Radiology Case Reports 19 (2024) 661–664

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Case Report

# Prenatal sonographic findings of prominent fetal tricuspid annulus: A case report ☆

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ARTICLE INFO

*Article history:*
Received 30 September 2023
Revised 25 October 2023
Accepted 29 October 2023
Available online 25 November 2023

*Keywords:*
Prenatal sonography
Tricuspid annulus
Tricuspid valve

ABSTRACT

The tricuspid valve positioned between the right atrium and right ventricle is composed of 3 leaflets (anterior, posterior, and septal) anchored by a collagenous fibrous annulus, a saddle-shaped, oval structure, providing a firm yet dynamic structural support for the tricuspid valve. The annulus is considered to separate between the right atrium and right ventricle. Structural anomalies of the fetal tricuspid valve are rare and include Ebstein's anomaly, tricuspid atresia, partial absence, unguarded tricuspid orifice (absent leaflets) cleft, double orifice, bicuspid valve and Uhl anomaly (absence of the right ventricular myocardium with an apposing endocardium and epicardium). We present an unusual case in which a prominent peripheral circular structure was noted above the periphery of the fetal tricuspid valve at 31 weeks' gestation. Inflow across the tricuspid valve was unimpaired, with no tricuspid regurgitation. The right atrium appeared normal with a normal functioning foramen ovale, and the entire fetal cardiac anatomy and function were normal with no signs of congestive cardiac failure or fetal hydrops. The prominent non-obstructing circular structure in immediate proximity to the tricuspid valve leaflets was considered to represent a prominent tricuspid annulus. An appropriate for gestational age fetus was delivered at term and neonatal echocardiography was normal. This case emphasizes that normal variations in fetal anatomical structures should always be considered and specifically that unimpaired inflow across the tricuspid valve in diastole is key upon encountering an unusually prominent fetal tricuspid annulus, which may be noted at a considerable distance above the tricuspid leaflets within the right atrium.



☆ Competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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https://doi.org/10.1016/j.radcr.2023.10.079

## Introduction

The tricuspid valve, positioned between the right atrium and right ventricle is composed of 3 leaflets anchored by the tricuspid annulus a collagenous-fibrous, saddle-shaped, oval structure, which provides a firm yet dynamic structural support for the valve [1–3]. Dilatation and flattening of the tricuspid annulus compromises tricuspid valve coaptation, and may be associated with tricuspid regurgitation [4,5]. Overall, congenital structural anomalies of the fetal tricuspid valve are rare, and include Ebstein's anomaly, tricuspid atresia, partial absence, unguarded tricuspid orifice (absent leaflets) cleft, double orifice, bicuspid valve, and Uhl anomaly (absence of the right ventricular myocardium with an apposing endocardium and epicardium) [6–15]. We present an unusual case in which a prominent circular structure was noted in immediate proximity to, and slightly above the periphery of the fetal tricuspid valve at 31 weeks' gestation. The prominent non-obstructing circular structure in immediate proximity to the tricuspid valve leaflets was considered to represent a prominent tricuspid annulus. An appropriate for gestational age (AGA), vigorous neonate was delivered at term, and neonatal echocardiography was normal.

## Case report

A 29-year-old G4P1021 presented for prenatal care as a late registrant at 31 weeks' and 2 days gestation. Her previous pregnancy was uneventful with spontaneous vaginal birth of an appropriate for gestational age (AGA) neonate weighing 3033 grams, at 40 weeks' gestation.

Sonographic evaluation revealed a vertex-presenting AGA fetus with a normal biophysical profile (BPP), umbilical artery S/D, unilateral (left) hydronephrosis, and normal cardiac structure. Overall fetal anatomy was normal other than the above-mentioned marked unilateral left hydronephrosis. The contralateral right kidney, bladder, and amniotic fluid volume were normal. The fetal cardiac structure appeared normal including the 4-chamber view (Fig. 1) and right and left cardiac outflow tracts. Within the right atrium, slightly above the tricuspid valve, a prominent thickened membrane was noted around the peripheral circumference of the tricuspid valve (Figs. 2–4). Although initially a structural cardiac anomaly in particular of the tricuspid valve was considered, inflow to the right ventricle was unimpaired, and no tricuspid regurgitation was noted. No signs of congestive cardiac failure, or fetal hydrops were noted and the valve appeared intact, with normal function. Given the position of this structure in immediate proximity above the tricuspid valve, pediatric cardiology was consulted and Pediatric fetal echocardiography confirmed the presence of the annular structure in immediate proximity to the completely normal appearing and functioning tricuspid valve. According to pediatric cardiology, this structure was considered consistent with a prominent tricuspid annulus, with no further workup recommended other than a follow-up neonatal echocardiogram following delivery. The patient declined amniocentesis, sufficing with earlier obtained noninvasive prenatal screening, which was negative for aneuploidy and select microdeletions including 22q- (DiGeorge syndrome). Reflex genome-wide screening following notation of the above-described sonographic findings, indicated the absence of gain or loss events ≥ 7 Mb or select microdeletions below 7 Mb.

