DO PRENATAL INTRACARDIAC ECHOGENIC FOCI AFFECT POSTNATAL CARDIAC FUNCTION?

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Objective. To determine whether prenatally diagnosed intracardiac echogenic foci are associated with neonatal cardiac dysfunction and persistence.
Methods. Fetuses in whom intracardiac echogenic foci were shown on prenatal sonography at 1 perinatal center from (July 2005 to September 2006) underwent postnatal echocardiography at ages 1 month to 1 year. A single pediatric cardiologist assessed cardiac function by measuring the left ventricular shortening fraction and myocardial performance index. The presence of tricuspid valve regurgitation was also sought.
Results. Prenatally 12 fetuses with a mean age at diagnosis of 25±3.1years (mean±SD) had intracardiac echogenic foci. 9 (75%*)* had left ventricular intracardiac echogenic foci, and 3 (25%) had right ventricular intracardiac echogenic foci. Post natally , those infants, 7(58%) males and 5 (42%) females were examined. at a mean age ± SD of 8.2±4.1 months. . Prenatally, all infants had a normal left ventricular shortening fraction. The overall mean left ventricular myocardial performance index (reference value, 0.36 ± 0.06) was normal for both infants with left ventricular intracardiac echogenic foci (0.34 ± 0.06) and those with right ventricular intracardiac echogenic foci (0.33 ± 0.04). Trace tricuspid valve regurgitation was noted in 6 (50%) of the infants. Left ventricular intracardiac echogenic foci persisted in 7 infants (77%), whereas right ventricular intracardiac echogenic foci persisted in 1 infant (33%).
Conclusions. Prenatally diagnosed intracardiac echogenic foci can be persistent but is not associated with left myocardial dysfunction in the first year of life

Key words: echocardiography; intracardiac echogenic focus; prenatal diagnosis; sonography.

Abbreviations
ICEF, intracardiac echogenic foci; LV, left ventricular; LVSF, left ventricular shortening fraction; MPI, myocardial performance index;; RV, right ventricular; TVR, tricuspid valve regurgitation

A FETAL ECHOGENIC INTRACARDIAC FOCUS (EIF) is most commonly a normal variant in a normal fetus, but owing to reports of an increased risk of aneuploidy with EIFs,[1–6] the finding causes concern when noted on routine obstetric sonograms. The reported incidence of EIFs varies from 0.17% to 20%.[1,2,4–10] This wide variation in incidence makes counseling of patients about the significance of an EIF difficult. Although some obstetricians would advocate amniocentesis when a fetal EIF is visualized in a patient population at high risk for aneuploidy, this recommendation cannot be applied to low-risk populations.

Fetal intracardiac echogenic foci (ICEF) represent papillary muscle calcification and fibrosis of unknown etiology.[11] One of the most common aneuploidy markers,[12] ICEF are associated with an increased frequency of fetal chromosomal abnormalities in both high-risk[13-16] and low-risk populations [13,17-19] Fetuses with normal chromosome complements who have ICEF are no more likely than the general population to have congenital heart disease.[20,21] Investigators have not addressed neonatal cardiac function in otherwise healthy offspring with prenatally diagnosed ICEF. This issue has clinical implications for prenatal parental counseling and neonatal care. Therefore, we performed the following prospective study.

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Materials and Methods

We reviewed our fetal echocardiography database from July 2005 through September 2006 for all fetuses who had ICEF and normal chromosome complements. In the absence of an available karyotype, normal neonatal physical examination findings served as a surrogate for the absence of a chromosomal abnormality. All prenatal and postnatal ultrasound examinations were performed on HP Sonos 7500 machine (Philips Medical Systems,) equipped with a 4–6-MHz curved-array and a 5-12 MHz sector transducers by a single pediatric cardiologist with extra training in fetal cardiology (RSB). Results of the examinations were interpreted and entered into the database. Intracardiac echogenic foci were defined as bright reflectors occupying the vicinity of the papillary muscle in an intracardiac location and moving in synchrony with the valve leaflets. Prospective parents were informed of the sonographic findings at the time of the prenatal study.

