

Cardiology in the Young

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Measurement of right ventricular function following stage 2 Norwood operation for hypoplastic left heart syndrome

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Introduction Outcome following the Norwood operation for hypoplastic left heart syndrome (HLHS) depends on the ability of the right ventricle (RV) to function as a systemic ventricle. However no gold standard for non-invasive assessment of RV function exists.

Aims To assess Tricuspid Annular Plane Systolic Excursion (TAPSE) as a non-invasive measure of RV function following stage 2 of the Norwood procedure, by comparing it with radionuclide angiographic (RNA) measurement of RV ejection fraction (EF) and to correlate pre and postoperative RV function with specific postoperative outcome criteria.

Method Twenty-six children undergoing stage 2 Norwood at Guy's Hospital between August 1996 and October 1999 were studied. Excluded were those who did not have classical HLHS (5), who had severe tricuspid regurgitation (1), or who had moved away necessitating follow up elsewhere. (1). Assessment of RV function was by TAPSE measurement at the first postoperative clinic visit, averaged over 3 cardiac cycles by a single observer. This was compared with RNA measurement of EF which was performed at approximately the same time. RNA scans were also routinely performed preoperatively in these children. Postoperative outcome parameters included peak central venous pressure (CVP) measurement, presence or absence of significant pleural effusions which required drainage, and length of stay on intensive care.

Results Surgery was carried out at a mean (se) age of 8.6 (0.6) months and mean weight of 7.4 (0.3) kg. Mean length of stay on intensive care was 48.5 (6.2) hours, and mean peak CVP was 18.6 (0.9) mm Hg. 4/19 children had significant pleural effusions post-operatively. Mean preoperative EF was 60 (3.8) % and mean postoperative EF was 61 (2.6) %. Mean TAPSE postoperatively was 0.82 (0.04) cm. There was **no significant correlation** between postoperative RNA EF and TAPSE measurements. There was a **significant negative correlation** between preoperative EF and peak CVP measurement ($r = -0.41$), such that the worse the RV function preoperatively the higher the peak CVP was likely to be postoperatively. However there was **no significant correlation** between pre or postoperative RV function measured by either method and any other postoperative outcome criteria.

Conclusions This study suggests that TAPSE does not provide a reliable non-invasive measurement of RV function in HLHS following stage 2 of the Norwood procedure. However assessment of RV function is very important in these children, as they depend on their right ventricles for their cardiac output. In view of this we plan to continue to evaluate TAPSE as the number of cases increases, as well as to look at other methods of assessment.

Classification of systolic heart murmurs using time-frequency analysis and artificial neural networks

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Digitally recorded pathological and non-pathological phonocardiograms (PCGs) were characterised by a time-frequency (TF) method known as the trimmed mean

spectrogram (TMS). It was found from the observation of typical innocent murmurs that they manifested a linear signature at around 110 Hz in the first half of systole. Other types of murmur exhibited different signatures in the TF domain. (Refer to the figures.) Features were extracted from the TMS containing the distribution of the systolic signature in the TF domain. Together with the relative acoustic intensity in systole (with respect to those in diastole), these features were used as inputs to the probability neural networks (PNN) for classification. A total of 36 PCGs were employed to train the PNN including 15 non-pathological PCGs (i.e. 10 innocent murmurs and 5 normal PCGs) and 21 pathological PCGs (i.e. 6 ASD, 5 VSD, 8 aortic stenosis, 1 pulmonary stenosis and 1 mitral regurgitation). The PNN was then tested with a different group of 22 non-pathological and 40 pathological PCGs. The system provided a sensitivity of 97.5% (39/40) and a specificity of 95.5% (21/22) in detecting pathological systolic murmurs. The mis-classified pathological sample was considered to be a very quiet localised VSD murmur whereas the mis-classified nonpathological murmur was from a patient with a small atrial communication. The results show that the system offers a promising methodology for classifying murmurs.

Catheter ablation of incisional atrial tachycardia using Localisa

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Background Incisional atrial tachycardia is a potentially dangerous arrhythmia which occurs after surgical correction of congenital heart defects. It is caused by reentry around surgical scars. Drug therapy is usually unsuccessful. Catheter ablation requires localisation of the scar and the creation of a line of block to interrupt the reentrant circuit. We have developed a novel mapping system (Localisa) which uses small transthoracic currents to localise the position of standard endocardial mapping electrodes in real time, in 3-dimensional space.