Repeat ultrasound assessments were continued at 2-week intervals, with no change noted in the tricuspid annulus or

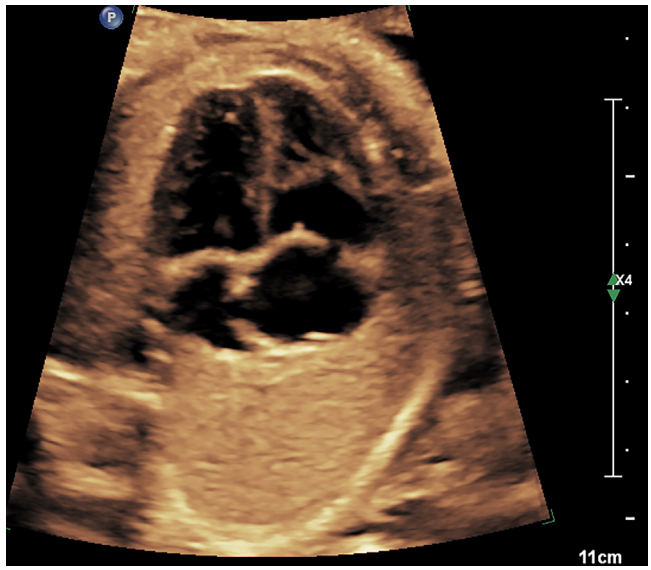


**Fig. 1 – Four-chamber view of the fetal heart. Note the right ventricle on the right with the moderator band at the apex. The normal functioning foramen ovale can be seen "billowing" into the left atrium, where 2 pulmonary veins are also depicted.**

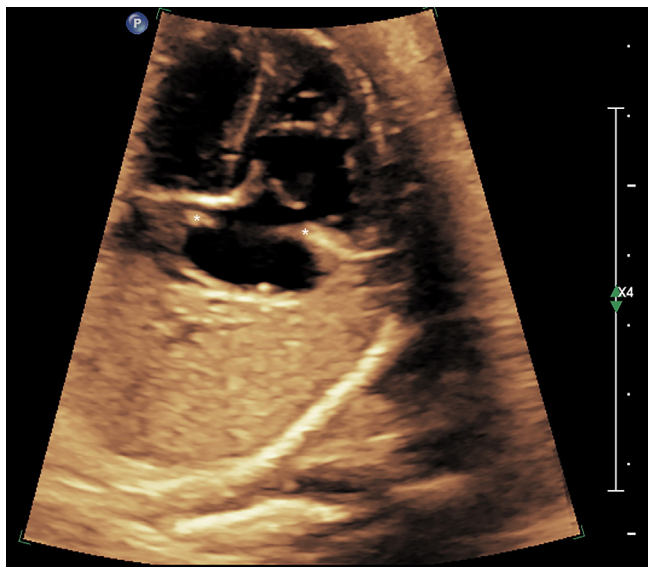


**Fig. 2 – The tricuspid valve complex during mid-diastole depicting open leaflets. Note the prominent tricuspid annulus (the annular ring marked with asterisks) positioned above the tricuspid valve.**

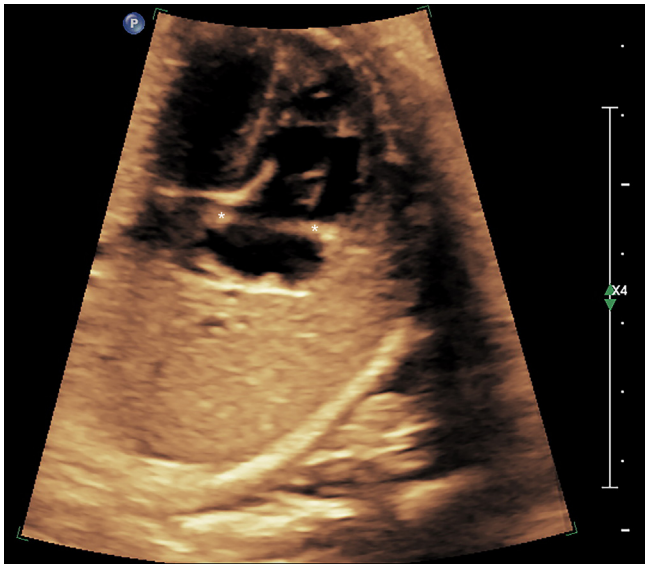

**Fig. 3 – A posterior view of the right atrium during mid-diastole, depicting open tricuspid leaflets. Note the almost complete annular ring structure, the prominent tricuspid annulus (marked with asterisks) positioned above the tricuspid valve.**