Parents were asked if they would like to participate in this study and were given a postnatal appointment for physical examination and echocardiographic examination. The contact information of the parents were attached to the echocardiographic report. Subjects were excluded if the parents could not be contacted or declined participation, the affected fetus was one of a multiple gestation,

Postnatal echocardiography was done by the same pediatric cardiologist (RSB) using the same echo machine on each of the 12 infants. Ventricular contractility was assessed by measurement of the left ventricular shortening fraction (LVSF) in a standard M-mode method from the parasternal short axis view. The LVSF was calculated as the difference between the left ventricular (LV) end diastolic and end-systolic diameters divided by the LV end-diastolic diameter and then multiplied by 100.[22] The LV myocardial performance index (MPI) represents a combined measure of systolic and diastolic function. This global assessment of ventricular function was calculated as the sum of the isovolumetric contraction and relaxation times divided by the ejection time (Figure 2).[23-24] Pulsed Doppler tracings of LV inflow and outflow were averaged from 3 successive beats and applied to the formula for MPI calculation.[23] The presence of tricuspid valve regurgitation (TVR) was also sought by color Doppler interrogation of the valves from 3 standard imaging planes as measures of papillary muscle and atrioventricular valve function. More than trace regurgitation was considered abnormal. The secondary outcome was ICEF persistence, determined by correlating the locations of neonatal echogenicity with those of the prenatally detected ICEF. Additional data collected were subject age and sex. Statistical comparisons variables were performed by the Fisher exact test, and the unpaired Student *t* test. $P < .05$ was considered statistically significant.

Results

A total of 22 fetuses examined by sonography from 2005 through 2006 were reported as having ICEF. 10 of these fetuses were excluded because of aneuploidy or multiple gestation. Prenatally 12 fetuses had intracardiac echogenic foci with a mean age ± SD at diagnosis of 25±3 1.9 75% had left ventricular intracardiac echogenic foci, and 3 (25%) had right ventricular intracardiac echogenic foci (Figure).

Postnatally, these infants, 7(58%) males and 5 (42%) females were examined at a mean age ± SD of 8.2±4.1 months. Prenatally, all infants had a normal left ventricular shortening fraction. The overall mean left ventricular myocardial performance index (reference value, 0.36 ± 0.06), was normal for both infants with left ventricular intracardiac echogenic foci (0.34 ± 0.06) and those with right ventricular intracardiac echogenic foci (0.33± 0.04).

Trace tricuspid valve regurgitation was noted in 6 (50%) of the infants. Left ventricular intracardiac echogenic foci persisted in 7 infants (77%), whereas right ventricular intracardiac echogenic foci persisted in one (33%)

Results with infants who had prenatally diagnosed LV ICEF were compared with those who had prenatally diagnosed RV ICEF. The LVSF was normal in all infants and did not vary by ICEF location. Likewise, the mean LV MPI was normal[24] regardless of ICEF location. When observed, TVR were trace in all instances.

Discussion

Our preliminary investigation showed the absence of myocardial or atrioventricular valve

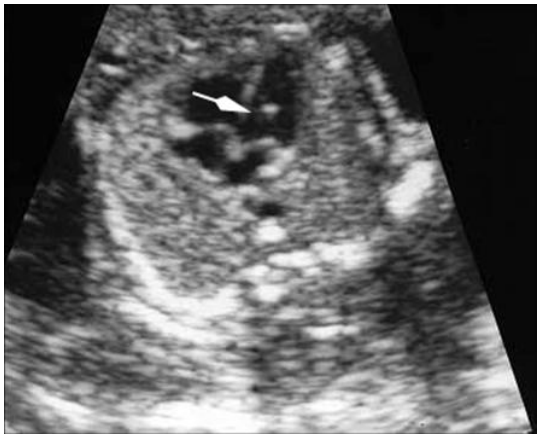

Figure 1: *Axial scans through the fetal chest show a four-chamber view of the heart showing a single echogenic focus within the left ventricle.*

dysfunction in infants with prenatally diagnosed ICEF. The overall mean LVSF, 38% ± 4%, was similar to the 36% ± 4% reported in the unaffected pediatric population by Gutgesell et al.[22]

Likewise, the mean LV MPI (0.36 ± 0.06) was consistent with the normative pediatric range of 0.35 ± 0.03 described by Eidem and colleagues.[24] We are aware of only a few other studies evaluating cardiac function in the presence of prenatally diagnosed ICEF.[24,25] In contrast to our study, Degani et al reported 48 case of fetuses with 50 control fetuses without ICEF showed a significant difference in the mean ratio of the E wave (early ventricular filling) to A wave (active atrial filling) peak velocities. Similar to our neonatal study, the mean LVSF was normal in both groups, leading to the authors' conclusion that the lower E/A ratios in fetuses with ICEF might indicate diastolic dysfunction.[25] In our study all infants who had prenatally diagnosed ICEF had normal cardiac function. This opens the door for further studies with perhaps a larger number of patients to assess the cardiac function postnatally.

