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Case Report

Application of Hong's technique for removal of stuck hemodialysis tunneled catheter to pacemaker leads

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ABSTRACT

The term "stuck catheter" refers to situations where a central venous catheter cannot be removed from the central veins or right atrium using standard technique, usually due to development of a fibrin sheath leading to adherence to SVC or right atrial wall. Endoluminal dilatation is an interventional radiology technique that has been previously reported in the removal of stuck hemodialysis catheters, and to the best of our knowledge, this case describes the first application of the technique to remove a hemodialysis catheter that was adherent to SVC wall and transvenous pacemaker leads.

Introduction

Tunneled central venous dialysis catheters are often used as a temporary vascular access for dialysis patients, while they wait for an arterio-venous fistula (AVF) to mature. However, it can remain as a long-term measure in cases where the AVF fails or in patients unsuitable for AVF formation or transplantation [1].

The long-term consequences of permacath placement include an increased risk of catheter dysfunction, infection, thrombosis, fibrosis, vessel stenosis, and vessel perforation which may eventually require the surgical removal of the catheter [2–4].

Surgical removal is usually a straightforward procedure performed under local anesthesia by dissecting the cuff from the tunnel, but this can be complicated by the presence of tight fibrin adhesions between the catheter and the vessel wall preventing catheter removal. In these cases, attempted forceful removal can lead to catheter fragmentation, embolization, or fatal vessel or right atrial tear [4–7].

There are many alternatives to open surgery including complex endovascular techniques, laser and nonlaser sheath removal, and more recently, endoluminal dilatation.

Endoluminal dilatation is an interventional technique pioneered by Hong [8] to remove a stuck catheter. It involves

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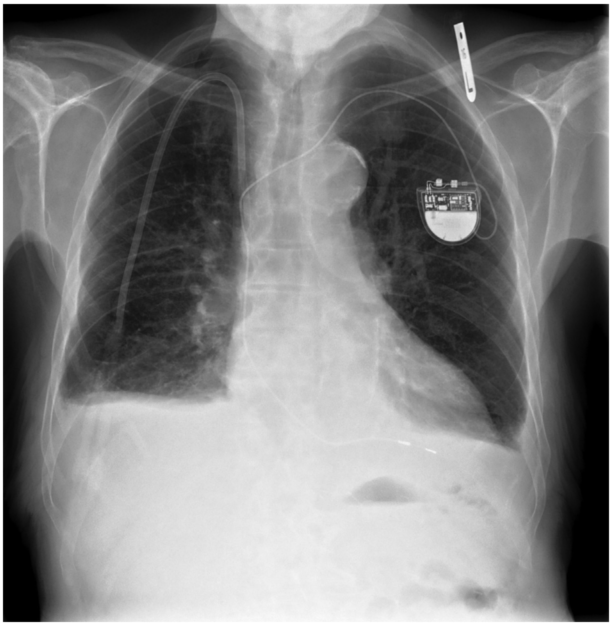

Fig. 1 – Chest radiograph shows right sided tunnelled dialysis catheter projected over wire from single lead pacemaker at SVC confluence and proximal SVC.

balloon dilatation within a catheter lumen, enlarging the lumen and stretching the catheter wall, breaking any adherent fibrin sheath which allows the catheter to be removed. Laser sheaths advanced over stuck pacemaker wires involve the use of laser energy to disrupt fibrin sheaths [9] and have been used to remove pacemaker leads adherent to indwelling catheters [10,11].

In our case, the catheter was tethered to adjacent transvenous pacemaker leads as well as the SVC wall which made removal impossible using standard techniques without affecting the pacemaker on which this patient was still dependent. To the best of our knowledge, this report describes the first case where Hong's technique has been successfully used to remove a catheter adherent to pacemaker leads in addition to SVC wall.

Case report

An 85-year-old man with metastatic renal clear cell carcinoma and end-stage renal failure had a permacath inserted in November 2011 for hemodialysis, while waiting for a left brachiocephalic AVF to mature. He had been deemed unsuitable for renal transplantation. He also had a single lead pacemaker inserted 2 years prior to permacath insertion and remained pacemaker dependent (Fig. 1).

Unfortunately, he had failure of the left brachiocephalic AVF in January 2012, and he continued to have hemodialysis, 3 times a week for 3 years, via the right internal jugular tunneled catheter before a small hub crack was noticed in November 2014. An attempt to seal this with a repair kit was unsuccessful. Due to the risk of air embolus and infection, dialysis was stopped via this route and commenced via a right femoral nontunneled catheter, and catheter exchange was requested by the renal team.

The patient was brought to the IR room with a view to straightforward exchange of the right internal jugular permacath for a new catheter via the same track.

