Magnetic navigation and voltage mapping guided implantation of a pacemaker atrial lead in a previously unpaceable patient

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We report successful implantation of the atrial pacing lead in a patient in whom such operation had previously failed with the manual approach. Right atrial (RA) electro-anatomical voltage mapping was used to identify an area suitable for pacing and magnetic navigation to allow exhaustive RA exploration leading to successful RA lead screwing.

Keywords Atrial pacing; pacemaker; voltage mapping; magnetic navigation

Magnetic guidewire and catheter guidance aims at replacing the manual-guided approach in cases of difficult manipulation while increasing catheter stability. It is independent of operator manual dexterity and a high degree of precision is reached, thanks to computerization/integration with available mapping systems. We report successful implantation of the atrial pacing lead in a patient in whom such operation had previously failed twice with the manual approach.

A 56-year-old male with past tricuspid endocarditis and valve replacement presented with severe symptomatic sinus node dysfunction. Two attempts at implantation of a right atrial (RA) lead failed because of lead inability to touch most of the RA wall as well as to approach/penetrate to the coronary sinus. Left chambers volume and function were normal. Additionally, when contact was possible on part of the RA wall, electrical silence was recorded. Surgical implantation was rejected by the patient. Recent symptoms aggravation prompted re-evaluation of transvenous implantation.

Because of the two above-mentioned limitations, extensive RA electro-anatomical voltage mapping was planned to identify an area suitable for pacing. Magnetic navigation was also used as it allows exhaustive chamber exploration while enhancing catheter tip wall contact.

The first step consisted of the RA insertion via the femoral vein of a dedicated electrode catheter loaded with three permanent magnets at the tip which align with the direction of the remote controlled magnetic field. The CARTO® sensor was used to edit the RA surface. The catheter was able to touch the whole RA wall as shown by fluoroscopic position and a dedicated contact bar. Complete map revealed a particularly enlarged cavity (volume = 207 mL), the surface of which was almost entirely lacking any recordable potential. It was again impossible to catheterize the coronary sinus despite multiple attempts. In only a very limited area, posterior and superior to the projected coronary sinus ostium did potentials exceeded 0.7 mV to reach 1.2 mV (Figure 1).

The magnetic field corresponding to this position was then permanently applied, firmly applying the catheter tip against the wall in this area. A second operator approached the area via the left subclavian vein with a permanent screw-in lead that, under radiological guidance, was positioned very close to the magnetic catheter allowing effective screwing. Local P-wave amplitude via the pacing lead was also 1.2 mV, and pacing threshold was 1.8 V at 0.5 ms. Magnets were then stowed, and a ventricular lead and a permanent dual chamber pacemaker were implanted. After 6 months of permanent atrial pacing (AAI mode), despite no major changes in RA function, symptoms had disappeared, and pacing/sensing threshold were unchanged.

Magnetic navigation has been proposed to guide pacing leads placement by steering the guidewire within the coronary sinus during resynchronization. This case, however, is the first of its kind in that magnetic navigation was not used to control a guidewire but to find and identify an area suitable for pacing via a regular EP ablation catheter. The combination of voltage mapping with magnetic navigation allowed us to overcome a double problem: extremely low voltage in a very sick RA (allowing identification of an area of normal voltage) and extreme dilatation prohibiting accurate wall mapping (which explains the previous failures of implant). The soft end of the magnetic catheter was easily manipulated to reach areas that were previously not attainable by the hand-held pacing electrode.

Conflict of interest: none declared.
Figure 1  (Top) Right atrial voltage mapping using remote magnetic navigation. Anterio posterior (right) and right posterior (left) views of the RA chamber. Almost all the RA chamber potentials are below 0.5 mV excluding any possibility to find an appropriate pacing target. A very limited area in the posterior septal region exhibits potentials above 0.65 mV allowing appropriate pacing. (Bottom) Left (right) and right anterior oblique views of the appropriate pacing site. The mapping catheter tip position is maintained by the applied magnetic field on the target zone, while serving as a target for the screw in pacing lead.