Interestingly, 77% of LV ICEF and 33% of RV ICEF were readily visualized up to one year of age. The apparent difference in persistence between right and left ventricles likely represents technical difficulty in visualizing the RV papillary muscles

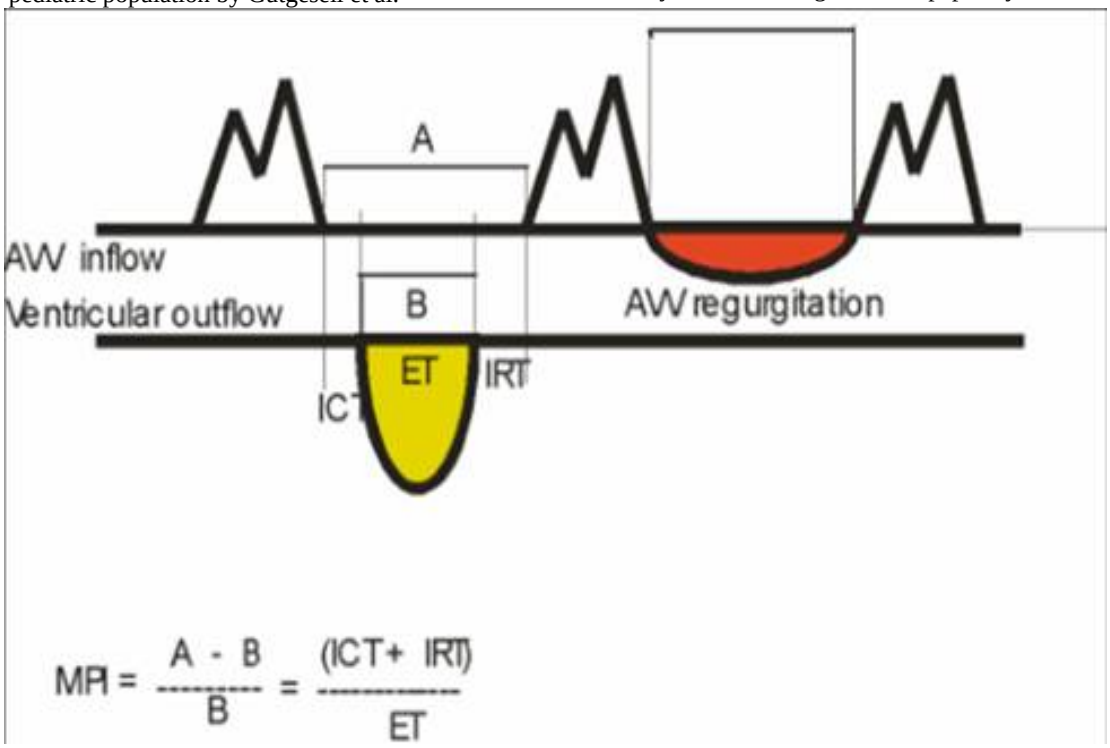

Figure 2: *Calculation of the myocardial performance index (MPI) or Tei index AVV=atrioventricular valve,, IRT= isovolumic relaxation time, ICT=isovolumic contraction time, ET=ejection time.*

and free wall. Previous studies of postnatal ICEF persistence have been limited to the neonatal period, with most reporting rates of 60% to 100%.[16,25-30] Because ICEF represent papillary muscle calcification and fibrosis, common persistence into infancy is not surprising. One unexpected incidental observation is worthy of mention. Endocardial fibrosis is characterized sonographically by contiguous echogenic scarring along lengthy segments of the endocardium and is almost invariably associated with Doppler inflow abnormalities. Thus, this condition is readily differentiated from ICEF, which are discrete, punctate lesions within the papillary muscles.

There are several limitations to our study. The number of fetuses /infants involved in this preliminary study is not large enough to come to a definitive statement that most prenatally recognized ICEF persist into the neonatal period. Our study provides initial data suggesting that prospective parents may be reassured that in fetuses with no other abnormalities, prenatally diagnosed ICEF are unlikely to be associated with neonatal cardiac dysfunction. The pediatric cardiologist was not blinded to the history of prenatally diagnosed ICEF. Ideally, echocardiography also should have been performed on a control group of age- and gender-matched infants known not to have had prenatally diagnosed ICEF, with the cardiologist blinded to the subjects' designations as cases or controls. Our study, designed as a preliminary investigation, did not have such a control group.

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