

The bovine arch case series: A novel finding

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ABSTRACT

The “Bovine arch” (BA) defines anatomical variants in which the left common carotid and innominate artery share a common origin. While the definition and terminology are debated, there is no consensus regarding the

anatomy as a marker of pathology or normal variant. The reported association of the BA with thoracic aortopathy and a rapidly expanding aorta may carry clinical significance. If consistently validated, this could potentially alter management guidelines regarding the timing of repair and surveillance of thoracic aortic aneurysms in BA patients. The study sought to identify if the BA was associated with proximal thoracic aortopathy.

Key Words: *Bovine arch; Aortopathy; Aneurysmal; Thoracic aneurysm.*

INTRODUCTION

The “Bovine arch” (BA) defines anatomical variants in which the left common carotid and innominate artery share a common origin. While the definition and terminology are debated, there is no consensus regarding the anatomy as a marker of pathology or normal variant. The reported association of the BA with thoracic aortopathy and a rapidly expanding aorta may carry clinical significance. If consistently validated, this could potentially alter management guidelines regarding the timing of repair and surveillance of thoracic aortic aneurysms in BA patients. The study sought to identify if the BA was associated with proximal thoracic aortopathy

CASE SERIES

This was a single center retrospective study of BA patients abstracted from a radiology registry over a two-year period. Demographics and imaging modality were recorded. Measurements of the proximal aorta were taken at the sinuses of valsalva, ascending aorta and mid arch. The frequency of aortopathy between male and female patients was compared. Aortopathy was defined as either ectasia or aneurysmal disease. Ectasia was defined as a diameter greater than 4 cm at sinuses of valsalva or an ascending aorta greater than 3 cm. Aneurysmal disease was defined by a diameter greater than 5 cm at the sinuses of valsalva or an ascending aorta greater than 4 cm.

RESULTS

309 patients with a common origin of the left common carotid and innominate artery were identified. Median age was 56 years, 169 (54.7%) were female and 140 (45.3%) male. Diagnosis was based on CTA head and neck, CTA chest and CT chest in 205 (66.3%), 59 (19.1%) and 47 (15.2%) patients respectively. The term BA was used in nineteen (6.1%) patients only.

Forty-four (14%) patients had aortopathy. In this subgroup, twenty-seven (61.3%) were female and seventeen (38.6%) male.

Of those with aortopathy, sixteen (36.3%) patients had aneurysmal disease with 62.5% being male. Males with aortopathy were twice likely to have aneurysmal disease as compared to females ($p = 0.02$). The median age of male patients with aneurysmal disease was 54 years and 51.2 years for the females

DISCUSSION

The term “bovine arch” (BA) defines arch variants in which the left common carotid and innominate artery share a common origin. Terminology and clinical significance of the BA has been debated. The reported association of the BA with thoracic aortopathy and a rapidly expanding aorta may carry clinical significance [1,2]. If consistently validated in large population studies, this may alter management guidelines regarding the timing of repair and

surveillance of thoracic aortic aneurysms in BA patients.

Currently, elective repair is recommended in asymptomatic patients when the ascending aortic aneurysm is > 5.5 cm, > 6.0 cm for the descending thoracic aorta, or when the rate of dilatation is > 0.5 cm/year. In patients with Marfan and Loays-Dietz syndromes, repair is done with smaller diameters (4.0 – 5.0 cm for the ascending aorta and 5.5-6.0 cm for the descending aorta). These recommendations are based on the known natural progression of thoracic aneurysmal disease, but do not consider the presence of a BA. In some studies, the BA was associated with an aortic mean growth rate of 0.29 cm/year as compared to 0.09 cm/year in controls [1,3]. If the progression of thoracic aneurysms in BA patients is thus accelerated, then management recommendations may need to be defined.

Hornick et al. correlated the BA with thoracic aortic aneurysmal disease and a rapidly expanding aorta. This was after a retrospective of CT and/or MRI scans of patients with thoracic aortic disease. In other retrospective studies, a statistically significant association between the BA and dilated aortas was seen in patients older than 70 years old or when dilatation involved the arch [4]. In this study, CT and MRI images of patients with a dilated thoracic aorta were compared with consecutive, unselected patients as controls.

In our series, the BA was twice observed in female patients. However, aneurysmal disease was twice more likely in male patients in a statistically significant manner. The median age of these patients was 54 years. The reported aortic mean growth rate of 0.29 cm/year and the relatively young age of this BA population may warrant defining surveillance guidelines specific to the BA. In order to further validate the mean aortic expansion rate, male and female with BA anatomy and similar aortic dimensions can potentially be enrolled in a surveillance study and comparisons drawn.

Mylonas et al. identified the BA as an independent predictor of mortality in patients with type B aortic dissection [5]. Further studies are needed to validate this finding. In another study, the BA was an independent predictor for stroke in patients with Stanford type A acute dissections [6]. This may be explained by the proximity of the left common carotid artery to the primary entry of the dissection tear in BA [7].

Interestingly, recent pediatric studies have found an association between BA and recoarctation rates after an extended end-to-end anastomosis via left thoracotomy [8]. This finding may influence future surgical approach to coarctation in children with the BA.

Regarding the terminology, it is well known that the term BA is a misnomer [9]. This anatomical variant is seen in canines, felines and macaque monkeys but not in cattle or buffalo [10]. Consequently, some have suggested a complete eradication of this terminology in favor of a descriptive one [11].

Others have sought to call this anomaly simian arch instead of bovine arch

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[12]. This may cause further confusion in medical literature and radiology reports. In our series, use of the term BA by radiologists did not cause any confusion. In fact, the term consistently identified common origin of the left common carotid and innominate artery. Though a misnomer, the BA terminology is appropriate and instinctively identifies the anomaly.

In our series, the bovine arch was slightly more common in females than males. Male patients with aortopathy were twice likely to have aneurysmal disease compared to their female counterparts. This novel finding needs further validation in larger population studies. If consistently proven, this could potentially alter management guidelines regarding the timing of repair and surveillance of ascending thoracic aneurysm in this relatively young bovine arch population.

CONCLUSION

In our series, the bovine arch was slightly more common in females than males. BA anatomy with concurrent proximal aortopathy was observed twice as frequently in female patients. However, male patients with aortopathy were twice likely to have aneurysmal disease than their female counterparts. If this novel finding is consistently validated in larger population studies, surveillance and timing of intervention in this relatively young bovine arch population may be altered.

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DISCLOSURES

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