Femoral implantation and pull through as an adjunct to traditional methods in cardiac resynchronization therapy

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BACKGROUND We have described the use of femoral access followed by pull through of the lead to a pectoral position to circumvent difficulty in implanting a left ventricular (LV) lead by standard methods.

OBJECTIVE The purpose of this study was to establish the effect of femoral implantation and pull through on the overall rate of success in percutaneous implantation of LV leads.

METHODS We collected data prospectively in all attempts at LV lead implantation from the time that we envisioned the femoral pull-through approach.

RESULTS In the 6 years to September 30, 2014, our group attempted to implant a new LV lead in 736 patients, including 16 who previously had failed attempts by other groups. A standard superior approach was successful in 726 of 731 patients (99.3%) in whom it was attempted. In 5 patients (0.7%), we failed to deliver a lead from a superior approach; in 5 of 16 patients, with previous failed attemtps (31%), we judged that those attempts had been exhaustive. In all 10 cases, LV lead placement was achieved from a femoral approach, with the procedure time being 186 ± 65 minutes. In the first case attempted, the pull through failed; the lead was tunneled to the pectoral generator. In 1 case, the coronary sinus was found to be occluded at the ostium: a transseptal approach was used with the subsequent pull through. No complication occurred. At 22.3 ± 18.5 months after the implantation, all systems implanted by a femoral approach continued to function.

CONCLUSION Used as an adjunct to standard methods, the femoral access and pull through method allows percutaneous LV lead placement in virtually all cases.

KEYWORDS Left ventricular pacing; Femoral approach; Pull through; Surgical left ventricular pacing; Endocardial left ventricular pacing; Transseptal left ventricular pacing

(Heart Rhythm 2016;13:1260–1265)

Introduction

Despite advances in implantation techniques and equipment, it occasionally proves impossible to place a left ventricular (LV) lead in a suitable position by traditional methods. When the difficulty is due to occlusion of veins of the upper body, it can usually be circumvented by the extraction of existing leads, balloon dilatation of venous stenoses, or both. Our experience suggests that the other principal cause of failure is an inability to engage the ostium of the coronary sinus (CS) in a stable manner and to a suitable depth from a superior approach, often because of tortuosity or unfavorable angulation of the proximal part of the CS relative to the superior vena cava.

We reasoned that the CS that is difficult to engage from above might prove amenable to an inferior approach; having achieved this, we realized that the lead could be pulled up through the circulation to a standard subclavian access point for convenience. We have published proof of the feasibility of this method[1]; we have since been endeavoring to determine its usefulness and safety.

Methods

From the time that we first envisioned the femoral pull-through method in September 2008, we kept a detailed prospective record of all cardiac resynchronization therapy (CRT) procedures. Patients in whom we could not obtain satisfactory LV pacing by standard methods were offered the femoral pull-through method as an alternative to surgical

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  http://dx.doi.org/10.1016/j.hrthm.2016.01.027

