New Technique

Antegrade Visualisation of the Coronary Sinus for Left Ventricular Pacing

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Key words:
Coronary sinus, left ventricular pacing, resynchronisation therapy.

Introduction: Failure to achieve left ventricular pacing remains one of the obstacles to cardiac resynchronisation therapy.

Methods: A new technique for the placement of left ventricular pacing leads in the tributaries of the coronary sinus is described. Antegrade visualisation of the coronary sinus is accomplished by selective coronary angiography and a hydrophilic 0.032" wire is advanced along the coronary sinus. This facilitates advancement of a coronary sinus sheath over a multipurpose diagnostic catheter. A hydrophilic angioplasty wire is then utilised for negotiation of the inferior left ventricular vein and successful placement of the left ventricular pacing lead.

Results: In 5 patients in whom cannulation attempts were unsuccessful despite prolonged fluoroscopy time (39.85 ± 9.6 min), the new technique resulted in successful placement of the left ventricular pacing lead within an average fluoroscopy time of 6.5 ± 2.1 min.

Conclusion: Antegrade visualisation of the coronary sinus via selective coronary angiography and the use of a hydrophilic angiography wire may facilitate successful implantation of a left ventricular pacing lead in difficult cases.

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Cardiac resynchronisation therapy (CRT) is an established therapeutic option for certain patients with advanced heart failure.[1,2] However, despite recent advances in lead-delivery technology, the failure of successful left ventricular pacing remains one of the obstacles to CRT. Inability to cannulate the coronary sinus and/or advance the pacing lead into one of its tributaries is mainly responsible for the reported unsuccessful implant rates of 5-13%.[3-5] In certain patients who have a peculiar coronary sinus anatomy, placement of a left ventricular pacing lead may be very challenging.[6-9] We report on a new technique for rapid cannulation of the coronary sinus and advancement of the left ventricular pacing lead with minimum fluoroscopy and procedure time in cases where conventional techniques have been unsuccessful.

Methods

Patients

Five patients with adverse coronary sinus anatomy were studied (Figures 1, 2). In all patients, the coronary sinus could not be successfully cannulated with a steerable electrophysiology electrode despite prolonged efforts, exceeding 30 min of fluoroscopy time, and the use of multiple coronary sinus sheaths, such as all three curves of the Rapido Cut-away (Guidant) and the Attain (Medtronic) sheaths.

Technique

Left coronary angiography is performed using a 5F diagnostic 4L Judkins catheter through the femoral route. Digital acquisition at 12.5 frames/s is maintained until

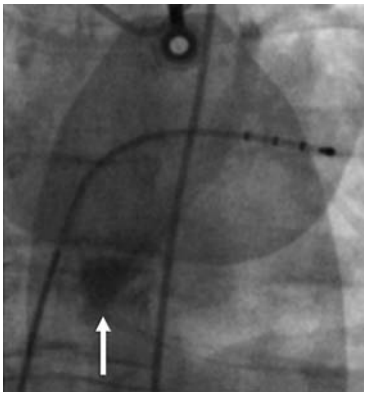

Figure 1. Localisation of a low positioned coronary sinus ostium in the anteroposterior projection. A very low position (arrow) of the coronary sinus ostium is seen (as judged by the position of the tetrapolar electrode that records a His bundle potential) and the coronary sinus itself has a very steep course. Advancement of steerable electrodes or pacing leads in such cases is extremely difficult.

full visualisation of the coronary venous system is accomplished. Usually, technically challenging cases involve an ectopic position of the coronary sinus ostium and/or a subsequent steep angle of the coronary sinus course such that manipulation and advancement of any lead is virtually impossible (Figures 1, 2). A cineangiogram obtained in the 20° left anterior oblique projection allows orientation of the tip of a coronary sinus sheath towards the ostium of the coronary sinus. Thus, the ostium of the coronary sinus may be engaged, but further advancement of either the sheath or a steerable electrophysiology electrode may be impossible.

A hydrophilic 0.032" J wire (Terumo) is then advanced through a 5F multipurpose catheter along the coronary sinus towards the great cardiac vein. The hydrophilic nature of this wire allows easy negotiation of the coronary sinus lumen and provides support for advancement of the 5F multipurpose catheter and consequently the coronary sinus sheath into the coronary sinus just below the ostium of the inferior left ventricular vein. Alternatively, it can be exchanged with stiffer wires for this purpose. A PT^2, LS (Boston Scientific) hydrophilic angioplasty guide wire is used for negotiation of the inferior left ventricular vein and the left ventricular pacing lead is advanced over it.

