Bubbles in the Brain

Treating an irregular heart rhythm (cardiac arrhythmia) can sometimes require drastic invasive procedures, which often result in undesired complications. For this reason, research at the University of Leicester is helping efforts to reduce the side-effects of targeting arrhythmia, as alumnus **Dr David Spiers** explains.

During the 2011-12 academic year, I took time out from my medical studies to conduct a research BSc under the Faculty of Medicine and Biological Sciences. The work entailed measuring the number of potentially harmful emboli - small solids or air bubbles in the bloodstream - which are a by-product of a procedure aimed at treating patients with a specific form of cardiac arrhythmia called Atrial Fibrillation (AF).

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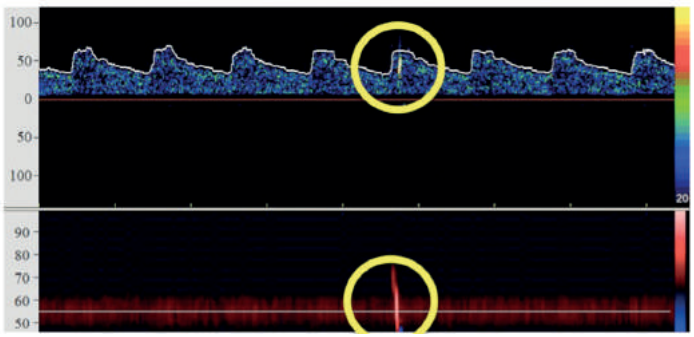
AF is an irregular rhythm of the heart that causes the flow of blood in the heart to become turbulent. It can result in blood clots being deposited in the brain, predisposing a patient to cerebrovascular (brain) injury. Emboli are any detached masses carried in the blood that are capable of clogging arteries, and those that reach the brain can result in damage known commonly as a stroke. AF can be treated with medication but in patients whose AF is resistant, an alternative treatment called catheter ablation is performed. This procedure involves passing wires through blood vessels in the patient's groin, up to their heart to burn the areas of tissue suspected of causing the irregular rhythm in their heart (see CARTO3 map).

Previous studies have demonstrated that potentially significant numbers of emboli are produced during ablation, however the incidence of stroke in these situations is unclear. Using cardiac surgery as a well-studied comparison, with a low incidence of stroke, this research compared the number of emboli produced throughout both procedures.

To achieve this, patients from Leicester's Glenfield Hospital undergoing catheter ablation for their AF were recruited to the research. Ultrasound probes were placed against patients' heads while they underwent ablation and then analysed post-procedure for signals of emboli, this can be seen in the image below. These results were then compared to recordings from patients who had undergone heart surgery. The comparison of the two procedures showed rates of embolisation to be similar.



Arterial Doppler ultrasound trace demonstrating an embolus (circled) detected in a patient during catheter ablation for AF

This research demonstrates an effective use of ultrasound to establish the frequency of emboli and could potentially lead to technologies that reduce patients' exposure to these potentially harmful masses. However we acknowledge that the technique has limitations, currently it is unable to reliably discriminate between solid and gaseous emboli. The majority of emboli detected during catheter ablation procedures were assumed to be dissolvable air bubbles in the brain, much less sinister than solid emboli. As a result further studies into the significance of embolisation rates during catheter ablation for AF and the impact of emboli on patient cognition require investigation, with the aim of further improving patient safety.

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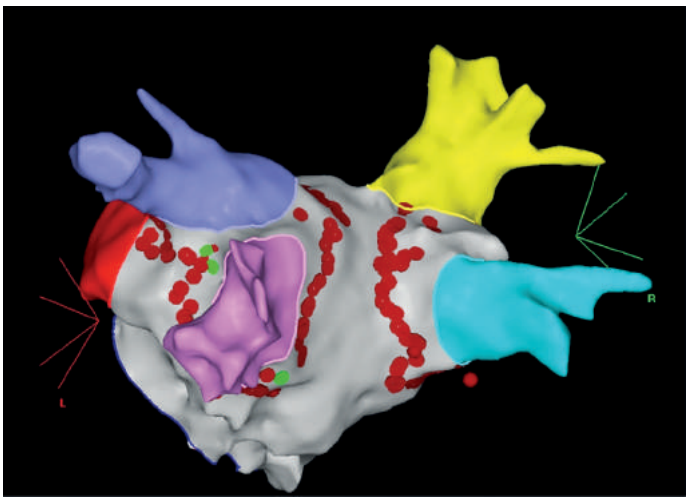

Three-dimensional CARTO3 map of the posterior aspect of the left atrium with the four pulmonary veins highlighted; Red dots indicate the location of ablation lesions

Dr David Spiers has graduated from the University of Leicester and now works in the East Midlands.