Prevalence of Bovine Aortic Arch Configuration in Adult Patients with and without Thoracic Aortic Pathology

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Background: Bovine aortic arch (BA) occurs in approximately 15−35% of the US population and is regarded as a clinically insignificant, normal variant. The aim of this study was to assess the prevalence of types I (type I bovine arch [T1BA], common origin of innominate and/or left common carotid artery) and II (type II bovine arch [T2BA], left common carotid originating from innominate) bovine arch in patients with and without thoracic aortic pathology.

Methods: We retrospectively reviewed all serial computed tomography images ($n = 817$) performed at our institution over 4 months to determine the overall prevalence of BA. Thoracic aorta and/or arch vessels were visualized, with images read by certified radiologists. A separate analysis compared a series of 156 consecutive patients with thoracic pathology (dissection or aneurysm $\geq$ 4.0 cm), from a 25-month period, with 757 control patients without pathology from the original sample. Statistical analysis included a chi-squared contingency table.

Results: Analysis revealed a bovine arch prevalence of 31.1% ($n = 254$), including 14.9% T1BA and 16.2% T2BA. Patients with thoracic aortopathy ($n = 156$) had aortic dissection ($n = 26$) or aneurysm ($n = 130$). These patients were older and had an increased prevalence of hypertension, hyperlipidemia, and aortic calcification. In addition, there was increased prevalence of T2BA in the pathology group (23.7%) compared with controls (15.9%; $P = 0.03$). T1BA was not significantly different between groups (11.5% vs. 14.9%; $P = 0.59$). When thoracic disease was stratified by pathology type, T2BA occurred more frequently in patients with thoracic aortic aneurysm (24.6% vs. 15.9%; $P = 0.04$). BA trended upward, in patients with thoracic aortic dissection (42.3% vs. 30.8%; $P = 0.28$).

Conclusions: Our analyses revealed a prevalence of bovine arch of 31% in our patient population. BA occurred more frequently in patients with thoracic aortopathy than controls. Therefore, patients with BA may be associated with higher levels of thoracic aortic pathology and may benefit from increased clinical vigilance.

Presented at the 25th Annual Vascular and Endovascular Surgery Society Meeting Vail, CO, January 29−February 1, 2015.

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Ann Vasc Surg 2016; 30: 132–137
http://dx.doi.org/10.1016/j.avsg.2015.05.008

Manuscript received: March 6, 2015; manuscript accepted: May 5, 2015; published online: July 10, 2015.

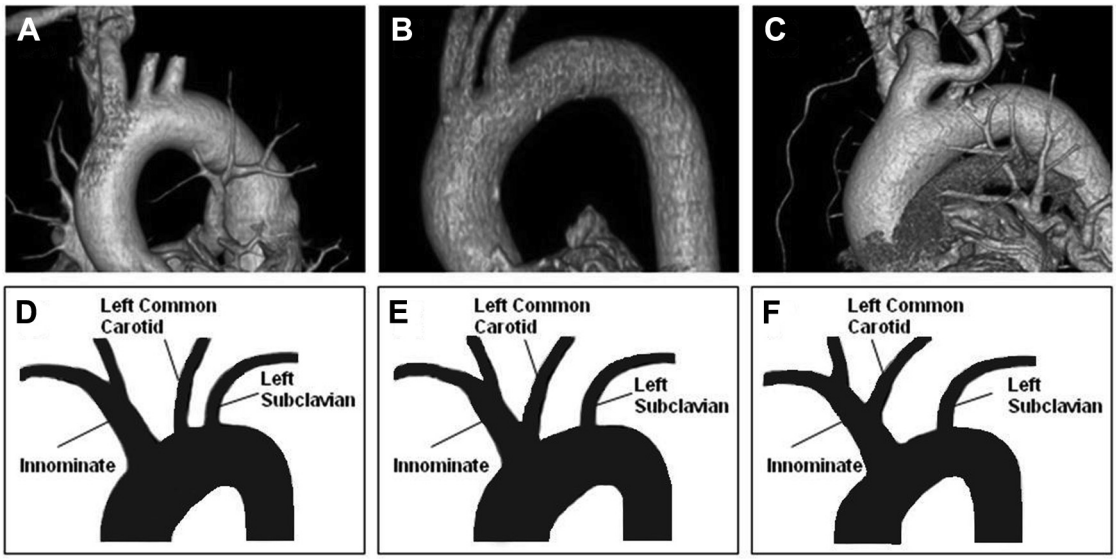

Fig. 1. Angiographic (**A**–**C**) and pictorial (**D**–**F**) images of aortic arch configurations. Standard arch configuration (**A, D**) depicting separate origin of the innominate, left common carotid, and left subclavian arteries. T1BA (**B, E**) depicting a common origin of the innominate and left common carotid arteries at the level of the aortic arch. T2BA (**C, F**) in which the left common carotid artery originates directly from the innominate artery at an average distance of <1 cm and not greater than 2.5 cm from the aorta.

INTRODUCTION

The standard and most common aortic arch branching pattern contains separate origins of the 3 great vessels, the innominate, left common carotid, and left subclavian arteries. The term bovine aortic arch (BA) refers to a group of known congenital variants of human aortic arch vessels, in which there is aberrant origin of the left common carotid artery (Fig. 1). The most common of these variants, a type I bovine arch (T1BA), has a common origin of the innominate and left common carotid arteries at the level of the aortic arch. A type II bovine arch (T2BA) in which the left common carotid artery originates directly from the innominate artery at an average distance of <1 cm and not greater than 2.5 cm from the aorta is slightly less common.[1] The prevalence of bovine arches seen on imaging has been reported to range from 15% to 35% of the US population.[1–4] Bovine arches are more prevalent in the African American population than among Caucasians.[1,4] Other arch vessel branching patterns exist, however, bovine arches are far more common, comprising 97% of anatomic variation observed.[5]

Bovine arch is traditionally viewed as a ''normal'', clinically benign variant[6]; however, a higher incidence of neurologic events has been reported during endovascular procedures in these patients.[7] This may require alteration in the approach or technique during cerebrovascular procedures.[8–10] At this institution, anecdotal observation of a number of patients with acute aortic dissection and aneurysm in the setting of BA was the impetus for this study. There have been recent case reports and small studies suggesting a possible association between thoracic aortic pathologies (i.e., aneurysms and dissections) and bovine arch configuration[6,11,12]; however, none of these studies have examined disease prevalence among the subtypes of bovine arch.

The purpose of this study was to evaluate the prevalence of bovine arch subtypes and characterize their association with thoracic aortopathy. We hypothesized that there is an association between nonstandard arch configuration and thoracic aortic pathology.

METHODS

Study Design

We retrospectively reviewed computed tomography (CT) images of the chest performed at a single tertiary institution. Included images visualized the complete thoracic aorta (TAA) and branching arch vessels. CT reports were generated by board-certified radiologists. Indications for imaging included assessment for thoracic aortic disease, trauma, postoperative complication, pulmonary embolism, pulmonary infection, malignancy, and others. Patients with congenital heart defects, such as bicuspid aortic valve, or connective tissue