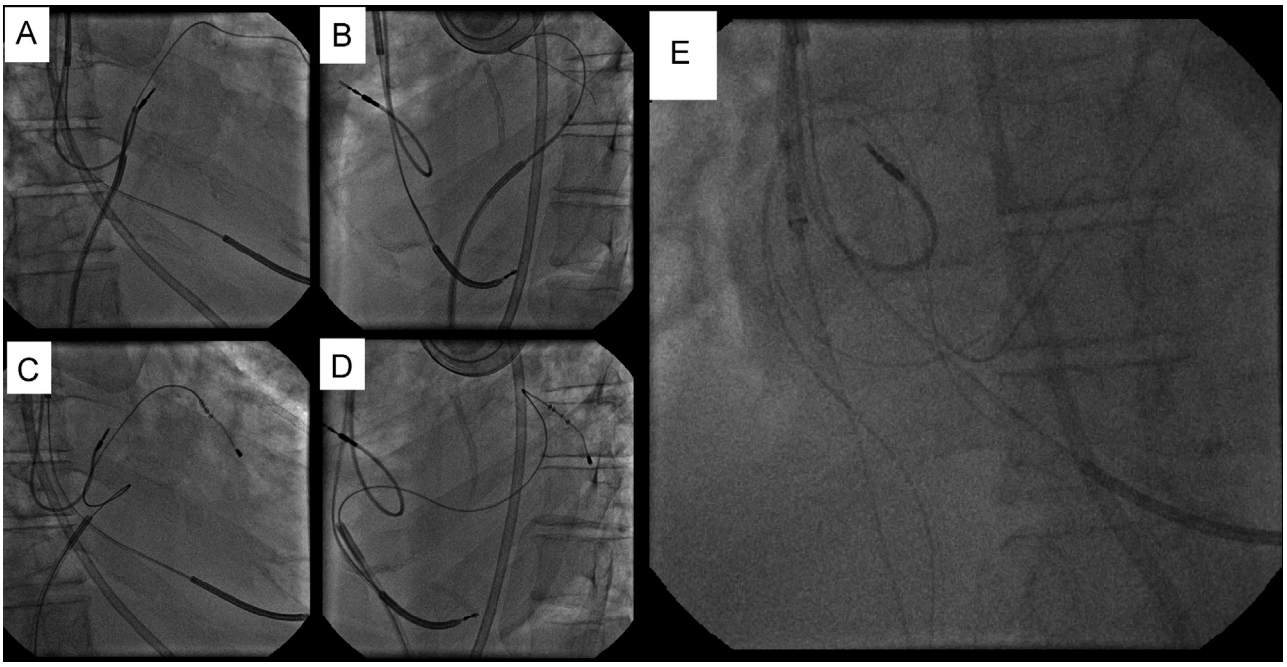

Figure 1 Radiological images showing the steps involved in femoral implantation and pull through in a typical case (case 6). In panel **A** (right anterior oblique projection) and panel **B** (left anterior oblique projection), the coronary sinus has been entered using a hydrophilic guidewire delivered as far as the distal part of the great cardiac vein through an Amplatz left coronary catheter via an extended hook delivery system. After coronary sinus venography, a StarFix lead was deployed in a posterior left ventricular vein. In panels **C** and **D**, the lead has been deployed and the delivery system withdrawn to the right atrium. Panel **E** shows a fluoroscopy frame recorded during the pull through of the lead. The IS1 connector is seen lying within the SL0 sheath adjacent to the atrial lead; loops of the lead lie in the right atrium, extending into the inferior vena cava.

placement of an epicardial LV lead. The study received approval from the local ethics committee.

Patients who were referred to us after failed attempts at LV lead placement by other operators were evaluated carefully: a further attempt at a standard superior approach was offered if we thought that that there was still a reasonable probability of success. If the failure had occurred after exhaustive attempts in the hands of an operator known to us and trusted, we offered the patient the option of a femoral pull-through procedure as an alternative to a surgical epicardial approach as the next step.

All femoral procedures were performed in a biplane catheter laboratory by the same experienced electrophysiologist. We executed the procedures as previously described.[1] Coronary artery injection with cine acquisition in the venous phase was used to image the venous anatomy in most cases. We engaged the CS using a delivery system inserted via a 14F sheath (Cook Medical, Bloomington, IN) in the right femoral vein. A deployable LV lead, usually a Medtronic Attain StarFix 4195 (Medtronic, Minneapolis, MN), was placed and deployed securely in a suitable coronary vein, and the LV lead delivery system was removed (Figure 1).

A guidewire was passed through the same 14F femoral sheath alongside the pacing lead to reach the superior vena cava where it was grasped by a 25-mm Amplatz GooseNeck snare (ev3 Endovascular, Inc., Plymouth, MN) that had been passed through a 14F sheath in the subclavian vein on the side of the generator. The guidewire was pulled out through the superior access sheath and held taut as an 81-cm 8F SL0 sheath (Daig, St. Jude Medical, Inc., St Paul, MN) was passed downward over it from the superior access site to emerge through the femoral sheath (Figure 2). The guidewire and introducer were removed from the sheath; the IS1 connector of the lead was pushed forcefully into the open end of the sheath and sutured in position using 0 Ethibond (Johnson & Johnson, New Brunswick, NJ). We found it necessary to make a 1-cm slit longitudinally in the end of the sheath to push the connector into it to a sufficient depth to suture securely.

Two operators were required for the pull through of the lead: one applied steady traction to the SL0 sheath at the superior end, while the other worked at the femoral access site to guide the lead through the sheath. This involved gentle pressure to ease each component of the lead through the resistance of the hemostatic valve of the sheath. From the sixth case onward, we removed the hemostatic valve from the sheath at this stage (Figure 2), cutting the sheath circumferentially just below the valve using the splitting tool supplied with the delivery system. This allowed us to control the lead on each side of the valve to pass it through without strain. The sheath was pinched gently to prevent blood or air flow as the lead was helped through it into the vein.

Once in the venous system, the lead was pulled upward quickly to minimize the risk of transport of a loop of lead by blood flow into the right ventricle and pulmonary circulation. As soon as the distal end of the SL0 sheath and the IS1 connector emerged from the subclavian sheath, we knew that the widest parts of the lead lay within the sheath: the sheaths and lead were withdrawn as one, continuing to withdraw steadily until the loops of the redundant lead in the circulation were reduced to the curve that is customarily used in a standard superior implantation. A purse-string suture was used to control bleeding at the superior access site.