The catheter was withdrawn through a small neck incision, clamped and cut and the proximal fragment then dissected from the tunnel and removed. A guide wire was then inserted through the distal fragment still in the vein and advanced to the inferior vena cava (IVC). It was then attempted to remove the in situ distal fragment of the catheter, but there was significant resistance felt. On fluoroscopy, as the catheter fragment was pulled, the pacemaker lead moved with the catheter at the confluence of the SVC, and during this maneuver, there were multiple ectopic beats on cardiac monitoring. It was decided that forceful traction was not appropriate due to the risk of central vein tearing and also dislodgement of pacemaker leads.

Endoluminal dilatation was then attempted using standard 6 mm × 4 cm and 4 mm × 4 cm balloon dilatation catheters through the lumens of the permacath (14-F split cath, Medcomp, PA, USA), but these would not pass. Unfortunately, lower profile balloon dilatation catheters were not available at that time. In view of this, it was decided to proceed with other maneuvers to remove the stuck permacath.

Initially, the right subclavian vein was punctured as the right internal jugular above the catheter was occluded and a standard 7 French vascular sheath inserted over a guide wire. Venograms revealed a tight SVC stenosis around the dialysis catheter and pacemaker wire at the confluence of the SVC, and this was dilated with a 10-mm balloon initially with no significant change in the stenosis following this due to recoil.

A 20-mm wire loop snare (Cook Medical, Bjaeverskov, Denmark) was advanced from the right subclavian, through the stenosis to the IVC, and the guidewire in the IVC was engaged. The snare was then withdrawn over the wire to the permacath in an attempt to strip the sheath from the permacath and release the catheter. This appeared successful over the initial 2–3 cm, but then, the snare would not advance any more proximally. Multiple attempts were then made to disengage the snare from the catheter by using multiple different shaped angiographic catheters, balloons, and longer sheaths to dislodge the snare, but none of these were successful. There was also a risk of the snare cutting through the dialysis catheter with distal embolization of a catheter fragment.

The right common femoral vein was then punctured, and a wire was eventually manipulated through the SVC stenosis into the right brachiocephalic vein. This proved difficult due to the recoiled stenosis at the SVC confluence and multiple collateral vessels, which the wire would preferentially cannulate. A range of angiographic catheters and balloons were used to try to dislodge the snare from the dialysis catheter from below, but these also proved unsuccessful due to the confined space in the right brachiocephalic vein (Fig. 2A–C).

After a prolonged procedure (approximately 4 hours), a discussion took place between the nephrology team, IR team, and the patient's relatives. Due to his advanced age and background of metastatic renal cell carcinoma, it was decided not to refer the patient to a cardiothoracic surgical

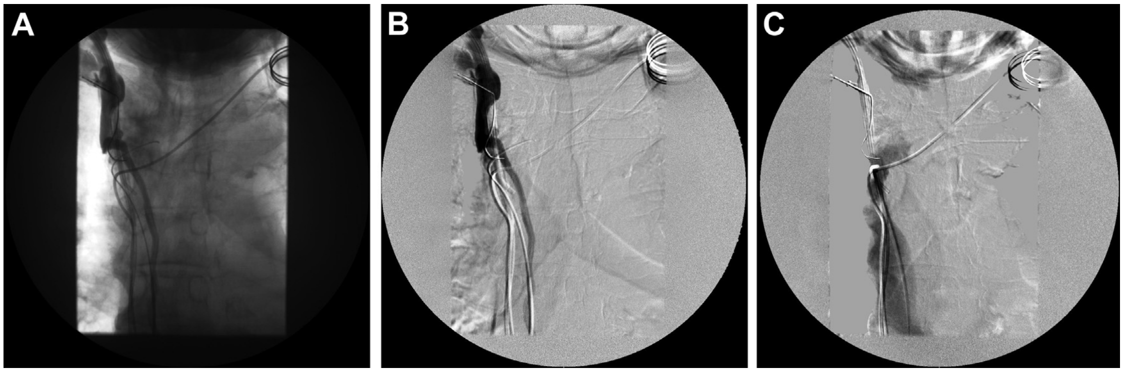

Fig. 2 – Images (A) and (B) taken from venogram showing recoil stenosis at SVC confluence with reflux in to azygous vein and a guidewire extends from the right femoral punture to distal left brachiocephalic vein. Venogram (C) using a catheter via right femoral access opacifies distal left brachiocephalic vein with no opacification of right brachiocephalic vein.

center for further attempts at permacath retrieval. It was explained to the patient's next of kin that there would be a risk of severe sepsis secondary to the retained fragments of dialysis catheter and snare, but there were no significant concerns regarding fragment embolization. It was also explained at the time that it may be worth repeating an attempt at endoluminal dilatation when lower profile balloons were in stock.