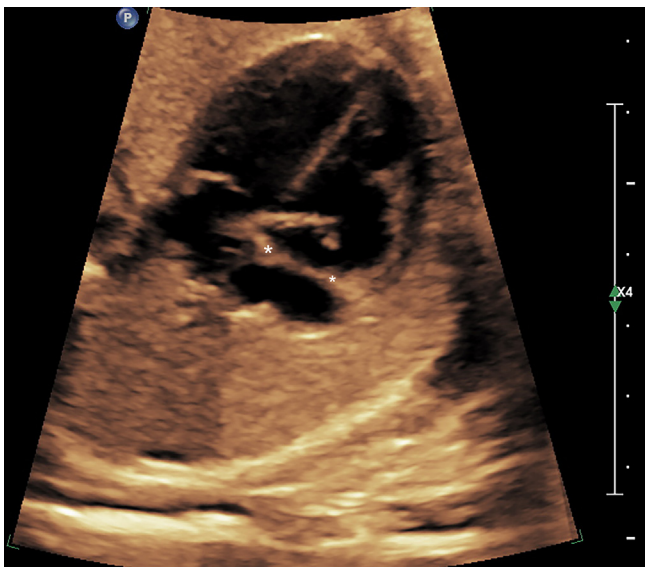

**Fig. 4 – An additional posterior view of the beginning of diastole. Note the opening septal leaflet of the tricuspid valve and the apparent constricting membranous ring (marked with asterisks) later correctly identified as the prominent tricuspid annulus within the right atrium above the tricuspid valve, forming a complete peripheral annular ring structure.**

cardiac function. Twice weekly nonstress fetal testing was conducted, and the remainder of the pregnancy was uneventful. At 40 weeks' gestation, the patient spontaneously delivered a vigorous male neonate with Apgar scores of 9 and 9 and 1 and 5 minutes, respectively. Birth weight was 3355 grams, umbilical artery pH = 7.27, and base excess = -4. No dysmorphic features were noted. The presence of neonatal unilateral left hydronephrosis was sonographically confirmed, and the neonatal pediatric echocardiogram was normal. The infant was discharged on day 4 of life, with Pediatric Urology postnatal follow-up of the left hydronephrosis planned.

## Discussion

The asymmetrical, saddle-shaped tricuspid annulus (the latter defined by an area between the outer edges of 2 concentric circles) is an integral component of the fibrous skeleton of the heart and consists of a ring of a collagenous tissue extending around the peripheral attachments of the tricuspid leaflets [1–3]. The tricuspid annulus merges with the fibrous intermediate layer of the leaflets and with other valves by mode of the fibrous cardiac skeleton [16]. The tricuspid annulus is inclined to face the cardiac apex, is not uniformly thick throughout the entire circumferences, and exhibits a dynamically deformable function, which allows it to change its structural contour with varying loading conditions presented with each cardiac cycle and with increasing age of the individual [16]. In adults, the tricuspid annulus can be imaged and measured utilizing 3-dimensional transesophageal echocardiography [17]. Tricuspid regurgitation resulting from a dilated annulus is the most common pathology affecting the tricuspid annulus [16]. Pertinent to our case is that while the annulus consists of a ring of collagenous tissue that extends around the attachment line of the tricuspid valve leaflets, which merge with the fibrous intermediate layer of the leaflets, at certain points, the leaflet lamina fibrosis may extend for a distance beneath the endocardium before reaching the annulus at a distance [16]. Worded differently, the attachment line of the tricuspid valve leaflets may not always correspond with the site of the annulus. It appears that this precise apparent disconnect between the attachment line of the valve leaflets and the fibrous layer of the annulus seen in our case (Figs. 2–4), led to the appearance of the considerably prominent, although otherwise normal tricuspid annulus.

Systematic review of the English literature (PubMed, Google Scholar, and Medline, 1966-2023) using the search terms "prenatal ultrasound," "fetal echocardiography," "tricuspid annulus," "tricuspid valve," "fibrous cardiac skeleton," confirm that prenatal sonographic findings of a prominent tricuspid annulus have not been reported previously. This case emphasizes that attention to normal variations in fetal anatomical structures should always be considered and specifically that unimpaired inflow across the tricuspid valve in diastole is key when encountering an unusually prominent fetal tricuspid annulus, which may be noted at a considerable distance above the tricuspid leaflets within the right atrium.

## Patient consent

Please note that we have obtained the patients informed written consent for publishing our case report.

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