from the outer half, down the main length of the vessel. There was also a hole in the wall, because it is not as thick as it should be. The blood flow, cutting the heart and other organs, was not only very serious. Another was the heart of the body. The team indicated that David had had to be prepared, the fact that



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Aneurysms Largely Asymptomatic

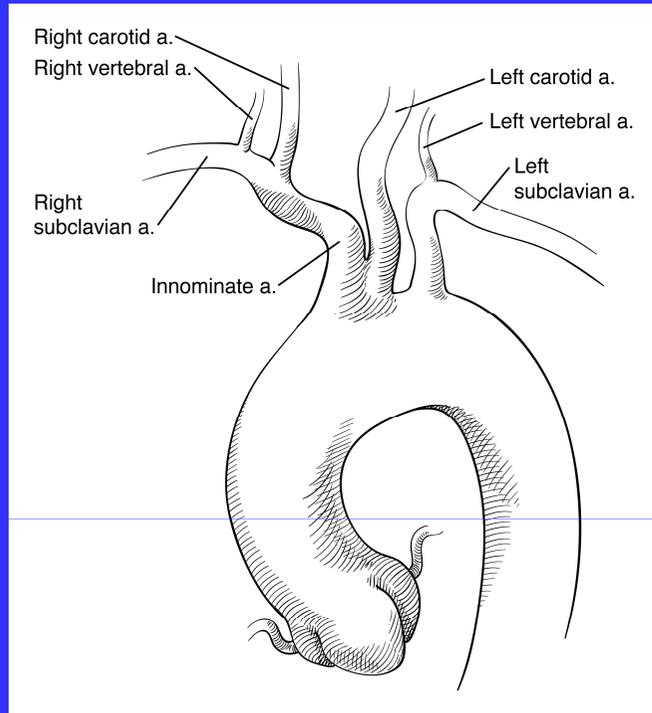
- Vast majority of patients with TAA (90-95%) have no sx until rupture/dissection occur.^{1,2}
- First symptom is usually death from rupture or dissection.
- Urgent need for screening tests.

1. Barrat-Boyes BG. Lancet 1957:716-720.

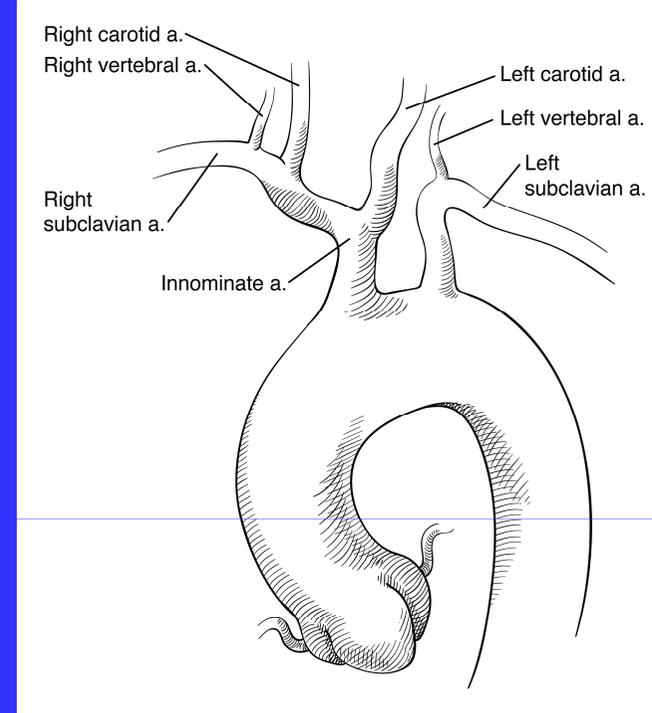
2. Elefteriades JA et al. Diseases of the Aorta. Hurst's The Heart. McGraw-Hill. New York. 2008.



