
There are a growing number of invasive electrophysiologists who believe that the future will bring improved patient outcomes, safety, and efficiency through the technology of robotics. One of the leading robotic technologies is remote magnetic catheter navigation technology (RMT).

Recent medical literature contains a number of case reports and series demonstrating the feasibility of this technology in many settings. These include mapping and ablation of tachycardias in the setting of complex congenital heart disease,1,2 more routine supraventricular tachycardias,3 and ventricular tachycardia.4–6 There has also been a small trial comparing transseptal versus retrograde aortic approaches to left-sided accessory pathways using RMT.7

Beyond feasibility, we are of course concerned with the question of demonstrated improvement over current technology. There is supporting literature for the use of RMT to reduce fluoroscopy times for both the patient and the physician, while producing similar outcomes.8–12 As with mapping and ablation in congenital heart disease, there is also demonstrated benefit in navigating difficult anatomy.13 Theoretical benefits, with less supporting literature, include 1) more accurate cardiac geometry creation due to consistent catheter tip–tissue contact without regional distortion from excess force;13–14 2) improvement in safety through atraumatic catheter movement and therefore reduction in the risk of cardiac perforation; 3) improved ablation through more consistent catheter–tissue contact; and 4) improved workflow through shortened and more consistent procedure times.

There are concerns that have been raised as well. These include 1) potential lack of catheter tip stability and therefore reduced ablation efficacy due to limited tissue contact force; 2) the effect of the learning curve on practice processes; and 3) increased cost of equipment. Each of these must be addressed as the technology becomes more widely utilized.

In this case report, the authors present an innovative use of RMT that allowed for the successful completion of a difficult case in which the diagnosis was straightforward, but the patient’s anatomy was not. It highlights the unique capabilities of the system in safely accessing challenging anatomy. It also highlights the innovative thinking required to get the most from this new technology. In particular, the team addressed the concern that the floppy nature of the RMT catheter, considered a positive attribute with regard to safety and accessing difficult anatomy, would limit catheter tip stability along the mitral annulus. Their innovative approach, in which the catheter is prolapsed into the left atrium from the left ventricle and then back to the mitral valve, is clearly effective in avoiding this difficulty.

The importance of highlighting this example lies in more than demonstrating a particular technique for a particular case or situation. This case study represents one of the most important steps toward the adoption of new technology: thinking “outside the box.” As new technology is adopted, we initially try to replicate what is being done with existing tools. However, once the operator is familiar with the technology, the true innovation comes in the application of the technology in new ways.

This point is brought home by a recent case in our lab in which RMT was used to successfully map and ablate a patient suffering from frequent superior mitral annular premature ventricular contractions and non-sustained ventricular tachycardia. As the fluoroscopic and three-dimensional electroanatomic images display (Figure 1), the chosen approach was transseptal. The unique flexibility and navigation capabilities of the RMT system were used to map from this approach not just the left ventricle and mitral annulus, but also the aortic root. This was accomplished by prolapsing the catheter within the left ventricle and out the aortic valve, and then prolapsing once again within the ascending aorta to direct the catheter tip back down to the aortic root.

Among the biggest challenges facing any emerging technology, beyond the simple question of “does it work,” is the jump from use by a limited number of early adopters to more generalized use. The first step in this process is the
demonstration that the technology is useable in everyday routine practice, and not just reserved for especially difficult cases. Are the techniques employed in the cases presented here the only ways to care for these patients? Of course not: we have been doing similar cases successfully for years. Nevertheless, they do demonstrate the versatility of this new technology. In particular, they remind us that cases that might seem straightforward on the way into the lab may prove to be more challenging than expected. Clearly, RMT is capable of providing good outcomes for our more routine work. The availability of technical capabilities and techniques for handling more complex situations safely and effectively is where RMT may shine in providing the best outcomes for our patients.

A second key to the broader adoption of RMT will be the publication of convincing evidence of good outcomes and successful integration of the technology into practice processes. Although the above mentioned publications are a start, randomized studies have yet to be performed and reported.

What we all hope for are innovations that will eventually lead to better outcomes through successful achievement of procedural goals, improved safety, and gains in efficiency that justify the associated expense. Robotic technologies are in the early stages of defining their role in current practice. They certainly hold much promise for our vision of the future.

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References


Figure 1: Three-dimensional electroanatomic image (a) and fluoroscopic image in LAO projection (b) demonstrating the map created from a transseptal approach by prolapsing of the catheter within the left ventricle and out the aortic valve, and then prolapsing once again within the ascending aorta to direct the catheter tip back down to the aortic root.