CASE STUDY

Exchange of pacing or defibrillator leads following laser sheath extraction of non-functional leads in patients with ipsilateral obstructed venous access

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Abstract

Occlusion of the subclavian or brachiocephalic vein in pacemaker or defibrillator patients prohibits ipsilateral implantation of new leads with standard techniques in the event of lead malfunction. Three patients are presented in whom laser sheath extraction of a non-functional lead was performed in order to recanalise the occluded vein and to secure a route for implantation of new leads. This technique avoids abandoning a useful subpectoral site for pacing or defibrillator therapy. The laser sheath does not affect normally functioning leads at the same site.
(*Heart* 2000;**83**:e12)

Keywords: laser sheath; venous occlusion; pacemaker; lead extraction

At the time of lead replacement, occlusion of the subclavian or brachiocephalic vein prohibits insertion of new leads from the same site with standard techniques. We describe three patients in whom a laser sheath was used to extract non-functional leads and to create a route to implant new leads during the same procedure.

Methods

Lead extractions were performed under general anaesthesia in the operating room with the patient prepared for thoracotomy. First, a locking stylet (Cook Inc, Indiana, USA) was introduced into the central lumen of the pacing lead, then, a 12, 14, or 16 F laser sheath (Spectranetics, Colorado, USA) and a synthetic outer sheath were inserted over the pacing lead. Laser energy was provided by a xenon chloride laser with a wavelength of 308 nm (Excimer; Spectranetics). Repetition rate was set at 40 Hz and energy flux at 60 mJ/mm^2. The laser sheath was advanced first using the lead as a guide to recanalise the obstruction and detach the lead from the fibrous bindings. The outer sheath followed closely to support the manipulation of the laser sheath. After reaching the distal electrode, if the lead was not yet detached from the cardiac wall, counter traction using the outer sheath was applied to free the tip of the lead. The laser sheath and the pacing lead were then removed, and the outer sheath kept in position distal to the occlusion. One or two 150 cm long 0.035″ guide wires were introduced beyond the occlusion in order to secure access to the central venous circulation before the outer sheath was removed. A soft peel away sheath was then inserted over the guide wire beyond the occlusion. This sheath also prevented a false route or perforation of the recanalised vein during insertion of the new lead. One or two new leads were then inserted in a standard way. The same pocket was used for insertion of the new pacemaker or implantable cardioverter defibrillator (ICD) generator.

Patients

Patient 1, a 41 year old man with sick sinus syndrome, had a dual chamber pacing system implanted in the left subpectoral area. At the time of elective generator replacement five years later, the ventricular lead was malfunctioning and the lead abandoned. A single chamber pacemaker was connected to the atrial lead. After complaints of dizziness associated with atrioventricular block, insertion of a new ventricular lead through puncture of the ipsilateral subclavian vein failed. Phlebography showed occlusion of the left subclavian vein from the site of insertion of the leads up to the brachiocephalic vein. Extensive collaterals drained into the internal jugular vein. We extracted the ventricular lead with a 14 F laser sheath; the atrial lead was left in situ. A new ventricular lead was implanted in the right ventricular apex, and with the original atrial lead, connected to a dual chamber pulse generator. The procedure was uncomplicated and both leads functioned normally at serial follow up.

Patient 2, a 12 year old girl with congenital heart block, had a VVI pacemaker implanted via the right subclavian vein when she was 8 years old. The generator was replaced three years later due to high current drain resulting from a high stimulation threshold. At the time, it was not possible to advance the lead to accommodate for growth. A year later, this resulted in intermittent capture as the lead became more taut, as confirmed by the chest *x* ray. Although she was asymptomatic,

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Accepted 17 January 2000

Figure 1 Preoperative phlebography of patient 3. The defibrillator lead is inserted via the left subclavian vein (arrow). There is occlusion from the site of insertion to the superior caval vein. Collaterals drain via the right brachiocephalic vein into the superior caval vein. An abandoned artial lead from the right side is also present.

phlebography showed occlusion of the right brachiocephalic vein. Collaterals draining into the left brachiocephalic and the right internal jugular vein provided venous drainage. The lead was extracted with a 12 F followed by a 14 F laser sheath. After removal of the lead, two guide wires were inserted through the outer sheath. New atrial and ventricular pacing leads were positioned and connected to a dual chamber system. The procedure and follow up were uneventful.

Patient 3 was a 40 year old woman with a history of surgical correction of tetralogy of Fallot and pacemaker therapy for postoperative atrioventricular block. After resuscitation for ventricular fibrillation, a single chamber ICD with an Endotak C 0125 lead (CPI, St Paul, Minnesota, USA) was implanted in the left subpectoral area. A right sided atrial lead as well as epicardial atrial and ventricular leads were abandoned. Two years after implant, an attempt to insert an atrial lead in the left subclavian vein in order to upgrade the ICD to a dual chamber system failed and a new single chamber ICD was connected. Two years after this procedure, she experienced circulatory collapse. At admission, there was ventricular non-capture as the result of an increased pacing threshold of the defibrillator lead. Preoperative phlebography showed occlusion of the left subclavian and brachiocephalic vein with collaterals to the opposite site (fig 1). At surgery, there was an isolation defect of the ventricular pace/sense electrode of the ICD lead. The lead was removed with a 16 F laser sheath. Two guide wires were inserted through the outer sheath and a new ICD and atrial pacing lead were implanted and connected to a dual chamber defibrillator. Bleeding from the entry site into the subclavian vein, possibly resulting from severing a small artery, complicated the procedure. A chest *x* ray after the procedure showed no signs of bleeding into the thorax. Her recovery was uneventful.