“Bovine Arch” Anatomy



Common origin of innominate artery and left common carotid artery (most common)¹

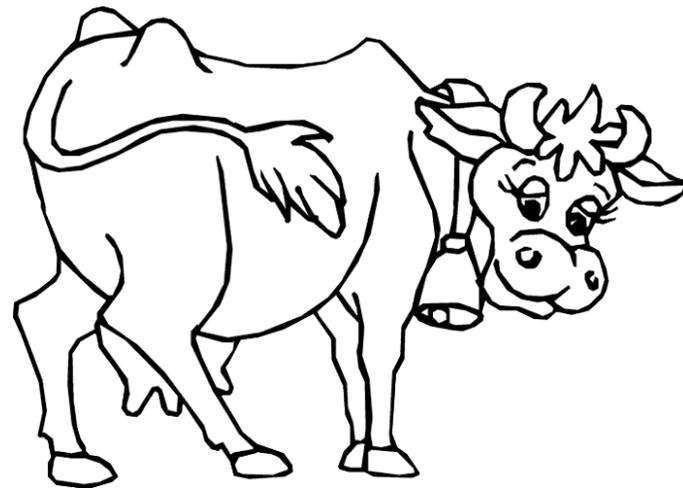
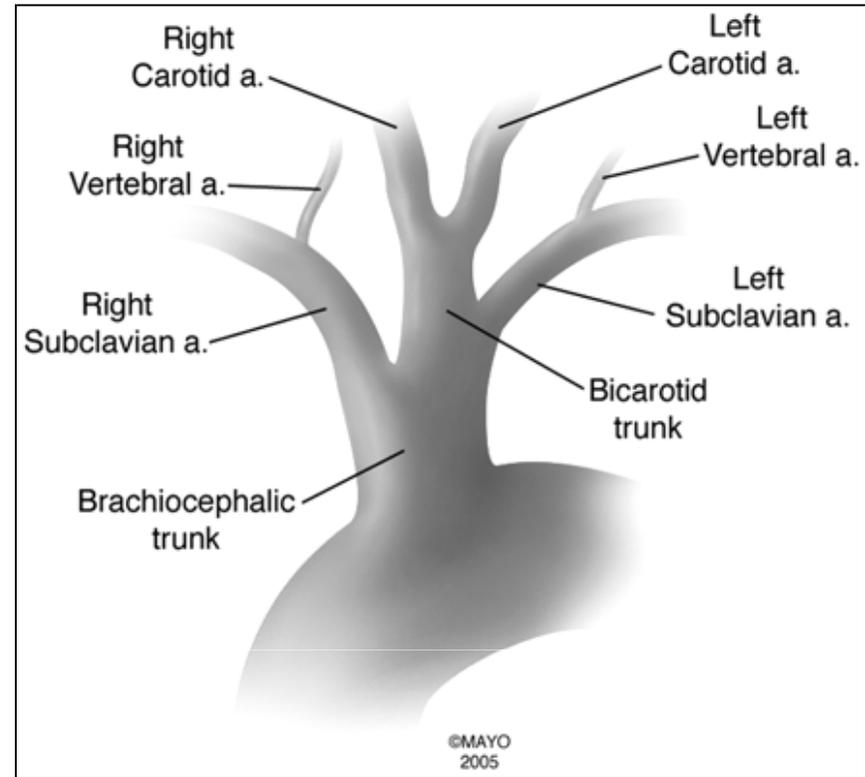


Left common carotid artery originates from innominate artery at distance from aorta (less common)¹

* Note that **bovine arch is a misnomer** – the cow’s aorta does not resemble either of these configurations.²

1. Lippert H, Pabst R. Arterial Variations in Man: Classification and Frequency. München: J.F. Bergmann Verlag, 1985.

2. Layton KF, Kallmes DF, Cloft HJ, Lindell EP, Cox VS. Bovine aortic arch variant in humans: clarification of a common misnomer. *AJNR Am J Neuroradiol* 2006;27:1541-1542.



Study Aims

- Bovine arch traditionally viewed as “normal,” clinically insignificant variant
- We have noted in OR that bovine arch is common in patients with thoracic aortic aneurysm (TAA)

We wish to better define any association between bovine arch and thoracic aortic disease

