HOSTED BY
ELSEVIER

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/IPEJ

Overcoming the challenge of venous occlusion for lead implantation

*Haran Burri**

Electrophysiology Unit, Cardiology Service, University Hospital of Geneva, Rue Gabrielle Perret Gentil 4, 1211 Geneva 14, Switzerland

ARTICLE INFO

Article history:
Available online 29 July 2015

Keywords:
Pacemaker lead
Implantable cardioverter defibrillator lead
Vein stenosis
Vein occlusion

ABSTRACT

Vein stenosis or occlusion is a frequent finding in patients with previously-implanted transvenous leads. This editorial describes the different techniques that may be used to overcome this hurdle in case a new lead needs to be implanted, and discusses two case reports in this issue of the journal.

In patients implanted with a pacemaker or implantable cardioverter defibrillator (ICD), venous stenosis or occlusion due to thrombosis/fibrosis resulting from the presence of the lead is a frequent finding. Total venous occlusion is found in 9% of patients implanted with an ICD, and up to 25% of patients display some degree of stenosis [1]. Neither the hardware (size, number and material of the leads) nor the access site (cephalic, subclavian or axillary vein) appear to affect the rate of this complication. Venous thrombosis is usually asymptomatic and goes most often unnoticed due to the formation of collaterals providing venous drainage. It is usually of no clinical consequence, unless the patient needs to undergo implantation of additional leads e.g. in case of lead failure or upgrade to an ICD or cardiac resynchronization therapy (CRT). Venous occlusion is best identified by phlebography via an ipsilateral peripheral catheter, which can specify the site and approximate length of the stenosis/occlusion. In patients with vein stenosis, access can usually be achieved by use of hydrophilic 0.035″ guidewires (e.g. Terumo Glidewire®), sometimes with dilators used for enlarging the constrictions, and long sheaths to allow passing leads in case of a distal stenosis (e.g. of the innominate vein). However, total venous occlusion is more challenging, and leaves the operator with the following options:

1. *Contralateral implantation of a completely new system:* This is the simplest solution, but will result in a greater total number of leads. Current recommendations discourage having more than 4 leads placed via the superior vena cava [2], although this number is empiric and not based upon any data. Another consideration is that the abandoned leads will contra-indicate MRI being performed in the patient.
2. *Contralateral implantation of the new lead with subcutaneous tunnelisation to the old pocket.* This is most often achieved with blunt dissection, but may also be achieved using tunnelling tools.

* Tel.: +41 22 37 200; fax: +41 22 372 72 29.
E-mail address: haran.burri@hcuge.ch.

Peer review under responsibility of Indian Heart Rhythm Society.
http://dx.doi.org/10.1016/j.ipej.2015.07.006

3. *Recanalisation by lead extraction*. One or several indwelling leads are extracted, usually using extraction sheaths, thus creating access for implanting the new lead(s).
4. *Recanalisation without lead extraction*. This technique, analogous to that described above for stenosis, may often be successful for short occlusions. Recanalization using laser tools has also been described, but requires special equipment and skills [3].
5. *Gaining access medially to the occlusion*. This may require a very medial subclavian puncture, with risk of pneumothorax, collateral damage (e.g. puncture of the trachea or non-compressible arteries) and future lead crush. As an alternative to subclavian puncture, a supraclavicular approach has been described with a puncture lateral to the head of the sternocleidomastoid muscle [4]. However, this approach, as for internal jugular venous puncture, requires tunnelling the lead over the clavicle.
6. *Femoral/iliac access with a femoral/abdominal pocket*. This technique has been used in case a superior access is impossible (e.g. in case of bilateral subclavian occlusion). It requires use of long leads and has been associated with lead instability (especially the atrial lead) and of pocket erosion [5]. Implantation of CRT has also been described by femoral venous access [6].
7. *Inside out access*. This involves puncturing the occluded venous segment anteriorly in the subclavicular region and through the skin using a transeptal kit by femoral access [7]. This is an innovative approach, but needs further clinical evaluation before being applied more widely.
8. *Surgical access*. This most commonly involves implantation of an epicardial lead, but could also involve placing a standard pacing lead endocardially, e.g. via a transatrial access.
9. *Leadless pacemakers*. These devices have been recently introduced into clinical practise for pacing the right ventricle [8]. A leadless system implanted into the left ventricle via a retrograde aortic access for CRT has met safety issues [9].

The choice of one or the other strategy depends on individual anatomical considerations, on the tools available, and on the physician's experience with a specific technique. In this issue of the *Indian Heart Journal*, two reports describe the implantation of coronary sinus leads for CRT upgrades in the setting of subclavian vein occlusion.

Sadarmin et al. [10] report two ICD patients requiring an upgrade to CRT-D, in whom subclavian vein occlusion required contralateral implantation of the coronary sinus lead, which was subsequently tunnelised to the old pocket (i.e. option 2 listed above) using a Baird Groshong central line kit. The kit includes silicone tubing and a metal tunnelling device. The tubing was used to connect the IS-1 connector of the pacing lead to the tunnelling rod, which is pushed through the subcutaneous tissue to the contralateral pocket, pulling the lead freely through the tissue. This is an ingenious adaptation of material for an alternative use, and has the advantage of requiring little tissue dissection. Specific tunnelling tools have been available (e.g. the Traverser® by Pressure Products). Nevertheless, tunnelling across the chest is usually achieved simply by blunt dissection using long clamps, taking care not to puncture through the skin. This technique may not be suitable in very thin patients with little subcutaneous tissue.

