International Journal of Gynecology and Obstetrics xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

International Journal of Gynecology and Obstetrics

journal homepage: www.elsevier.com/locate/ijgo

CLINICAL ARTICLE

Retrospective case series examining the clinical significance of subjective fetal cardiac ventricular disproportion

Rinat Gabbay-Benziv, Bilge Cetinkaya Demir, Sarah Crimmins, Sertac Esin, Ozhan M. Turan, Sifa Turan *

Department of Obstetrics, Gynecology and Reproductive Sciences, University of Maryland School of Medicine, Baltimore, Maryland, USA

ARTICLE INFO

Article history:
Received 18 December 2015
Received in revised form 14 March 2016
Accepted 24 May 2016

Keywords:
Case series
Congenital heart defects
Fetal aortic coarctation
Fetal echocardiography
Right-to-left ventricular ratio
Ventricular disproportion

ABSTRACT

Objective: To evaluate fetal cardiac ventricular disproportion as a marker of cardiac anomalies. *Methods:* A retrospective case series included data from all patients who had a fetus diagnosed subjectively with ventricular disproportion by routine obstetric ultrasonography between January 1, 2007 and December 31, 2013 at a single tertiary center in the USA. Fetal and neonatal echocardiography, and neonatal outcome data were retrieved. Outcomes were described for all fetuses with subjective ventricular disproportion. Then, the objective right-to-left ventricular ratio (RLVR) was calculated as a continuous (after transformation to gestational age specific z-scores) or categorical value (>2SD for gestational week), based on previously published reference values. Subsequently, correlations between the objective RLVR and neonatal outcomes were evaluated. *Results:* Records from 60 fetuses diagnosed with ventricular disproportion at 16–38 weeks of gestation were included. These pregnancies resulted in 54 live deliveries; postnatally, 20 (37%) of these neonates were diagnosed with aortic coarctation and 39 (72%) were diagnosed with other cardiac anomalies, with or without aortic coarctation. No significant differences in objective prenatal diagnostic findings (RLVR) were demonstrated between neonates who were diagnosed postnatally with aortic coarctation or any cardiac anomaly and those not. *Conclusion:* Subjective ventricular disproportion, regardless of objective diagnosis, was associated with cardiac defects. The use of fetal and neonatal echocardiography following diagnosis of fetal ventricular disproportion appears justified.

1. Introduction

Cardiac defects are the most common neonatal anomalies, occurring in 5–8 of every 1000 deliveries [1]. Prenatal diagnosis of cardiac anomalies is important in planning neonatal treatment and subsequent follow up.

Ventricular disproportion is diagnosed subjectively and is defined as any noticeable visual difference between the right and left chambers of the heart [2], primarily the left chamber being smaller than the right; this could indicate the presence of left heart obstruction [3–7].

At healthcare centers with significant experience of fetal ventricular disproportion, the identification of isolated fetal cardiac ventricular disproportion on a routine obstetric scan is normally followed by a fetal echocardiography examination; however, this is not the case at all centers. The guidelines of the International Society of Ultrasound in Obstetrics and Gynecology indicate that both ventricles should appear similar in size, although mild ventricular disproportion could be normal during the third trimester [8]. However, a recent study [9] established nomograms for the widths and ratios of fetal cardiac ventricles by extrapolating data from 1242 normal fetal echocardiography examinations made at 16–38 weeks of gestation. This study demonstrated that although the right-to-left ventricular ratio (RLVR) increased with gestational age, the difference did not demonstrate any clinical significance [9].

The prenatal diagnosis of overt ventricular disproportion is highly suggestive of left heart obstruction; however, in cases of subtle ventricular disproportion, the clinical value of this observation is questionable. Moreover, measuring ventricular width is not routine clinical practice and there is a paucity of data in the literature regarding RLVR and any correlation to congenital heart defects and neonatal outcome [5]. In the present study, it was hypothesized that ventricular disproportion is a marker for cardiac anomalies other than left-side obstruction. Therefore, the aims of the present study were to report cardiac outcomes in neonates diagnosed subjectively with ventricular disproportion prenatally and to evaluate the contribution of using objective criteria based on the RLVR in prenatal diagnoses of cardiac anomalies.