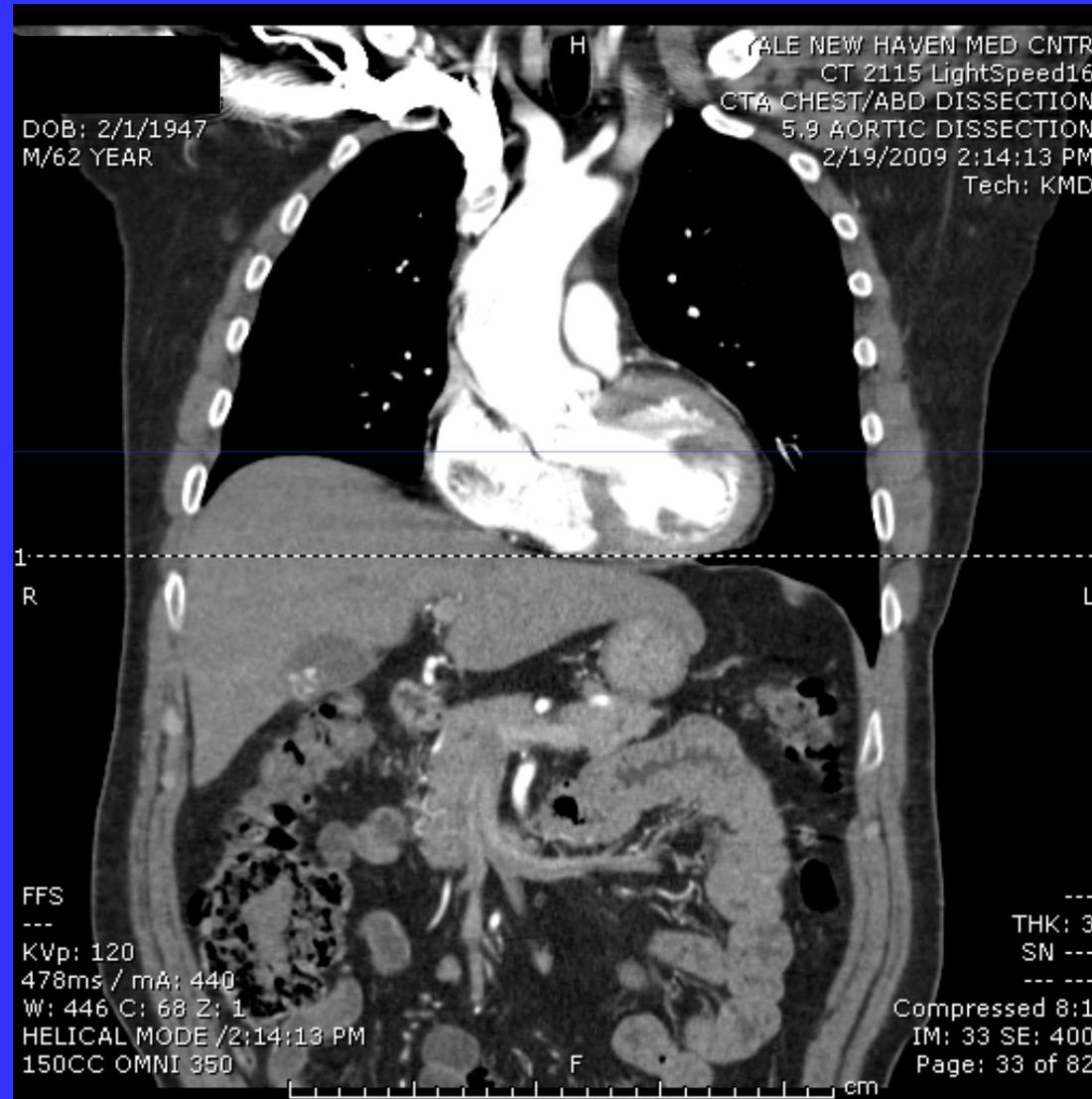
Patient Population

- Disease group: 383 pts w/ known TAA and thoracic CT or MRI scan on record
- Control group: 350 pts without aortic disease, randomly selected from all patients who underwent thoracic CT scan at YNHH