In the second report, Menezes et al. [11] report a patient with a dual-chamber pacemaker implanted since 7 years who was upgraded to a triple-site CRT pacemaker (with 2 right ventricular leads and one coronary sinus lead) using option 4 listed above. The subclavian vein was occluded, and the atrial lead (which was redundant due to chronic atrial fibrillation) was extracted by traction using a locking stylet, creating a lumen through which a guidewire and sheath were successfully placed, allowing implantation of the additional ventricular leads. The authors were fortunate in that the extracted lead did not cause any stripping of the vein, or recoil/plugging of the lumen by fibrinous material, which would have made it difficult to regain access to the vein and place the guidewire past the occlusion. Most physicians employ special sheaths (either mechanical or laser) to extract leads. The extraction sheath, which is retained beyond the occluded segment (and ideally up to the level of the right atrium in order to be past any tract that may offer resistance) then allows ready access for placing a guidewire and subsequently a long introducer sheath or the coronary sinus guiding catheter. One potential pitfall of this strategy is damage by the extraction sheaths to the neighbouring leads. The remaining leads therefore need to be carefully tested and replaced if necessary. As an alternative, a pull-through technique using a guidewire inserted into the lead which is then extracted by femoral access offers the possibility to place a dilator and introducer sheath over the proximal end of the retained guidewire [12]. However, it may be necessary to perform venoplasty of the fibrous tract through which the guidewire courses in order to pass introducer sheaths or coronary sinus guiding catheters.

Understanding the different techniques described above will help overcome the hurdle of venous obstruction in most cases. However, as in other tricky situations, one also has to be able to improvise in order to have a successful outcome.

REFERENCES

[1] Lickfett L, Bitzen A, Arepally A, Nasir K, Wolpert C, Jeong K-M, et al. Incidence of venous obstruction following insertion of an implantable cardioverter defibrillator. In: A study of systematic contrast venography on patients presenting for their first elective ICD generator replacement; 2004. p. 25–31.

[2] Wilkoff BL, Love CJ, Byrd CL, Bongiorni MG, Carrillo RG, Crossley 3rd GH, et al. Transvenous lead extraction: Heart Rhythm Society expert consensus on facilities, training, indications, and patient management: this document was endorsed by the American Heart Association (AHA). Heart Rhythm 2009;6:1085–104.

[3] Worley SJ, Gohn DC, Pulliam RW. Excimer laser to open refractory subclavian occlusion in 12 consecutive patients. Heart Rhythm 2010;7:634–8.

[4] Antonelli D, Freedberg NA, Turgeman Y. Supraclavicular vein approach to overcoming ipsilateral chronic subclavian vein obstruction during pacemaker-ICD lead revision or upgrading. Europace 2010;12:1596–9.

[5] Mathur G, Stables RH, Heaven D, Ingram A, Sutton R. Permanent pacemaker implantation via the femoral vein: an alternative in cases with contraindications to the pectoral approach. Europace 2001;3:56–9.

[6] Agosti S, Brunelli C, Bertero G. Biventricular pacemaker implantation via the femoral vein. J Clin Med Res 2012;4:289–91.

[7] Elayi CS, Allen CL, Leung S, Lusher S, Morales GX, Wiisanen M, et al. Inside-out access: a new method of lead placement for patients with central venous occlusions. Heart Rhythm 2011;8:851–7.

[8] Sperzel J, Burri H, Gras D, Tjong F, Knops R, Hindricks G, et al. State of the art of leadless pacing. Europace 2015 [in press].

[9] Auricchio A, Delnoy PP, Butter C, Brachmann J, Van Erven L, Spitzer S, et al. Feasibility, safety, and short-term outcome of leadless ultrasound-based endocardial left ventricular resynchronization in heart failure patients: results of the wireless stimulation endocardially for CRT (WiSE-CRT) study. Europace 2014;16:681–8.

[10] Sadarmin P, Chelliah R, Timperley J. Contralateral transvenous left ventricular lead placement of implantable devices with pre-sternal tunnelling in chronically obstructed subclavian veins. Indian Pacing Electrophysiol J 2015;15(2):113–7.

[11] Menezes M, Bernardes A, de Sousa J, Marques P. Overcoming a subclavian complete occlusion: simple single lead extraction by the subclavian vein allowing implantation of two new leads and upgrade to CRT-P with multi-site pacing. Indian Pacing Electrophysiol J 2015;15(2):118–20.

[12] Rogers DP, Lambiase PD, Chow AW. Successful coronary sinus lead replacement despite total venous occlusion using femoral pull through, two operator counter-traction and subclavian venoplasty. J Interv Cardiac Electrophysiol 2007;19:69–71.