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Bovine aortic arch variant T2BA: a novel association with cardiovascular pathologies and fetal structural abnormalities

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Objective

Bovine Aortic Arch (BAA) is defined when left carotid artery (LCA) arises directly from brachio-cephalic artery (BCA) instead of the aortic wall. According to recent anatomopathological classification in Type 1 BAA the origin of LCA and BCT from aortic wall arch is common; in Type 2 BAA the connection of LCA with BCA is distant from its origin from the aortic arch. We evaluate the incidence of fetal Bovine aortic arch Type 2 in a low risk population and its association with cardiac or other structural fetal anomalies and aneuploidies.

Methods

The study group consisted in 635 low risk singleton or twin fetuses in which fetal cardiac scan included 4 chamber, long axis, three vessels view and sagittal plane for aortic arch obtained for all the pregnancies in both first (12-14 weeks), second (19-24 weeks) and third trimester (32-34 weeks). Directional high definition power Doppler has been used in order to identify the origin and course of brachio-cephalic artery (BCA), left carotid (LCA) and subclavian artery (LSA). Prenatal Type 2 BAA diagnosis consisted in the origin of LCA directly from BCA at least 2 mm off the connection of BCA with aortic arch in the second trimester scan. When LCA and BCA shared the same connection with aortic arch (common or adjacent) BAA Type 1 was defined.

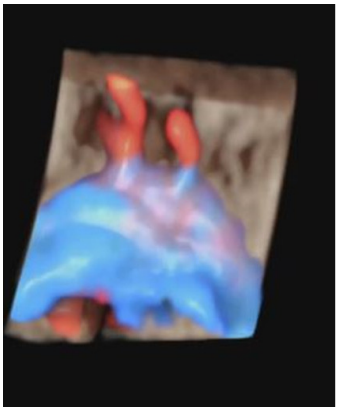
Results

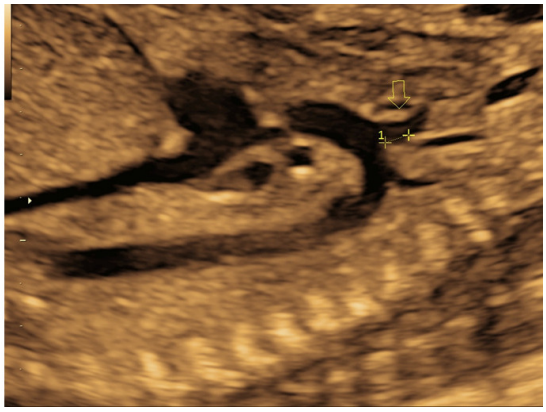
13 cases of T2-BAA have been identified in our study population (Incidence 13/635 2, 0%). Average time of diagnosis 23, 7 weeks with no cases diagnosed in first trimester scan (early pregnancy detection rate of supra aortic vessels 21%, 133/635). The overall rate of fetal major anomalies in the study group has been 5, 6% (36/635) and among them T2-BAA was found in 5 fetuses (5/36 13, 8%). Second trimester soft markers of aneuploidies were present in 5/13 fetuses with T2-BAA (38, 4%) but karyotype was normal in 9/13 fetuses with available chromosomal analysis. The rate of overall fetal structural anomalies in T2-BAA group was 53, 8% (7/13); major anomalies in 5/13 (38, 4%, SE: 13, 8%, SP: 98, 6%, VPP: 38, 4%, VPN: 95%); minor anomalies in 2/13 (15, 3%). Major anomalies: Ventricular septal defect muscular type; double Inlet left ventricle with pulmonary atresia and great arteries transposition (D-TGA), unilateral foot oligodactyly/syndactyly with mesomelic lower limbs dysplasia; aberrant right subclavian artery; intrahepatic umbilical vein varix. Minor anomalies: bilateral nasal bone agenesis; hyperechoic bowel with peritoneal calcifications. Cardiovascular anomalies were associated in 4/13 (30, 7%) fetuses with T2-BAA. Neonatal outcome was abnormal and required surgery or neonatal follow-up and therapy in 4/13 T2-BAA fetuses (30, 7%).