2. Methods

The present study was a retrospective case series that included data on all fetuses subjectively diagnosed with right-to-left ventricular

* Corresponding author at: Fetal Heart Program, the Center for Advanced Fetal Care, Department of Obstetrics, Gynecology and Reproductive Sciences, University of Maryland School of Medicine, 22 South Greene Street, 6th floor, room N6E16, Baltimore, MD 21201, USA. Tel.: +1 410 328 7806; fax: +1 410 328 6098.
E-mail address: sturan@fpi.umaryland.edu (S. Turan).

http://dx.doi.org/10.1016/j.ijgo.2016.03.016
0020-7292/

disproportion at the Center for Advanced Fetal Care at the University of Maryland Medical Center, USA, between January 1, 2007 and December 31, 2013. The inclusion criterion was a subjective diagnosis of ventricular disproportion on any obstetric ultrasonography examination performed at any point during pregnancy. Subjective ventricular disproportion was defined as a visually noticeable disproportion between the left and right ventricles of the heart at the level of the four chamber view, as well as any noticeable discrepancy between the aorta and pulmonary artery at the level of the three vessel trachea view at any duration of pregnancy (Fig. 1). Any obvious cases of hypoplastic left heart syndrome were excluded. The study was approved by the institutional review board at the University of Maryland Medical Center who waived the need to obtain specific informed consent.

Standard practice at the study institution was to perform fetal echocardiography for all patients following a subjective ventricular disproportion diagnosis, regardless of the gestational age of the fetus or the presence of other findings. All fetal echocardiography examinations were performed by sonographers who had been certified by the American Registry for Diagnostic Medical Sonography Fetal Echocardiography, using a Voluson E8 (Milwaukee, WI, USA) system in a standardized fashion according to guidelines from the American Institute of Ultrasound in Medicine and the International Society of Ultrasound in Obstetrics and Gynecology. The width of the ventricles and the RLVR were measured for every patient at least once during pregnancy. Measurements were made from the inner to inner line below the valves' insertion at end of diastole when the atrio-ventricular valves were closed prior to the onset of systole [2] in the four-chamber view of fetal heart (Fig. 2). In addition to sonographic evaluation, maternal demographic and patient history details were recorded. Following ultrasonography examination, all data were stored using a computerized database. Whenever a prenatal cardiac anomaly was suspected, including isolated ventricular disproportion, neonatal echocardiography was performed prior to patient discharge. Following delivery, neonatal outcome data were recorded using the same database. If women underwent delivery outside the hospital, they were contacted following delivery to verify maternal and neonatal outcomes in accordance with standard institutional procedures.

In the present study, records were retrieved from all pregnancies where a subjective diagnosis of ventricular disproportion was made. Neonatal medical records were reviewed to confirm neonatal echocardiography results, surgical interventions, and clinical outcomes. Details of prenatal or postnatal genetic evaluations were retrieved when available. Aortic coarctation diagnoses were made after birth

