

## OBSTETRICS

# Maternal cardiac evaluation during uncomplicated twin pregnancy with emphasis on the diastolic function

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**OBJECTIVE:** The objective of the study was to evaluate the longitudinal changes in maternal systolic and diastolic function in a series of women carrying an uncomplicated twin pregnancy.

**STUDY DESIGN:** A series of women carrying a twin pregnancy underwent standard M-mode, 2-dimensional color Doppler, and tissue Doppler transthoracic echocardiography during the first (11–13 weeks), the second (20–23 weeks), the third (28–32 weeks) trimesters, and the postpartum (6 months after delivery).

**RESULTS:** From January 2012 to September 2013, 30 women with an uncomplicated twin pregnancy were included in this prospective study. All the pregnancies were diamniotic including 24 dichorionic and 6 monochorionic sets. Overall, 60 live births were observed with a mean gestational age at delivery of  $37 \pm 1$  weeks and a mean birthweight of  $2532 \pm 313$  g. During pregnancy a significant worsening of left ventricle systolic function expressed by ejection fraction, fractional

shortening and S1 longitudinal contractility decrease was observed. These findings also persisted at postpartum assessment. Regarding diastolic function, our data showed a significant progressive reduction of pulsed Doppler E-wave velocity and an increase of A-wave from the first to the third trimester. Similar changes were documented for tissue Doppler E1 and A1 peak velocities assessed at the level of the mitral and tricuspid annulus. After delivery diastolic findings returned to values comparable with those obtained in the first trimester.

**CONCLUSION:** In uncomplicated twin gestations, significant changes in maternal systolic and diastolic function occur from the first to the third trimester. Moreover, although diastolic parameters normalize after pregnancy, a relative systolic dysfunction seems to persist after delivery.

**Key words:** diastolic function, echocardiography, hypertension, myocardial function, tissue Doppler

Cite this article as: Ghi T, degli Esposti D, Montaguti E, et al. Maternal cardiac evaluation during uncomplicated twin pregnancy with emphasis on the diastolic function. *Am J Obstet Gynecol* 2015;213:376.e1-8.

Maternal cardiac function assessment in pregnancy has recently gained much interest because abnormal findings at echocardiography have been

associated with a higher risk of obstetric complications including hypertensive disorders and placental insufficiency.<sup>1-3</sup> Most of the studies have been carried out among singleton gestations,<sup>4-9</sup> whereas a paucity of data is available on maternal hemodynamics in twins.<sup>10-14</sup>

On the other hand, considering the greater increase in circulating volume that is expected in twin gestation, a detailed assessment of maternal cardiac changes throughout the pregnancy might offer a better insight to the process of cardiac adaptation to the multifetal pregnancy.

In a large cross-sectional study, Kametas et al<sup>15</sup> documented a significantly higher maternal CO among twin vs singleton gestations.

More recently in a group of women with uncomplicated twin gestations submitted to serial echocardiography from 20 to 34 weeks, our group had noted a progressive increase of CO and

a fall of total vascular resistances.<sup>16</sup> Furthermore, compared with uneventful pregnancies, in those twin gestations complicated by preeclampsia or placental insufficiency, either CO or total peripheral vascular resistance (TVR) did not show significant changes from the second to the third trimester.<sup>17</sup>

Data regarding maternal cardiac function since the first trimester and diastolic changes are lacking, with the only available studies including small numbers of patients.<sup>13,14</sup>

The aim of this study was to assess by serial echocardiograms maternal cardiac function among uncomplicated twin gestations since the first trimester and to compare these sonographic findings with those obtained after pregnancy.

## MATERIALS AND METHODS

We conducted a prospective longitudinal study that included patients with a viable

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Received Jan. 25, 2015; revised April 16, 2015; accepted May 2, 2015.

The authors report no conflict of interest.

Presented at the 23rd World Congress on Ultrasound in Obstetrics and Gynecology, Sydney, NSW, Australia, Oct. 6-9, 2013.

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0002-9378/\$36.00

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<http://dx.doi.org/10.1016/j.ajog.2015.05.003>

twin pregnancy who attended the Department of Obstetrics of Bologna University Hospital at 11–13 weeks of gestation for the first-trimester screening of aneuploidies.

A priori exclusion criteria were personal history of cardiovascular disease or chronic hypertension, systemic maternal disorders, smoking, or drug consumption. Patients were also excluded if at the time of ultrasound an increased nuchal translucency or a major structural anomaly was noted in 1 or both fetuses. At ultrasound performed at 11–13 weeks, the chorionicity and amnionicity were established.

