

Pulmonary stenosis: evaluation of global longitudinal strain and mechanical dyssynchrony

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Objective

To evaluate fetal cardiac remodeling and function in the presence of pulmonary stenosis (PS) using new echocardiographic techniques including speckle tracking echocardiography (STE) in a cohort of prenatal PS, and to identify predictors for neonatal valvuloplasty.

Methods

A cohort study was designed, including 7 critical and 17 mild-moderate isolated PS matched with 48 healthy controls adjusted for gestational age at echocardiography and followed at BCNatal, a referral center for congenital heart defects in Barcelona. Maternal and perinatal characteristics were obtained from medical records. Fetal ultrasound, standard functional echocardiography and off-line STE were performed in all participants. STE segmental analysis included the evaluation of mechanical dyssynchrony (intra-RV and intra-LV dyssynchrony index, defined as time-to-peak strain (ms) standard deviation between the 6 ventricular segments). Echocardiographic parameters were analyzed according to the need for neonatal valvuloplasty to identify possible predictors of early intervention.

Results

Maternal and perinatal characteristics were similar in both groups. Spontaneous prematurity was more frequent in the PS group (17.4% PS vs 2.1% control group, $p=0.018$). Birthweight and 5 minutes APGAR score were also significantly lower in the PS group. Mean gestational age at ultrasound was 28.82 [?] 6.62 weeks and 50% of the PS fetuses required a valvuloplasty within the first month of life. Critical PS fetuses showed global RV functional impairment (significantly reduced global longitudinal strain (GLS), tricuspid annular plane systolic excursion (TAPSE), fractional area change (FAC), tricuspid filling time fraction), and a more pulsatile ductus venosus (DV). Worse RV function was observed in the valvuloplasty group. No changes in LV morphometry and function were observed. Mechanical dyssynchrony showed a positive correlation between RV GLS and intra RV dyssynchrony index (GLS ($r=0.685$, $p<0.001$) and a negative correlation between FAC and intra RV dyssynchrony index ($r=-0.727$, $p<0.001$)). ROC analysis showed that a DV PI centile (cut-off value $\geq 79\%$), RV GLS (cut-off value of $\geq -15.85\%$), presence of reversed flow in the DA, and significant tricuspid regurgitation (defined as holosystolic regurgitation and peak velocity higher than 200cm/s) were predictors of neonatal valvuloplasty, and when combined in a scoring system the area under the curve was 0.931, $p=0.001$. Giving a score of 1 for each present variable, values [?] 2 predicted the need of neonatal valvuloplasty with a sensitivity of 91.7% and specificity of 100%.

Conclusion

Both mild and critical PS fetuses show signs of mechanical RV remodeling by means of STE. Decreased RV function is observed in critical PS fetuses, and correlates with mechanical dyssynchrony. A scoring system combining the DV PI centile and RV GLS; with the presence of reversed ductus arteriosus flow and significant tricuspid regurgitation, is a sensitive and specific tool to identify those fetuses in need of neonatal valvuloplasty, who will thus benefit from delivery at a tertiary hospital.