Poster Session -- Clinical case poster session 2

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Taking surgery out of reality: a repair of double outlet right ventricle planned by means of virtual reality

Milano EG.[1]; Pajaziti E.[1]; Sauvage E.[1]; Taylor AM.[1]; Marek J.[2]; Mortensen K.[2]; Cook A.[1]; Schievano S.[1]; Kostolny M.[2]; Capelli C.[1]

[1]University College London, Institute of Cardiovascular Science, LONDON, United Kingdom of Great Britain & Northern Ireland
[2]Great Ormond Street Hospital for Children, London, United Kingdom of Great Britain & Northern Ireland

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Background/Introduction

Double outlet right ventricle (DORV) is a complex congenital heart defect and the decision on a surgical strategy can be challenging, especially in presence of non-committed ventricular septal defect (VSD). Cardiovascular imaging technology has rapidly evolved towards 3D visualizations of complex anatomies. Images from computed tomography (CT), cardiovascular magnetic resonance (CMR), and 3D echocardiography can be converted into 3D models to enhance the perception of spatial relationship in cardiovascular structures. Virtual reality (VR) provides not only a unique visual experience but also allows for interaction with digital 3D objects. The user is completely immersed within a simulated environment and can handle complex objects as well as use various tools. This is commonly achieved through the use of a VR headset with a stereoscopic display and tracking capabilities via external sensors.

Purpose: This report outlines a case of repair of a DORV where VR tools were developed in-house as an aid in the pre-operative planning stage.

Clinical case

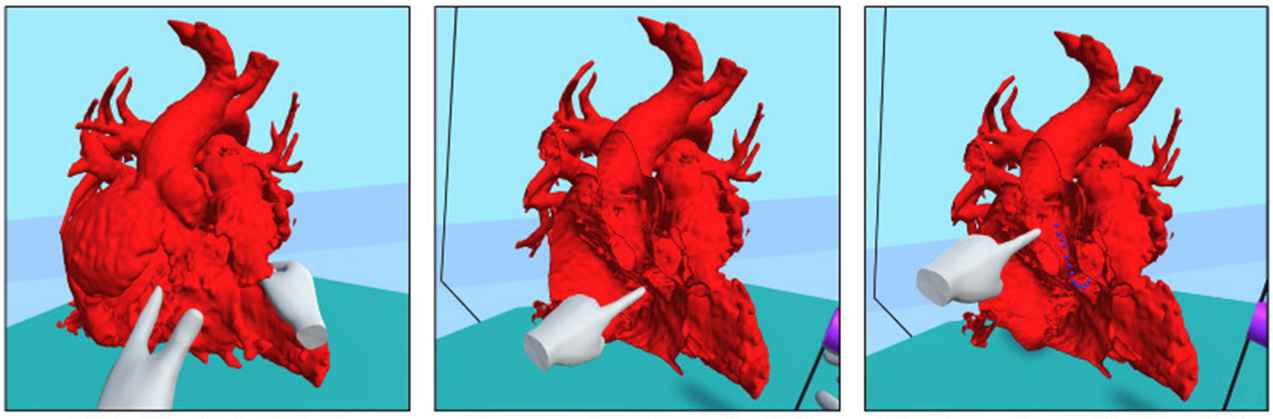
A 9-month-old patient was referred at our Centre with a postnatal diagnosis of DORV with side by side great arteries and uncommitted VSD. After an initial palliation with pulmonary artery (PA) banding, the case was discussed to plan feasibility of an intra-cardiac tunnelling of the VSD to the aorta. Transthoracic echo showed a balanced ventricular anatomy with uncommitted VSD and some chordal attachment of the tricuspid valve to the interventricular septum with mild tricuspid regurgitation. Cardiac CT was requested and it showed significant sub-pulmonary obstruction and right ventricular hypertrophy, PA band in situ with good calibre pulmonary artery trunk and branches, and unobstructed LV outflow tract.

A patient-specific 3D reconstruction was created from CT to use as an input for a VR application specifically developed by our team for planning cardiovascular operations. The patient's anatomy was assessed in VR prior to the procedure. Operators were immersed into intra-cardiac structures, explored multiple surgical access, measured spatial relationship and possible interference of intra-cardiac structures. VR tools were implemented to allow handling, rotation, multiple cross-sectional view, and visualization of the possible baffle path (Figure).

The patient successfully underwent an intra-cardiac biventricular repair with VSD enlargement and creation of a baffle from the VSD to the aorta, without the need for arterial switch. Post-surgery imaging showed an unobstructed left ventricular outflow tract.

Conclusion: A VR tool was designed in-house to aid planning the biventricular repair of a complex case of DORV. VR enhanced the understanding of specific anatomical intricacies and allowed visualization of potential surgical strategies. Virtual reality can become an accessible tool to render multi-modality cardiac images and therefore facilitate planning of procedures.

Abstract P358 Figure.



VR handling of patient's heart *VR cross-sectional view showing VSD* *VR tool shows the possible VSD-Ao baffle*