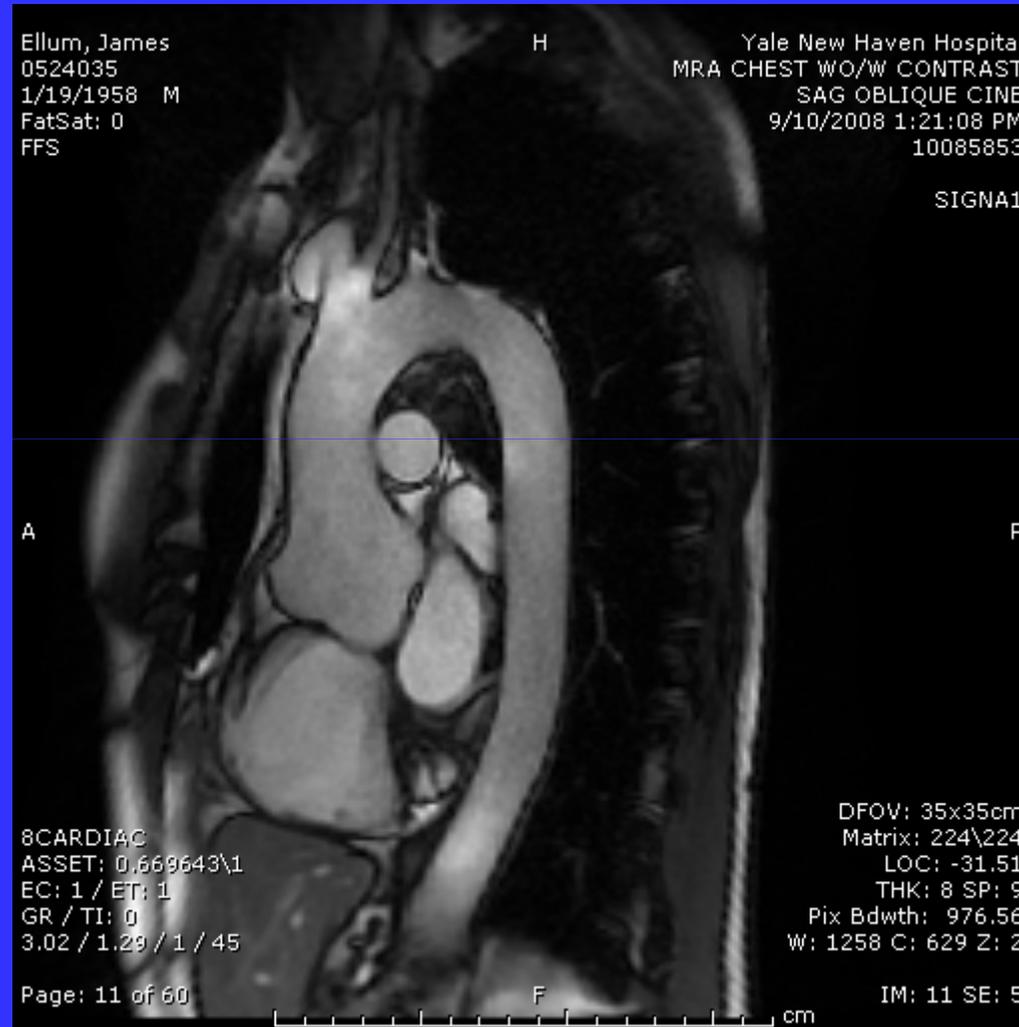
Methods

- Retrospective review of CT/MRI for presence of bovine arch
- Review of imaging reports for citation of bovine arch by original radiologist
- Disease group: asses
 - TAA diameter
 - presence of bicuspid aortic valve
 - clinical outcomes (dissection, rupture, repair)

