Cardiac Resynchronisation Therapy – An Approach to Difficult Left Ventricular Lead Placement

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Abstract

Left ventricular (LV) lead in cardiac resynchronisation therapy (CRT) is the most important and difficult lead to place, leading to abandonment of up to 10–15 % of procedures. Here we discuss various difficulties encountered in percutaneous placement of LV leads and what all can be done to ensure successful placement of the same and to prevent the already compromised patient from the requirement of epicardial lead placement.

Keywords

Cardiac resynchronisation therapy, left ventricular lead, percutaneous placement

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Of the three leads placed during cardiac resynchronisation therapy (CRT), the left ventricular (LV) lead is the most important and also needs to be placed precisely in the region that is activated last – hence it becomes the most difficult leads to be placed. With the advent of new and improved hardware and simultaneously more experience being gained by operators, percutaneous LV lead placement is now becoming more and more successful. However, up to 10–15 % of procedures are abandoned across the world due to failure of LV lead placement.[1–2] Since the patients selected for CRT placement generally have a very low ejection fraction (EF) and can have deterioration in their clinical status because of slightest insult, one must look into the factors that can predict a difficult lead placement, so that necessary measures can be taken beforehand.

Failure to access the coronary sinus (CS) remains the most important reason for difficult LV lead placement.[1–2] This may be due to enlarged right atrium (RA), severe tricuspid regurgitation, tortuous or vertically positioned CS ostium or because of a prominent Thebesian or Vieussens valve.[3–4] A study has shown that a very high location of CS ostium (as determined by computed tomography [CT]) to be a sole predictor for prolonged CRT implantation procedures.[5] Newly developed lead delivery sheaths with a large primary curve and a smaller secondary curve[6] are helpful in cases of large RA, as these take support from lateral atrial wall and superior vena cava. A good method is to push the sheath into the right ventricle and then pull with an anticlockwise rotation. At times contrast injections may have to used to locate abnormally placed CS ostium. Deflectable mapping catheters (with or without central lumen) may be helpful in engaging CS ostium in difficult cases.

Another challenge that an operator might face is that of difficult anatomy of the coronary venous system including lack of suitable venous branches, sharply angulated or tortuous venous branches or branches with valves or stenosis. One may plan to elucidate the anatomy beforehand by venous phase of coronary angiogram in plain right anterior oblique or left anterior oblique views to eliminate any surprise during the procedure, or a balloon occlusive venogram may be taken once CS ostium has been cannulated. In cases of failure of such a technique, other methods including CT, intracardiac echocardiography and fibre optic endoscopy have been used,[7–10] though data regarding the same are lacking. In case of a sharply angulated or tortuous target vein, one may use an appropriately shaped inner sheath that can selectively hook the desired vein and is capable of wire and lead delivery.[6] Other techniques include pushing the wire as much inside the vein as possible to gain extra support, or to pull the wire while advancing the lead, or using second stiffer wire to reduce the tortuosity and provide extra support.[11] Sometimes a different vein altogether may have to be chosen. Case reports of using stents to open up the vein or to stabilise the LV lead are also available. We presented a case at EuroPCR 2015, in which we had to place a coronary stent besides the precisely placed LV lead to stabilise it and to prevent distal migration, which was causing phrenic nerve stimulation and proximal placement causing prolapse into the RA. Another technique is to use retained guidewires for anchoring the LV lead. But all of these techniques make extraction of the lead near impossible if deemed necessary in future. Placement of the stent besides the lead may cause injury to the lead insulation.

Sometimes complications such as CS dissection may make visualisation of target vessels difficult, which may lead to a deferment of the procedure. In an interesting case report,[12] such a case was treated with prolonged inflation of a coronary angioplasty balloon, which allowed completion of the procedure in the same attempt.

Despite all these factors sometimes the procedure has to be abandoned and analternative way of LV lead placement chosen. These include minimally invasive surgical alternatives (minithoracotomy, video-assisted thoracoscopic surgery and robotically assisted placement of LV leads), minimally invasive subxiphoid epicardial approach, transseptal endocardial left ventricular lead implantation and bifocal right ventricular pacing.[13–18] In a prospective study[19] comparing a percutaneous transvenous approach via the CS versus epimyocardial placement via a left lateral mini-thoracotomy, both epicardial and transvenous LV-lead placement for CRT therapy were found to be safe and effective. The transvenous group had a shorter intensive care unit stay (0.66 versus 3.8 days) and shorter ventilation times (0.34 versus 3.2 hours). At 6 months follow-up, no major differences in LV-lead parameters (threshold, sensing and impedance) were observed. In another study[16] to assess the feasibility of transseptal endocardial LV pacing in patients in whom transvenous CS lead placement had failed, 10 such patients were taken up for endocardial LV lead placement, nine of whom could have the procedure completed successfully. The stimulation threshold was 0.78±0.24 V, and the R-wave amplitude was 14.2±9.7 mV. At 2 months follow-up, the stimulation threshold was 1.48±0.35 V with a 0.064±0.027 ms pulse width. There was no phrenic nerve stimulation observed in any of the patients. There were no thromboembolic complications at follow-up. LV transseptal endocardial lead implantation from the pectoral area was considered to be a feasible approach in patients with a failed CS approach and in whom epicardial surgical lead placement is not an option. Longer follow-up is warranted to determine the risk of thromboembolic complications.

To conclude, percutaneous LV lead placement though at times may be difficult, but it is still the preferred option. All measures should be taken to place the LV lead percutaneously as these patients have a severely compromised LV function and thus an additional burden of general anaesthesia and epicardial LV lead placement surgically can be detrimental. ■

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