Quality Assurance Testing of Transoesophageal Echocardiography Probes
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Introduction
Transoesophageal Echocardiography (TOE or TEE) probes are used for perioperative cardiac monitoring and considered best practice for several procedures [1]. Edinburgh Royal Infirmary performs approximately 70 procedures a month [2]. In total there is a stock of 9 TOEs at an approximate value of £135,000.

Six months after purchase concerns were raised by the anaesthetic team that there was degradation in image quality. An investigation was carried out and routine testing put in place. A visual inspection and image testing procedure was developed, Figure 1 & 2 respectively.

Methods & Results

1. Visual Inspection & Electrical Safety Tests:
Probes were inspected for signs of physical damage, with close attention paid to the insertion tube for bite marks or cracks. The tip of the probe is flexible and the angles of deflection were checked to meet manufacturer stated values. Applied part leakage and insulation tests as per IEC 60601-1 were carried out on the probe (insertion tube & probe tip only) submersed in 0.9% saline solution.

2. Image Tests:
The Edinburgh Pipe Phantom (agar based tissue mimicking material) and the Resolution Integral [3] can be used as a figure of merit for the evaluation of ultrasound B-mode imaging. Here we have used it to obtain indicative images and record Low Contrast Penetration (LCP). Performance was judged against results obtained at acceptance, or against the baseline mean of probes that had not been used clinically. Doppler functions were validated by imaging a vessel in palm of the hand or the carotid.

3. Results:
A total of 26 probes have been examined, including loan and replacement probes for the hospital’s compliment of 9 probes. 5 of the 26 have been excluded from the results presented here due to developing other faults. Figures 3 & 4 show common artefacts that developed on the TOE probes after 3-6 months clinical use.

4. Conclusions:
A proactive testing procedure for TOE probes has been put in place that incorporates visual, electrical safety and image quality checks six monthly or annually. It has allowed for serious problems to be detected and communicated effectively to the manufacturer. The suspected cause of the degradation is failed elements. While difficult to determine if elements have been damaged in phased array transducers it may explain the reduction in signal to noise ratio and resulting drop in LCP. As all the elements in the phased array also play a part in the focusing, the loss of a portion of them or increases the effect of grating lobes responsible for the B-mode artefact. This testing procedure has provided a substantial financial saving to the Health Board. 17 probes highlighted by Medical Physics have been replaced under warranty. It is hoped that similar problems are picked up quickly in future helping reducing downtime and increasing the clinicians’ confidence in their equipment.

References: