Pulmonary regurgitation following total repair of Tetralogy of Fallot: Correlation of MR flow quantification with clinical ECG findings

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Abstract:
Tetralogy of Fallot is a collection of four congenital heart defects including ventricular septal defect and pulmonary stenosis. Current patient management usually involves early surgical intervention. However, patients are often left with a partly incompetent pulmonary valve and suffer from pulmonary regurgitation. In this work, patients underwent phase velocity cine MRI to quantify their pulmonary regurgitation. A good correlation (r=0.69) was found between regurgitation fraction and QRS duration which is known to lengthen when the ventricular volume increases. A strong correlation was also found between the age at scan and the regurgitation fraction (r>0.9).

Introduction
Tetralogy of Fallot (TOF) accounts for 5-6% of all congenital heart disease in the UK. Treatment usually involves the early surgical correction of the anatomical anomalies that make up TOF. However, this in order to assess the amount of variation in QRS duration within a small sample of the normal population.

MR Imaging:
MR imaging was carried out using a 1 Tesla Siemens, Impact Expert MRI scanner (St Thomas’ hospital) or a 1.5T Philips Intera (Guy’s Hospital). All volunteers and 10 patients (patient 1 to 10) were scanned at St Thomas’ hospital; the remaining patients were scanned at Guy’s hospital. Flow in the aorta and the pulmonary artery were measured using phase velocity cine (PVC) MRI. The image parameters were optimized for each subject. However, echo time (TE) remains constant at 6.5 ms, as does slice thickness of 5 mm and a matrix size, which was 256x256. Retrospective gating was also used on the Philips scanner.

MR flow quantification was performed using Medis flow software. Function data was obtained using a series of short axis images through the right ventricle (Gradient echo on Siemens, SSFP on Philips scanner). Image parameters and number of slices was optimized for each patient. Images were analyzed using software supplied by the manufacturers (Siemens: Argus, Philips: Easyvision cardiac package).

Results
The net pulmonary flow closely correlated with aortic flow (r>0.9, p<0.001) and the forward pulmonary flow strongly correlated with the stroke volume (r=0.9, p<0.001) thus indicating that MR is ideal for measuring regurgitation fraction.

Results also demonstrated a significant correlation between QRS duration and regurgitation fraction (Fig. 1) confirming that the increased ventricular sized due to the regurgitant valve is associated with a QRS widening. The QRS duration was similar in most of the volunteer (82.9± 4.9 ms, range 80-90 ms). However, one volunteer presented with an abnormal QRS duration of 140 ms due to suspected Wolf-Parkinson-White syndrome.

Table 1 summarises the investigations carried out on the patient group. Four patients (patients 1, 4, 6, 10) were scanned under general anaesthetics in the presence of an anaesthetist concordant with normal hospital procedures.

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References