

Three-dimensional (3D) physical and virtual models of fetal hearts with congenital heart disease (CHD) and normal anatomy

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Background:

Congenital heart disease (CHD) is the most prevalent form of congenital malformation, with an estimated incidence of approximately 1 in 100 live births. It constitutes a significant cause of perinatal mortality. In the present context, prenatal diagnosis is of paramount importance. The advent of three-dimensional (3D) ultrasound, coupled with technological advances in 3D evaluation of the fetal heart, has engendered anatomical detailing and enhanced the accuracy of prenatal diagnosis. The advent of 3D reconstruction software, in conjunction with high-definition printers, has facilitated the physical reconstruction of 3D models and the virtual navigation of fetal hearts.



Objectives:

The objective of this study is to perform physical 3D reconstructions of fetal hearts in 30 cases (20 cases of different CHD and 10 normal cases) to:

- clarify diagnostic questions
- improve parental counseling
- teach cardiac anatomy to healthcare professionals and students



Methods:

This is an ongoing study in which 3D physical and virtual models of fetal hearts have been reconstructed, including 13 cases of CHD and 3 normal hearts. The reconstructed CHDs were: Hypoplastic left heart syndrome, common arterial trunk, Tetralogy of Fallot, Total atrioventricular septal defect, Left ventricular diverticulum, Transposition of the great arteries, Ebstein's anomaly, Double outlet right ventricle, Critical pulmonary stenosis, Ventricular Septal Defect, Rhabdomyomas, Left ventricular aneurysm and Tetralogy of Fallot with pulmonary valve agenesis (Figure 1).

All diagnoses were confirmed after delivery.



Results and Conclusions:

The 3D models of 16 hearts were reconstructed. The 3D printed models and virtual navigation of fetal hearts clarified diagnoses, improved counselling for parents and facilitated teaching of CHD anatomy. Interactive discussions could reduce costs and overcome geographical barriers by facilitating communication between healthcare professionals in a virtual environment.



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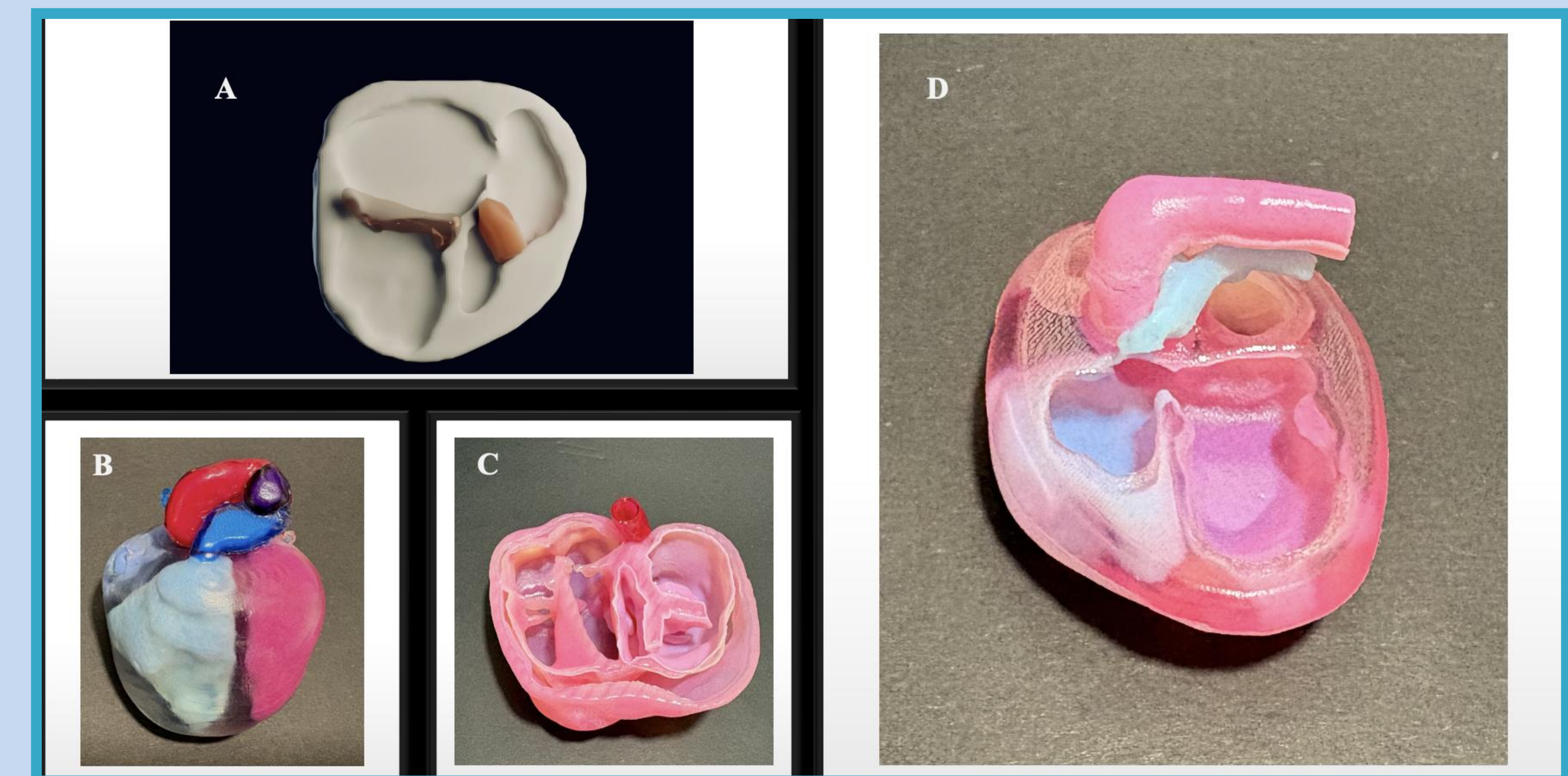


Figure 1- 3D virtual model: A- Hypoplastic Left Heart Syndrome. 3D physical models: B- Normal heart; C- Aneurysm of the left ventricle and D- Double outlet right ventricle type Taussig-Bing