

Bovine Aortic Arch Shortens Available Clamping Distance for Extended End-to-End Repair of Infant Coarctation of the Aorta

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Background:

Bovine aortic arch is an anatomical variant in which the innominate and left common carotid arteries share a common origin. It is generally considered to be benign. The current literature estimates its prevalence may be as high as 30%. Coarctation of the aorta is a congenital heart defect characterized by narrowing of the aortic arch, usually near the insertion of the ductus arteriosus. Untreated coarctation of the aorta can lead to hypertension, poor perfusion of the lower extremities, and left ventricular hypertrophy and failure. Resection with extended end-to-end anastomosis from a left thoracotomy remains the standard of care in the absence of arch hypoplasia. Extended end-to-end anastomosis requires the placement of a proximal clamp just distal to the innominate artery and a distal clamp on the descending aorta. The distance between the proximal clamp and the coarctation represents the amount of vessel the surgeon has available for reconstructing the aorta with this technique. The goal of this study is to determine if bovine aortic arch anatomy affects the clamping distance.

Methods:

34 chest CTAs and 15 chest CTs performed at the University of Iowa Stead Family Children's Hospital between 2012 and 2017 were obtained. Only scans from patients <1 year of age were included (mean age=41 days, 29% female, 37% bovine arch). Scans from patients with a history of previous aortic surgery (including aortoplexy), aberrant subclavian, right-sided aortic arch, double outlet right ventricle, hypoplastic left heart syndrome, D-TGA, truncus arteriosus, scoliosis, and Marfan syndrome were excluded. Scans were uploaded into CareStream software and a multiplanar reconstruction was performed. The distance between the distal edge of the innominate artery (or bovine trunk, in bovine arch patients) and the proximal edge of the left subclavian artery was measured. This measurement is denoted as the clamping distance (CD). The distance between the distal edge of the innominate artery/bovine trunk and the middle of the left subclavian artery was also measured as an alternate clamping distance (CD2). Clamping distances were standardized to the patient's weight at the time of scan to give a clamping index (CI).

Results:

The clamping index in bovine arch patients was significantly smaller than in normal arch patients. This held true when clamping index was calculated with both CD and CD2 measurements. The average clamping index in normal arch patients using CD measurements was 1.54 mm while the average in bovine patients was 0.77 mm ($p < 0.05$). The average clamping index in normal arch patients using CD2 measurements was 1.93 cm while the average in bovine patients was 1.16 cm ($p < 0.05$).

Discussion:

Bovine aortic arch, where the innominate and left common carotid arteries share a common origin, is usually considered to be a clinically insignificant variant. However, this study suggests that the clamping distance for extended end-to-end anastomosis in aortic coarctation repair is significantly smaller in patients with bovine arches than in patients with normal arches. Since shorter clamping distances decrease the length of vessel available for this repair, the outcome may be poorer in patients with concomitant bovine arch and coarctation of the aorta.