Methods Five consecutive patients (median age 21 yrs (range 9–48), with atrial tachyarrhythmias and previous surgical correction of congenital anomalies (ASD in 4, VSD in 1) underwent electrophysiological study (EPS). Scars were recognised by demonstration of split potentials and markedly disparate activation times on contiguous electrode pairs and marked on the Localisa image. The schematic shows 2 atrial scars in a patient – the atriotomy used for VSD closure and the cannulation site. These are marked on the Localisa image by hatched circles. A critical isthmus was identified in between scars or between scars and anatomical barriers using entrainment mapping. This area was ablated using radiofrequency (RF) energy (black circles). Localisa enables searching for residual conduction through the line of block and further RF lesion application to complete the line of block if required.

Results In one patient, a linear RF lesion was created between two surgical scars on the right atrial free wall (figure). In one patient the lesion was drawn from a septal scar to the tricuspid annulus. In three patients the lesion was drawn from a single surgical scar on the right atrial free wall to either the inferior (1) or superior (2) vena cava. Two patients had concomitant atrioventricular nodal reentrant tachycardia, of whom one patient also had common atrial flutter. All arrhythmia substrates were successfully ablated in a single session. All patients are arrhythmia free at 20 (1–20) months without pharmacological therapy.

Conclusions The Localisa system is highly successful in identifying surgical scars and

ablation targets. Lines of block can be created and verified in a precise manner. RF catheter ablation using Localisa provides definitive therapy for postoperative incisional atrial tachycardia.

Norwood type operation for hypoplastic left heart syndrome: shunt size, a critical factor

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To evaluate the perioperative outcome of Norwood type palliation for hypoplastic left heart syndrome with respect to shunt size.

Materials and methods: 23 patients underwent the first stage of modified Norwood procedure between January 1995 and July 1999. The median age was 13 days (2 to 60 days). Modifications of Norwood Stage I procedure were applied to accommodate morphological differences. Innominate artery to right pulmonary artery shunt, median size 3.5 mm (3 to 5 mm) provided the pulmonary blood flow. We now use larger size

shunt (3.5 mm) to start with and clip the shunt to reduce its size while coming off cardiopulmonary bypass as dictated by the haemodynamics of the patient.

Results: Perioperative mortality was 30.43%. 3 patients could not be weaned from cardiopulmonary bypass. 4 patients died in early postoperative period. Delayed primary closure of sternum was standard practice, median 5 days (2 to 14 days). Perioperative alteration of shunt size was required in 7 (30.43%) patients. 3 patients required increase in size, 2 patients had revision from 3 to 3.5 mm and in 1 patient from 3.5 to 4 mm. In 4 patients we clipped 3.5 mm shunt to reduce its size. In 2 patients, the reduction was done in theatre while in another 2 patients it was done in the Intensive Care Unit 6–12 hours postoperatively. In no patient we needed to remove the clip.

Conclusions: Standardisation of operative strategy and dedicated perioperative care in recent times have made Norwood Stage I palliation for hypoplastic left heart syndrome feasible with acceptable mortality. Proper selection of shunt size to achieve the balanced systemic and pulmonary blood flow in the postoperative period remains a difficult decision. Use of 3.5 mm shunt and alteration by a clip to reduce its size has the advantage of avoiding redoing of shunt and it is reversible should the pulmonary vascular resistance change in the postoperative period.

Research Award 2000 by “HERZKIND e.V.”

The association of parents and patients “Herzkind e.V.” is, for the fifth time, making two awards, each given at a maximum of DM 50,000, for scientific investigation in the field of the functionally univentricular heart, particularly of hypoplastic left heart syndrome.

The awards may either be given to two institutions, or split amongst a number of national or international institutions. The successful team are required to undertake a scientific investigation in the field of pure research, clinical diagnosis, cardiological or surgical interventions, or long term care and prognosis.

Essentially, the award is intended to cover additional costs for personnel and equipment costing greater than DM 5,000. Applications, including a detailed description of the scientific project, and the anticipated duration of the work and its financing, must be received before 31st May 2000 at:

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