The QRSVm ECG Parameter as a Predictor of Arrhythmia in Tetralogy of Fallot: A Pilot Study

Elliott Sexton*, Medical Student, Newcastle University – e.sexton@ncl.ac.uk
Dr Louise Coats MBBS MRCP PhD, Institute of Cardiovascular Research, Newcastle University.

Background

Tetralogy of Fallot (ToF)
- Recent research has suggested risk factors for arrhythmia in ToF patients, most promisingly a reduction in the QRS Vector magnitude (QRSVm) ECG parameter.
- If proven reliable and effective, QRSVm could provide a cheap, easy, non-invasive screening method for arrhythmia risk stratification in patients with ToF.

Complications
- Increasing survival means more ToF patients are suffering chronic complications (Fig. 2).
- Chronic altered heart anatomy/function + scarring from surgical incisions
- Altered electrical conduction in heart muscle
- Abnormal heart rhythms (arrhythmias)

QRS Vector magnitude (QRSVm)
- Recorded atrial tachycardia, n=2
- Recorded AV block, n=1

QRSVm <6 months after PVR
- Presented as individual data points, low sample sizes (Fig. 4).
- Trend suggests slight reduction in QRSVm in patients with AT vs. controls (T-test, p=0.191).
- Only 1 data point lower than all controls in arrhythmia group – low sensitivity.
- Same data point was the only value less than proposed threshold for intervention (1.24 mV).
- PVR itself did not significantly alter QRSVm (T-test, p=0.575).

Methods

Study Design
We conducted a retrospective pilot cohort study using 13 patients enrolled into the Freeman Hospital’s Adult Congenital Heart Disease Database who had also undergone a Pulmonary Valve Replacement (PVR).
- Relevant medical history and demographics obtained from patient notes.
- ECGs <6 months before PVR measured using electronic callipers and QRSVm calculated (Fig. 3).

Results

1) QRSVm <6 months after PVR
- Presented as individual data points, low sample sizes (Fig. 4).
- Trend suggests slight reduction in QRSVm in patients with AT vs. controls (T-test, p=0.191).
- Only 1 data point lower than all controls in arrhythmia group – low sensitivity.
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2) QRSVm over serial ECGs
- Large fluctuations seen in serial QRSVm measurements in some patients, whilst smoother pattern of reduction/gain in others.
- Casts some doubt over usefulness of measure for risk stratification if it is highly dynamic.
- Only 1 patient (of 3) with an arrhythmia remained consistently below proposed intervention threshold.

3) Tests for measurement error and IOV
- Bland-Altman plots suggest highly consistent measurements with low error rate and 1 outlier.*
- Difference between IOV in controls vs. arrhythmias approached significance (T-test, p=0.09).

Conclusions

Table 1: Power calculation outputs

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<th>QRSVm &lt;6m prior to PVR</th>
<th>QRSVm IOV</th>
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References

Acknowledgements
Dr Louise Coats (Project Supervisor) Newcastle University.
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Dr Stephen Murray, Consultant Cardiologist (EP Research Objectives)
1) To test whether results suggesting QRSVm reduction is predictive of subsequent arrhythmia are reproducible in a local patient population.
2) To measure QRSVm values over serial ECGs and qualify if any patterns of change over time are present.
3) To determine how susceptible the QRSVm parameter is to measurement errors and whether these influence accuracy.

Table 3: Measurement and calculation of QRSVm

Figure 1: ToF anatomy

Figure 2: Chronic ToF complications

Figure 4: QRSVm <6 months prior to PVR against arrhythmia history.

Figure 5: QRSVm recorded over serial ECG measurements. Colour coded to show individual patient progression. AF = Atrial tachycardia, AVB = Atrioventricular block.

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