Matrix array transducer for the examination of fetal heart

R. La Torre[1], E. Bevilacqua[1], V. D'Ambrosio[1], G. Pasquali[1], C. Aliberti[1], F. Ventriglia[2], A. Giancotti[1]

[1]Department of Obstetrics, Gynecology and Urologic Sciences "Sapienza" University, Rome
[2]Department of Pediatrics, Division of Cardiology "Sapienza" University, Rome (Italy)

Summary

The X6-1 xmatrix array transducer allows a completely new approach to the diagnostic ultrasound: it permits visualization of fetal heart in real time, without the need for gating, and it is unaffected by motion artefacts. It is obtained in real time, without any spatial reconstruction. The authors compared this technology with the traditional one in two case reports: a diagnostic doubt of small muscular ventricular septal defect was solved using this new technique; a diagnosis of complete atrioventricular septal defect was confirmed. Three-dimensional real-time imaging would seem very precise in the study of fetal heart: the defects were fully visualized from any angulations. This new technology is promising but from the authors' limited experience, there is no evidence to use it in routine practice. It should be very useful to commence a prospective study on fetuses at risk while testing the superiority of this technique.

Key words: Congenital heart defect; Matrix array transducer.

Introduction

Congenital heart defects (CHDs) are the most common congenital anatomic malformations [1] and are among the most frequently missed abnormalities by prenatal ultrasonography. Beginning from four-chamber view in B-mode real time, sensitivity of ultrasound to diagnose CHDs is 35- 48%. It increases to 78-86% with the left and right outflow tract views [2]. Although, the use of three-dimensional and four-dimensional echocardiography improved the diagnosis of CHDs, these are limited by artifacts produced by fetal movements, in combination with cardiac gating methods during volume acquisition [3, 4]. The X6-1 xmatrix array transducer allows a completely new approach to the diagnostic ultrasound: it permits visualization of fetal heart in real time, without the need for gating, and it is unaffected by motion artifacts [5]. Through electronic steering, the X6-1 xmatrix imaging is totally different from traditional mechanical volumetric imaging, because it is obtained in real time, without any spatial reconstruction. The authors compared this technology with the traditional one in two diagnoses of CHD after the women's consent was obtained.

Case Report

Case 1

A 37-year-old gravida 2, para 0, was hospitalized at Umberto I Hospital of Rome at 39 weeks. Her current pregnancy was complicated by gestational diabetes, and a small muscular ventricular septal defect was suspected during a scan at 21 weeks. Fetal echocardiography was performed by two-dimensional echocardiography at 34 weeks and it did not clarify the diagnostic doubt. During hospitalization, the fetal heart was studied using the X6-1 xmatrix array transducer. The diagnostic doubt was easily solved using this new technology (Figure 1). Diagnosis was confirmed by postnatal echocardiography.

Case 2

A 33-year-old gravida 4, para 1, was followed in the present unit from 21 weeks of gestation when a complete atrioventricular septal defect was diagnosed (Figure 2). The authors were able to analyse the defect with the X6-1 xmatrix array transducer. Real-time three-dimensional imaging proved superior to conventional two-dimensional imaging in depicting the anomaly of valvular plane: the septal defect was fully visualized from any angulations. Such a comprehensive assessment was not possible with B-mode real time imaging.

Discussion

Three-dimensional and four-dimensional ultrasound technologies allow a more comprehensive investigation of fetal heart. The imaging modalities obtained with the X6-1 xmatrix array transducer give additional tools to the examiner, to better delineate normal, as well as complex, fetal cardiac anomalies. With the X6-1 xmatrix array transducer and x-plane imaging, it is possible to visualize the septum in transverse view, from the apex to the valve plane, in real time and with considerable accuracy; moreover, it does not require any post-processing capability because, in order to define the "desired" second plane, you have only to use the trackball [6]. So far, it seems that the best technologies allow a better diagnosis and a higher resolution of anatomical structure arrangement in major heart anomalies. Having better information about fetal heart anomalies prenatally could allow better postnatal management. Otherwise, detection of very small heart defects without clinical significance could cause anxiety in the couple.