Patients were defined as having a complicated pregnancy and retrospectively removed from the study group if any of the following occurred after recruitment: miscarriage or intrauterine fetal death, congenital anomaly or disease diagnosed at birth, spontaneous or indicated delivery less than 34 weeks; small-for-gestational-age birthweight of 1 or both twins (below the

third centile), occurrence of maternal gestational hypertension (systolic blood pressure of  $\geq 140$  mm Hg and/or diastolic blood pressure of  $\geq 90$  mm Hg on at least 2 occasions in women known to be normotensive before pregnancy and before 20 weeks of gestation), or preeclampsia (gestational hypertension plus proteinuria of  $\geq 300$  mg per 24 hours).<sup>18–20</sup>

All women included in the study underwent a complete cardiological evaluation including both a clinical and a transthoracic echocardiographic study at 11–13 weeks, 20–23 weeks, 28–32 weeks, and 6 months after delivery.

The cardiological evaluation was performed by D.d.E. and M.R. and included the collection of medical and family history; body measurement assessment; blood pressure profile; and complete M-mode, 2-dimensional, and color Doppler echocardiography, comprehensive of tissue Doppler (TD) evaluation.<sup>21</sup>

Blood pressure was measured 3 times at 5 minute intervals, in patients lying

in the left lateral position, with an appropriate size sphygmomanometer, after 10 minutes of rest. If the diastolic blood pressure detected exceeded 90 mm Hg or the systolic blood pressure exceeded 140 mm Hg, the measurement was then repeated after 30 minutes following an examination.

In all subjects a standard M-mode, 2-dimensional, color Doppler, and TD echocardiography was performed by the same experienced operator, using a suitable commercially available instrumentation (SONOS 5500; Royal Philips, Breitner Center, Amsterdam, The Netherlands) according to international guidelines for echocardiography of the American College of Cardiology Foundation/American Heart Association.<sup>21</sup> The echocardiographic tracings were recorded simultaneously during the examination.

Methods of maternal cardiac assessment have been thoroughly described in a previous study published by our group.<sup>22</sup> The parameters used to assess systolic function were left ventricular (LV) end-diastolic volume; LV end-systolic volume; LV ejection fraction calculated with the Teichholz's formula derived from LV M-mode dimensions; LV fractional shortening, also calculated using LV M-mode measurements; CO (liters per minute) calculated with the formula  $CO = SV * HR$  (where HR is the heart rate and SV is the stroke volume); and the TVR calculated with the formula  $TVR = (\text{mean arterial pressure}/CO) * 80$  ( $\text{dynes}/\text{sec}^{-1}$  per centimeter<sup>-5</sup>).

As for diastolic function, E-wave peak velocity, A-wave peak velocity, E/A ratio, and isovolumetric relaxation time were measured. We also assessed pulsed TD, including the systolic anterograde myocardial velocity ( $S_1$ ) and the 2 retrograde diastolic myocardial velocities: protodiastolic ( $E_1$ ) and atrial ( $A_1$ ), all measured in centimeters per second. The TD sampling has been done on the mitral annulus, in both septal and left ventricle's side, and on the tricuspid annulus.

All tracings were recorded at the held-end expiration with the patient in the left lateral decubitus position and after 20 minutes of rest, measured on 3 separate beats and then averaged

**TABLE 1**  
**Demographic and pregnancy details of the study population**

Characteristics	Uncomplicated (n = 30)	Complicated (n = 8)
Maternal age, y	36.5 ± 4.8	36.3 ± 4.5
Maternal ethnicity, %		
White	29 (96.7%)	7 (87.5%)
Afro-Caribbean	1 (3.3%)	1 (12.5%)
Parity		
0	25 (83.3%)	7 (87.5%)
1	4 (13.3%)	1 (12.5%)
2	1 (3.3%)	0
Gestational age at delivery, wks	37 ± 1	35 ± 3
Birthweight, g	2535 ± 313	2155 ± 638
Chorionicity		
Monochorionic	6 (20%)	1 (12.5%)
Dichorionic	24 (80%)	7 (87.5%)
Conception		
Spontaneous	20 (66.7%)	5 (62.5%)
Medically assisted procreation	10 (33.3%)	3 (37.5%)

Data are given as mean ± SD or n (percentage).

Ghi. Cardiac function in twin pregnancies. *Am J Obstet Gynecol* 2015.

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