Bovine Arch on Thoracic Imaging



Bovine Arch on Thoracic Imaging

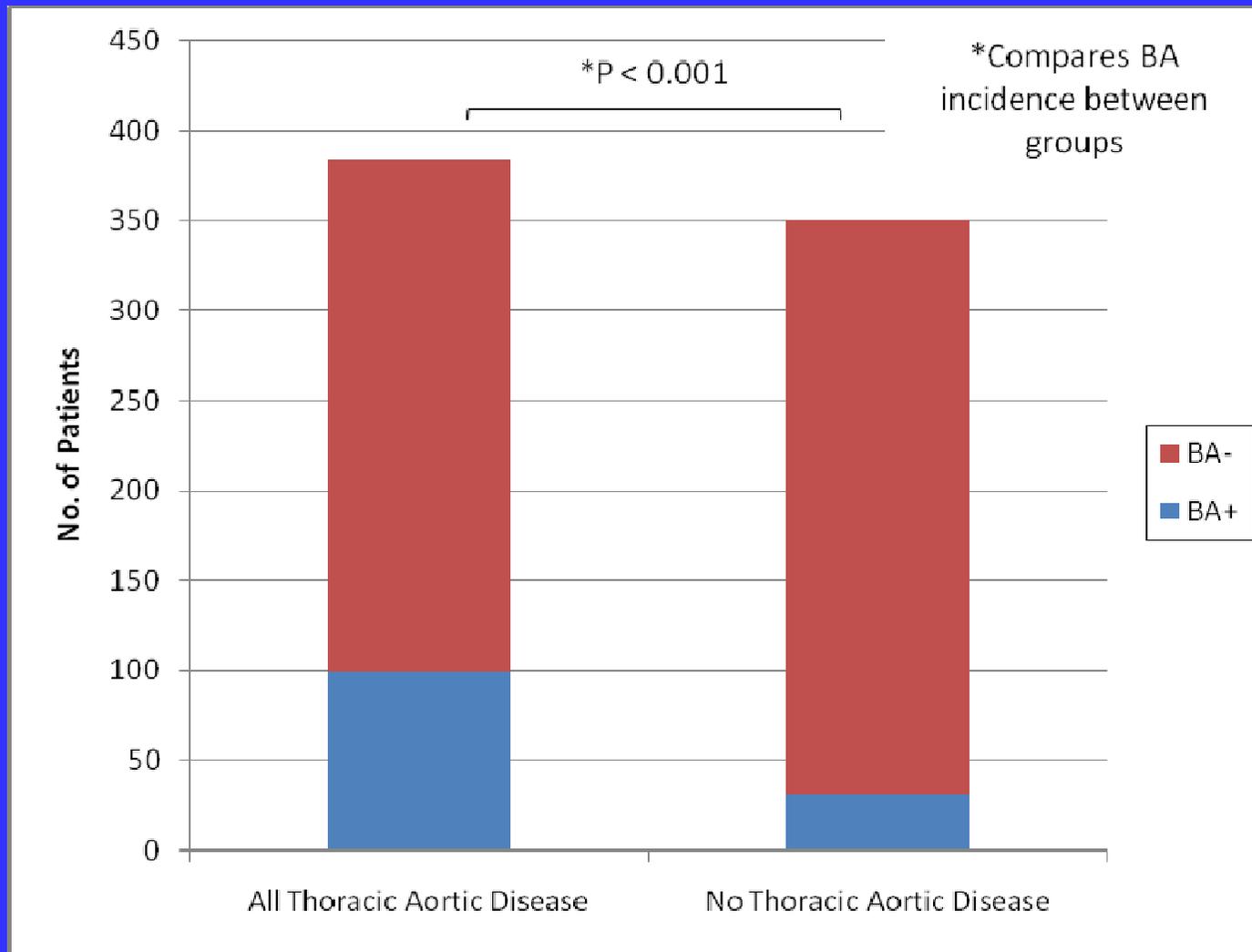


Results: Incidence of Bovine Arch

Variable	TA Disease Group	Control Group	P value
Total number	383	350	
Total BA+ (%)	99 (25.8%)	31 (8.9%)	<0.001

- Imaging reports (radiologists) cited bovine arch in only 11 of 99 (11%) of patients deemed BA+ by our group
- Incidence of bovine arch significantly greater in patients with thoracic aortic disease than in patients without disease

Incidence of BA in Thoracic Aortic Disease and Control Groups



Bovine Arch and TAA Growth Rate (cm/year)

Variable	All Yale patients ³	BA- (n=107)	BA+ (n=40)	P value (BA- vs. BA+)
All Thoracic Aortic Disease	0.10	0.10	0.30	0.02
Chronic Dissection	0.31	0.21	0.44	0.04
No Dissection	0.05	0.08	0.23	0.16
Ascending/Arch	0.09	0.08	0.19	0.27
Descending	0.12	0.15	0.50	0.01

- TAAs grow significantly faster in patients with bovine arch than in patients without bovine arch

3. Coady MA, Rizzo JA, Elefteriades JA. Developing surgical intervention criteria for thoracic aortic aneurysms. *Cardiol Clin* 1999;17:827-839.

BA not significantly associated with:

- Thoracic aortic dissection
- Location of thoracic aortic disease (ascending, arch, descending)
- Age at discovery of thoracic aortic disease
- Bicuspid aortic valve
- Gender

Conclusions

- 1) Radiology reports often overlook bovine arch.
- 2) Bovine aortic arch is significantly more common in patients with TAA than in the general population.
- 3) Aortas in bovine arch patients grow faster than general TAAs.
- 4) These observations argue strongly that bovine arch should not be considered a normal variant of aortic arch anatomy.

Recommendations

- 1) Radiologists must consistently look for and report bovine arch anatomy on thoracic scans.
- 2) Since “bovine arch” is a misnomer, we propose the name “common origin aortic arch” to describe this group of anatomic variants.
- 3) Patients with bovine arch should be followed for TAA.



Bovine arch anatomy on a routine CT scan can help us identify hidden patients with TAA.