The snare was then cut proximally and the cut end buried under the skin and the cut end of the dialysis catheter ligated and buried in a fascial pocket under the skin in the neck.

The patient remained well over the next 2 days on the ward and received intravenous antibiotics. Two days later, the patient returned to the IR room when low-profile balloons were available. A 6 mm $\times$ 4 cm low-profile balloon (Sterling, Boston Scientific, MN, USA) was then advanced over a 0.018 V18 control wire (Boston Scientific, Heredia, Costa Rica) which had been advanced to the IVC. The low-profile balloon advanced easily over the wire to the distal end of the catheter, and this was sequentially dilated to 14 atmospheres using an insufflator with elimination of all wasting. The catheter was dilated in this fashion back to its insertion site at the right internal

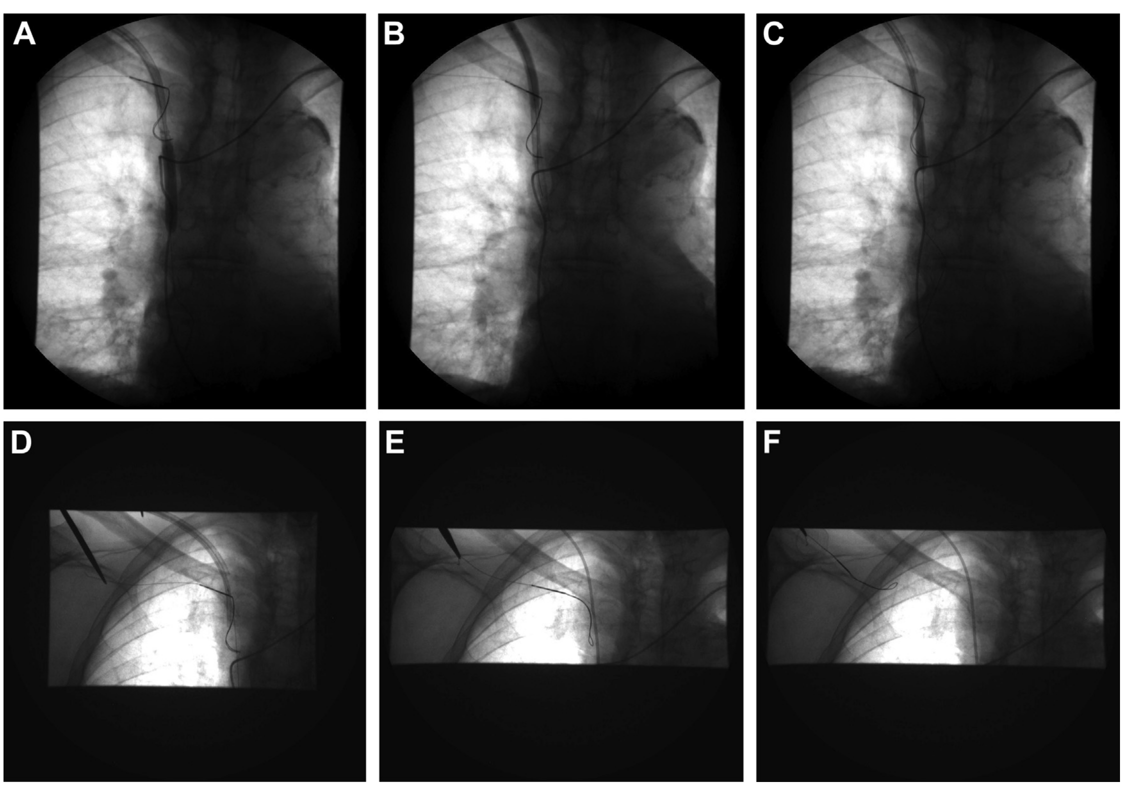

Fig. 3 – Images from the second procedure (A-C) show endoluminal dilatation with the low profile balloons which allowed easy withdrawal of the catheter. Subsequently, the cut end of the snare was located in subcutaneous fat and this was easily removed following withdrawal of the catheter fragment (D-E) leaving an access wire still in situ.