This new technology is promising but from the authors' limited experience, there is no evidence to support an ad-

Revised manuscript accepted for publication June 24, 2013

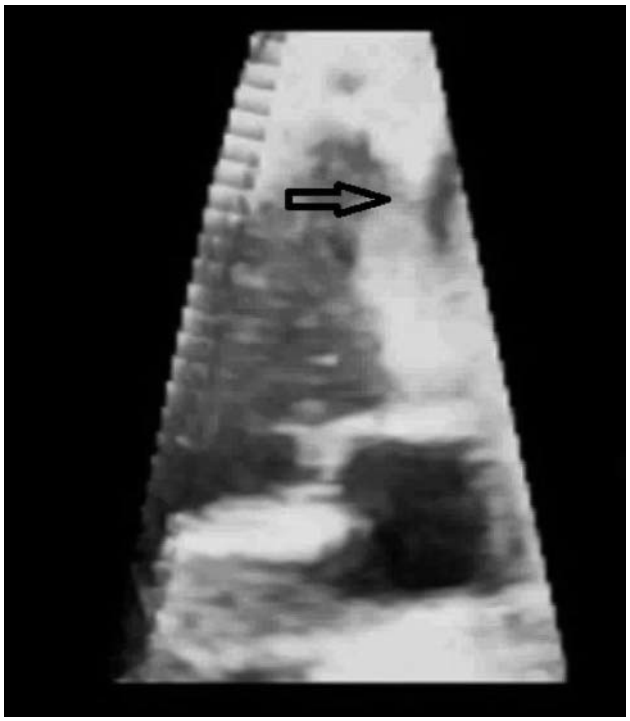

Figure 1. — Sonogram obtained with a X6-1 xmatrix array transducer showing a small ventricular septal defect.

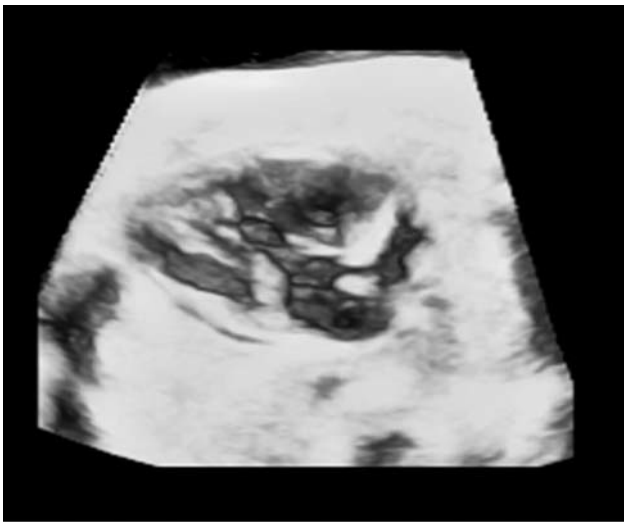

Figure 2. — Sonogram obtained with a X6-1 xmatrix array transducer in a fetus with complete atrioventricular septal defect.

vantage of using such technique. It should be very useful to commence a prospective study on fetuses at risk with CHD using matrix array probes, conventional two-dimensional ultrasound and/or four-dimensional ultrasound with spatio-temporal image correlation (STIC), and testing the superiority of any of these techniques.

References

[1] Hoffman J.I.E.: "Epidemiology of congenital heart disease: etiology, pathogenesis and incidence". In: Yagel S, Silverman NH, Gembruch U, (eds.), *Fetal cardiology*. London: Martin Dunitz, 2003, 79.

[2] Randall P., Brealey S., Hahn S., Khan K.S., Parsons J.M.: "Accuracy of fetal echocardiography in the routine detection of congenital heart disease among unselected and low risk populations: a systematic review". *BJOG,* 2005, *112*, 24.

[3] Devore G.R.: "Three-dimensional and four-dimensional fetal echocardiography: a new frontier". *Curr. Opin. Pediatr.*, 2005, *17*, 592.

[4] Yuan Y., Leung K.Y., Ouyang Y.S., Yang F., Tang M.H., Chau A.K., *et al.*: "Simultaneous real-time imaging of four-chamber and left ventricular outflow tract views using xPlane imaging capability of matrix array probe". *Ultrasound Obstet. Gynecol.*, 2011, *37*, 302.

[5] Maulik D., Nanda N.C., Singh V., Dod H., Vengala S., Sinha A., et al.: "Live three-dimensional echocardiography of the human fetus". *Echocardiography*, 2003, *20*, 715.

[6] Giancotti A., Bevilacqua E., D'Ambrosio V., Pasquali G., Gasbarri A.: "A new technology in the diagnosis of small ventricular septal defect". *J. Obstet. Gynaecol.*, 2012, *32*, 394.

Address reprint requests to:
R. LA TORRE, M.D.
Via del Policlinico 155,
00161 Rome (Italy)
e-mail: renato.latorre@uniroma1.it