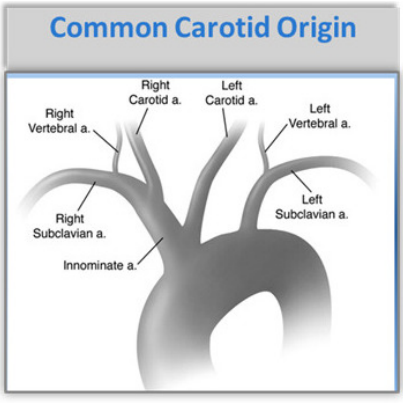
Conclusion

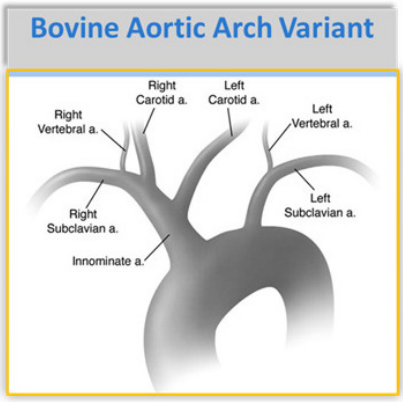
BAA is a common anatomic variant with an incidence in the overall population of 13% (black race: 25%, caucasian: 8%) for the Type 1 and of 9% (black race: 10%, caucasian: 5%) for the Type 2. (Bovine Aortic Arch Variant in Humans: Clarification of a Common Misnomer. K. F. Layton; American Journal of Neuroradiology August 2006, 27 (7) 1541-1542) Recent cardiovascular studies in literature report the prevalence of bovine aortic arch configuration T2-BAA in adult patients with thoracic aortic pathology (23. 7%) compared with controls (15. 9%; P = 0. 03); T2-BAA occurred more frequently in patients with thoracic aortic aneurysm (24. 6% vs. 15. 9%; P = 0. 04) and with thoracic aortic dissection (42. 3% vs. 30. 8%; P = 0. 28)(Moorehead PA. Ann Vasc Surg. 2016 Jan 30: 132-7). Other neonatal case reports identified association of BAA with supravalvular aortic stenosis (Idhrees M, Indian Heart J. 2016 Sep; 68 Suppl 2: S83-S84), double inlet left ventricle with pulmonary atresia (Alghamdi MH, Congenit Heart Dis. 2009 Jul-Aug;4(4): 295-7) and with skeletal Klippel-Feil syndrome and Sprengel deformity combined with an intraspinal course of the left subclavian artery (Floemer F, AJNR Am J Neuroradiol. 2008 Feb;29(2): 306-7) In our study T2 BAA variant showed an increased association with

major anomalies in the study group (38, 4%) and 30, 4% of T2-BAA fetuses had major cardiovascular anomalies. No association with aneuploidies was found but larger studies are necessary for detecting correlations with microdeletions or mutations with the introduction of new genetic techniques (array CGH, SNP-array). Para-sagittal scan for the aortic arch represents an useful plane for the study of supra-aortic vessels course and morphology and could identify a sub-group of fetuses at increased risk of general and cardiovascular anomalies. Prenatal diagnosis of Bovine Aortic Arch variants could furthermore select a group of patients at increased risk of surgical complication and neurological events in case of adult carotid catheterization procedures (G. L. Faggioli. European Journal of Vascular and Endovascular Surgery; Volume 33, Issue 4, April 2007, 436–441).









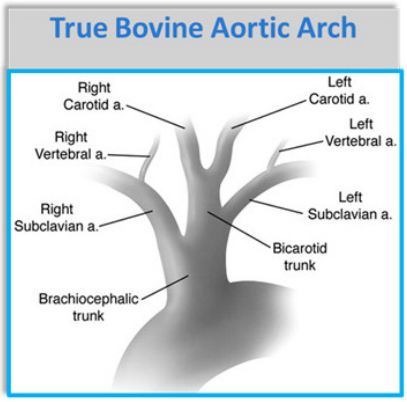


Table: Characteristics of cases.

Case no	Age	Diagnosis (w)	Karyotype	Anomalies	Delivery (GA)	Weight (g)	Outcome
1	42	24	46 XX CVS	NB agenesis	38	3800	normal
2	35	34		None	41	2900	normal
3	29	25	46 XX amnio	Hyperechoic Bowel G2	38	3000	normal
4	38	18	NIPT 21/18/13 norm	None	41	3740	normal
5	34	21	46 XX amnio	Muscular VSD	39	3050	Cardiological Follow-up
6	37	22	46 XX amnio	None	41	3750	normal
7	34	24	46 XX amnio	Umbelical Vein Varix	36	2450	CTG anomalies/Anemia
8	30	16	NIPT 21/18/13 norm	None	37	2850	normal
9	38	25		None	39	2500	normal
10	38	23		None	38	2700	normal
11	23	24	46 XY amnio	ARSA	41	4050	normal
12	32	32		Oligodactyly. Mesomelic Dysplasia Lower Limbs	39	2930	Orthopedic Surgery
13	42	21	46 XY amnio	Double Inlet LV+ PA+ TGA	37	2800	Cardiac Surgery
TOTAL	34.9	23.8	9/13 Normal	5 Major Anomalies	38.8	3117	4/13 Abnormal