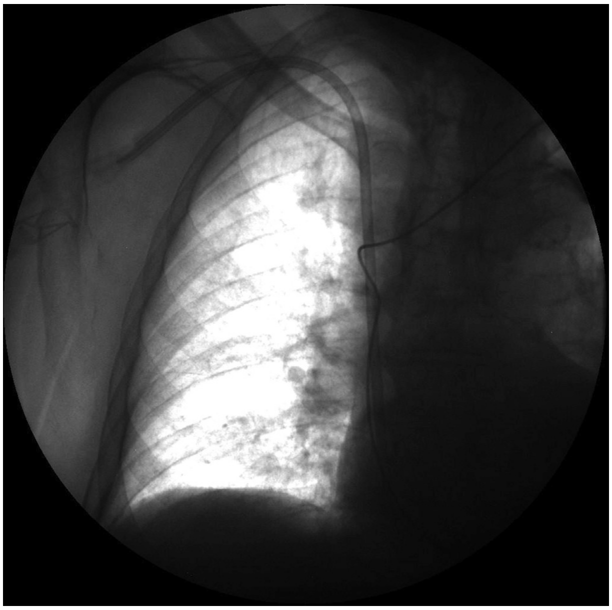

Fig. 4 – At the end of second procedure, a new 15F tunneled dialysis catheter has been placed in a good position and the pacemaker wire remained intact.

jugular vein, and both lumens were similarly dilated. Following this maneuver, the catheter fragment could be easily withdrawn (Fig. 3A–C). It was also noted that the snare had become freed from the catheter fragment and there was no effect on the adjacent pacemaker leads. The patient paced normally throughout the procedure.

The snare and dialysis catheter fragments were then removed without difficulty (Fig. 3D–E), and a new 15 F dialysis catheter inserted into a good position (Fig. 4). This second, significantly easier, procedure took approximately 30 minutes.

The patient returned to the ward and underwent dialysis later that day without difficulty. The new permacath and the in situ pacemaker both continued to function well for the next 6 months until the patient succumbed to his background metastatic disease.

Discussion

A device, such as a permacath, placed within the vascular system can lead to a fibrotic reaction with the development of a fibrin sheath which can make removal difficult. While the incidence of stuck catheters is not known, the overall indwelling time is thought to be the most important factor in causing adherence [12,13] with Ryan reporting an incarceration rate of 22% (5 out of 23) in indwelling catheters over 2 years old [14]. It is also thought that the presence of pacemaker leads, implantable cardioverter-defibrillators, and stents may favor catheter adherence due to vascular injury [15].

Further difficulty in the removal of the catheter was due to the central vein stenosis at the superior vena cava. This is a well-known complication of both catheter and transvenous lead placement [16,17]. This made the use of techniques such as snaring very challenging.

This case demonstrates the use of endoluminal dilatation in difficult cases of adherent catheters and pacemaker leads. Endoluminal dilatation is an interventional procedure pioneered by Hong that involves positioning balloons within a catheter, expanding the lumen and stretching the catheter wall. This leads to the disruption of the fibrin sheath and adhesions between the catheter and the vessel [8,18]. The technique is straightforward and has been reported to be used successfully without complications in the removal of stuck catheters, mainly single lumen catheters using standard balloons [14,19]. However, our double lumen 14-F catheter would not allow passage of a standard balloon, and low-profile balloons over a 0.018 wire were necessary.

Similar previous cases have involved the use of a laser sheath to remove both the catheter and pacemaker leads simultaneously, in the cases of infected pacemaker leads secondary to catheter-related bacteremia [11]. Usually, it is not necessary to remove pacemaker leads unless there is an indication such as infection.

The laser sheath releases laser energy from the distal end to disrupt the fibrotic sheath attached to the pacemaker lead. This avoids the possibilities of either a life-threatening vascular injury through excessive traction [9] or disrupting the pacemaker. However, this technique is considerably more expensive and requires general anesthetic and a trained operator. Furthermore, the laser sheath has a maximum internal diameter of 12.5 F which limits its use to pacemaker leads and small caliber central venous catheters [10,18].

Open surgical options in these cases include removal through thoracotomy or sternotomy. However, since this is major surgery, immunocompromised renal patients with cardiovascular comorbidities are unlikely to be suitable candidates due to the high risk of mortality. Despite the risks, a thoracotomy and cardiovascular bypass has been reported to remove a stuck catheter, but open surgical removal carries significantly increased morbidity and mortality risks than endovascular techniques [5].

Conservative management was considered in our case by burying the remaining fragment of catheter. There have been several cases reported where this has been used successfully [12]. However, any remaining catheter fragment can be a source of infection, thrombosis, or emboli, and indeed, Hong's technique has been used to successfully remove catheter fragments that had been buried in fascial pockets a number of years earlier as other techniques at the time had failed [13].

Conclusion

Stuck central venous catheters can present a significant challenge and have previously required complex endovascular and open surgical procedures to remove them. Some patients may not be suitable for these options, particularly open surgery.

Hong's technique is a technically straightforward method for stuck central venous catheter removal, uses relatively cheap materials, and should be the first line option for these patients when a stubborn central catheter needs removal.

Our case demonstrates how the technique can be easily and safely used to remove a catheter which is stuck to pacemaker leads as well as the SVC wall and also that certain dialysis catheters will require low-profile balloon systems to achieve removal.

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