Results

In 5 patients, coronary sinus cannulation attempts were unsuccessful despite prolonged fluoroscopy time (39.85 ± 9.6 min) (Table 1). Adoption of the new technique resulted in successful placement of the left ventricular pacing lead with an average fluoroscopy time of 6.5 ± 2.1 min. No complications were encountered.

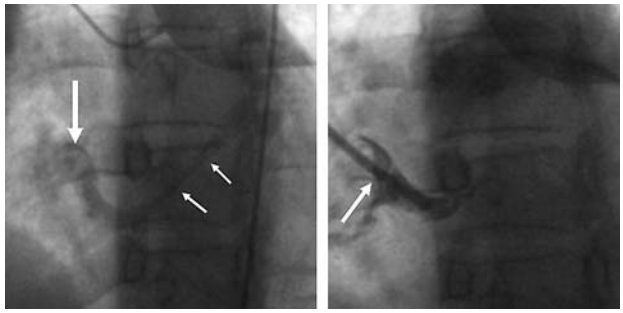

Figure 2. Localisation of a high positioned coronary sinus ostium in the 20° left anterior oblique projection (left panel). Despite the engagement of the coronary sinus ostium by the sheath following visualisation of the coronary sinus (right panel), no further advancement of the electrode or the sheath was possible without the use of the hydrophilic wire.

Discussion

One of the major technical limitations to achieving successful left ventricular pacing lies in the anatomic variability of the coronary sinus and its tributaries. So far, several techniques have been reported to facilitate lead placement in technically difficult cases. A markedly angulated coronary sinus poses special difficulties for intubation, particularly advancement of the left ventricular lead into a suitable tributary.[10,11] Such an anatomy might prohibit deep cannulation of the coronary sinus with a dedicated electrophysiology catheter that is usually employed for this purpose and/or further advancement of the coronary sinus sheath over the catheter. Lack of sufficient support

Table 1. Clinical and procedural characteristics. Fluoroscopy times (FT) required for unsuccessful attempts (Preceding FT) and for placement of left ventricular pacing lead with the new technique described.

Pt	Sex	Age	Diagnosis	Preceding FT (min)	FT with new technique (min)
1	F	65	DCM	52	9
2	F	68	DCM	36	7
3	F	56	IHD	48	6
4	F	60	DCM	31	4
5	M	65	IHD	32	4.5

DCM – dilated cardiomyopathy; IHD – ischemic heart disease.

with a coronary sinus sheath well into the coronary sinus may also prohibit successful advancement of the left ventricular lead into a sharply angulated inferior left ventricular vein. Variations in the morphology of the eustachian valve and its ridge may also create anatomical difficulties. Hellerstein and Orbison[12] have reported large, membrane-like valves that practically occlude the orifice in up to 25% of hearts; this might potentially make intubation extremely awkward, despite the use of a guiding flexible or curved-tip guiding catheter. In addition, sharply angulated side-branches may render the placement of a left ventricular lead extremely difficult, even using several techniques and modifications that have been proposed for technically challenging cases.[13-18]

Retrograde venography is often used for the delineation of coronary sinus anatomy. This, however, requires cannulation of the coronary sinus and, in addition, carries up to a 3-6% risk of venous dissection or perforation.[3-5,9] Antegrade visualisation of the coronary sinus via coronary angiography has been reported previously, and its use has been advocated in order to assist lead positioning via conventional techniques.[19,20] The use of a hydrophilic wire for the negotiation of the coronary sinus following its antegrade visualisation has not been reported before. The angiographic hydrophilic J wire is a steerable wire that is routinely used in the case of difficult femoral access due to extensive atheromatosis or tortuosity of the iliac-femoral system. In addition, it is sufficiently strong to provide support for the advancement of the multipurpose catheter and subsequently the sheath. Use of the double-wire technique,[17,18] when required, further improves support and facilitates left ventricular lead positioning in the inferior left ventricular vein.

Our technique has two main advantages. First, it allows easy identification of the coronary sinus orifice and selection of a suitable side branch for left ventricular pacing. Second, it provides support for the advancement of the sheath up to the orifice of this side branch. In our laboratory it is now routinely used in all biventricular pacing cases with considerable success and minimal radiation exposure. We advocate its use at least in technically challenging cases.

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