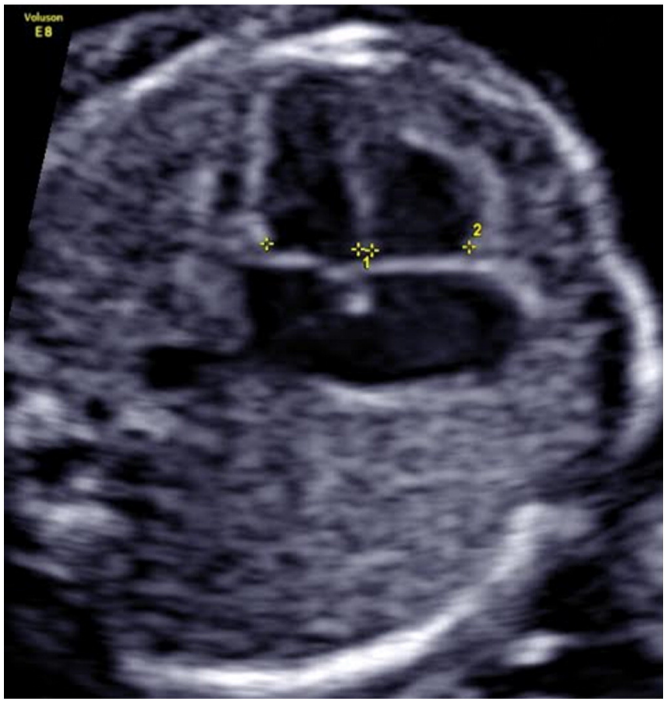

Fig. 2. Measurement of cardiac-ventricle width. Cardiac ventricle width was measured using the four-chamber view; the measurement was made from inner to inner line below the valves' insertion at end of diastole with the atrio-ventricular valves closed.

according to the criteria of discrete narrowing, exceeding two standard deviations (SD) from the normal, of the aorta or hypoplastic transverse aortic arch.

Following the detailed description of all cases diagnosed with ventricular disproportion during the study period, correlations between ventricular disproportion (assessed using the measurements made during the first fetal echocardiography examination for each patient) and cardiac anomalies were evaluated. The reproducibility of ventricle-width measurements at the study institution has been ascertained previously (data available upon request). RLVR reference values for pregnancies of different durations were adopted from previously constructed nomograms [9]. The objective diagnostic criterion for ventricular disproportion was defined as (1) a RLVR larger than the gestational mean

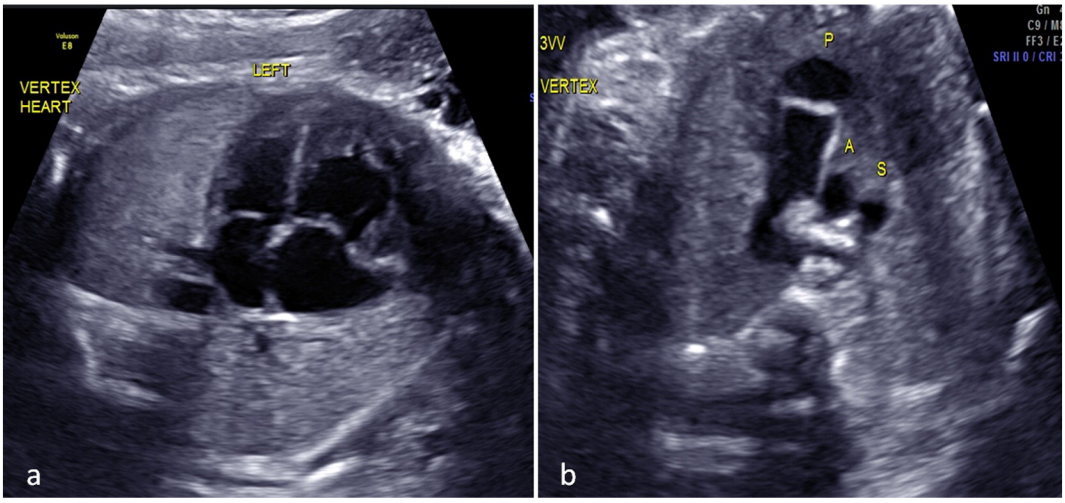

Fig. 1. Subjective fetal cardiac ventricular disproportion. Four-chamber view (a): fetal cardiac ventricular disproportion can be diagnosed from the left ventricle being smaller in size than the right ventricle. Three-vessel and trachea view (b): fetal cardiac ventricular disproportion can be diagnosed from the aorta (A) being smaller than the pulmonary artery (P) and a similar size to the superior vena cava (S).

Please cite this article as: Gabbay-Benziv R, et al, Retrospective case series examining the clinical significance of subjective fetal cardiac ventricular disproportion, Int J Gynecol Obstet (2016), http://dx.doi.org/10.1016/j.ijgo.2016.03.016