Discussion

Venographic and isotopic studies have shown an incidence of thrombosis of the subclavian or brachiocephalic vein related to pacing leads between 8% and 21%.[1–6] However, symptomatic occlusion occurs less frequently (3% to 10%) and rarely with clinically important morbidity. It is therefore advisable to perform routine preoperative phlebography in patients undergoing revision of pacemaker leads to detect occult occlusion.[7]

If occlusion is present, the possible options are insertion of new leads through the opposite subclavian vein, extraction of a non-functional lead to access the venous circulation, or an alternative route for access of the central venous circulation.

In the first option, both subpectoral areas can become compromised in case of complications and the patient is left with no conventional site for endocardial pacing. Also, the risk of bilateral occlusion is likely to be between 8% and 21% in these patients if both sides have a similar rate of occlusion.[4–8] This can be accompanied by the clinical picture of a superior vena cava syndrome.[4]

In the second option, the pacing lead is extracted and the occlusion recanalised to permit insertion of new leads via the same route. Ing *et al* described lead extraction with the Cook lead extraction kit (Cook Pacemaker Corporation, Leechburg, Pennsylvania, USA) in two patients with superior vena cava or brachiocephalic vein occlusion.[9] Lead extraction was performed first and the occlusion was crossed separately from another venous entry site in order to perform dilatation and stent implantation. Subsequently, new endocardial pacing leads were implanted from the original site.

We used a laser sheath with the pacing lead as a guide to extract the lead and recanalise the vein simultaneously. The laser sheath created a large enough lumen by ablation to be able to implant new leads directly. We did not dilate or stent the obstructed vessel: this would have complicated the procedure without clinical benefit to the asymptomatic patients.

There are no comparative reports between the Cook lead extraction kit and the laser sheath concerning the efficacy to recanalise an obstructed vein and to reimplant new leads. In a randomised trial, the laser sheath performed favourably compared to conventional sheaths in initial attempts at pacemaker lead extraction in general (94% *v* 64% complete removal).[10] However, as crossover was allowed, many investigators switched to the laser sheath when extraction with conventional sheaths became difficult. This suggested that the laser sheath was more predictable for lead extraction, even for operators with experience of conventional extraction techniques.

The higher probability of extracting a lead using a superior approach with the laser sheath makes subsequent insertion of new leads via the same route more likely. If a lead has to be removed using an additional inferior technique (the Byrd femoral workstation), no guide wire is positioned through the occlusion. Crossing the obstruction without guide wire has a greater chance of creating a false route or damaging the vessel.

The third option is using an alternative route for endocardial pacing. Adwani *et al* reported percutaneous puncture of a hepatic vein to achieve permanent transvenous pacing in children with Fontan circulation.[11] De Cock *et al* described a patient with bilateral total occlusion of the subclavian and innominate veins, in whom they used minimal invasive thoracotomy to enter the superior caval vein for single lead VDD pacing.[8] Such approaches may be applicable to a small minority of patients requiring permanent pacemaker therapy.

Our approach has to be balanced against the risk of complications of lead extraction. In the US Lead Extraction Database, extraction with a conventional approach was accompanied by major complications in 2% of the 1299 patients (haemopericardium 1.2%, haemothorax 0.5%, pulmonary embolism 0.2%, death 0.6%).[12] Major complications, including pericardial tamponade, haemothorax, and pulmonary embolism, have been reported in 2.5% to 3.5% and fatal complications in 0% to 0.8% of laser sheath procedures.[10 13–15] Therefore, in elderly patients or patients with serious comorbidity increasing the risk of lead extraction, insertion of a new system in the opposite subpectoral area is preferable. In the absence of obstruction, insertion of new leads ipsilaterally and abandonment of the non-functional leads is preferable. In adults, Furman *et al* and Parry *et al* reported on the safety of abandoning non-functional leads with the wires insulated to avoid exposure to tissue, and the lead securely fastened to the fascia.[16 17] They had only one complication in 189, and two complications in 119 non-infected leads that were abandoned. All complications related to infection. Only one lead needs to be extracted to gain access to the vein: leaving other non-functional leads in situ reduces the risk of the extraction procedure.

However, there are no studies in paediatric patients confirming the safety of abandoning non-functional leads. In principle, all non-functional leads in this population should be extracted to prevent the accumulation of abandoned leads as multiple lead changes in the course of a normal life expectancy can be expected. Long term follow up data in a large series of patients concerning the safety and efficacy of laser extraction are required before recommending this approach routinely in young children.

A further advantage of the approach described is that the laser sheath has no direct effect on the outer insulation of pacing leads. Therefore, coexisting normally functioning leads can be used again as in our first patient.[18]

CONCLUSION

In patients with pacemaker or ICD lead related venous occlusion, the advantage of salvaging an existing pocket and venous entry site, and thereby sparing the controlateral subpectoral area for future interventions, justifies extraction of a non-functional lead to access the venous system ipsilaterally.

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