

CASE REPORT

Knotting of a pulmonary artery catheter in the superior vena cava: surgical removal and a word of caution

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A case of postoperative pulmonary artery catheterisation complicated by knotting of the catheter (Swan-Ganz) within the superior vena cava is described. The catheter was cut off at the skin entry site. The remainder, together with the knot, was pulled out through a purse string incision in the superior vena cava.

Since its initial description by Swan and colleagues in 1970,¹ the balloon tipped pulmonary artery catheter has served widely as a valuable tool to monitor patients and guide treatment in the intensive care unit. Complications resulting from its use have been reported in up to 24% of cases.² We describe a case in which pulmonary artery catheterisation was complicated by the formation of a knot in the catheter, thereby entrapping it in the superior vena cava. Surgical removal was necessary.

CASE REPORT

A 68 year old woman was admitted to the intensive care unit after mitral valve replacement with a Hancock 29 mm xenograft and tricuspid annuloplasty with a 29 mm Duran band. Her medical history was significant for severe mitral stenosis, moderate tricuspid regurgitation, severe pulmonary hypertension, and chronic atrial fibrillation.

To measure postoperative cardiac output, a 7 French Swan-Ganz thermodilution catheter (Arrow, AH-05000-H) was inserted percutaneously through the left subclavian vein. Pressure monitoring of the distal catheter port showed the progress of the catheter to the right atrium. Several attempts to introduce the catheter to the right ventricle were unsuccessful, most probably due to the tricuspid annuloplasty with the Duran band. Therefore, we decided to remove the catheter with the balloon deflated. However, resistance was met before the last 25 cm of catheter was withdrawn. Chest radiography showed a knot in the catheter within a central vein (fig 1). An attempt by an interventional radiologist to straighten and remove the catheter by inserting a 25 mm guidewire was unsuccessful. Firm traction was not applied. After his consultation, no further attempts were made to remove the catheter and the patient was taken back to the operating room.

After the sternum was reopened, the catheter could be palpated in the superior vena cava. A purse string was placed on the superior vena cava. The catheter was cut at skin level, above the point of insertion into the subclavian vein, and the part remaining in the vein, including the knot (fig 2), was pulled out through an incision made in the centre of the purse string suture. The purse string was tied and the chest closed. Recovery was uneventful.

DISCUSSION

Both minor and major complications have been described with the use of pulmonary artery catheterisation. The reported rate of major complications is 3–17%³ and they

include atrial and ventricular arrhythmias, pneumothorax, intracardiac rupture, pulmonary embolism, pulmonary haemorrhage, pulmonary artery rupture, balloon rupture, bacteraemia, and death.^{3,4}

Knotting of an intravascular catheter was first reported by Johansson and colleagues in 1954.⁵ During the past two decades, pulmonary (Swan-Ganz) artery catheters were responsible for more than two thirds of all reported intravascular knots. This may be because these catheters are thin walled, long, and soft and are usually placed without fluoroscopic guidance.⁶ If the catheter bends over itself on introduction, its further insertion may cause the formation of a knot or coil. This usually occurs in the cardiac chambers. Most knots can be unravelled by a simple manoeuvre, although special techniques have been developed for those more difficult to handle. One approach is to tighten the knot as much as possible so that it may be removed through the vein insertion but this sometimes results in trauma to the vessel wall. This problem is usually overcome by withdrawing the catheter until it comes into contact with the introducer, allowing its removal by a small skin incision.⁷ Alternative approaches use a retrieval basket,⁸ a loop snare formed by a double-over guidewire or loop snares,⁹ endomyocardial biopsy forceps,¹⁰ and even an inflated angioplasty balloon to expand the diameter of the knot.

Interventional radiological techniques have largely replaced open surgical removal of knotted catheters. Surgery is now reserved for large, multiple loop ("bow tie") knots or knots that are fixed within the cardiac chamber. In these cases, direct withdrawal may lacerate the vein itself or lead to cardiac damage, making thoracotomy mandatory.⁶

Because our patient was still under the influence of residual anaesthesia and because there was a strong possibility that removal of the pulmonary artery catheter would require surgical intervention, we decided to reopen the sternum and withdraw the catheter through a purse string incision in the superior vena cava.

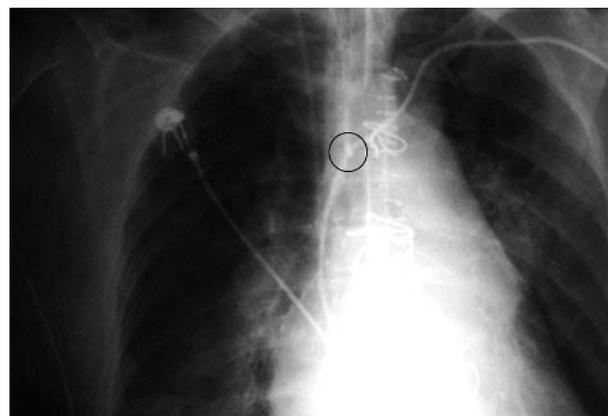


Figure 1 Chest radiographic film showing the knotted (encircled) pulmonary artery catheter fixed in the superior vena cava.

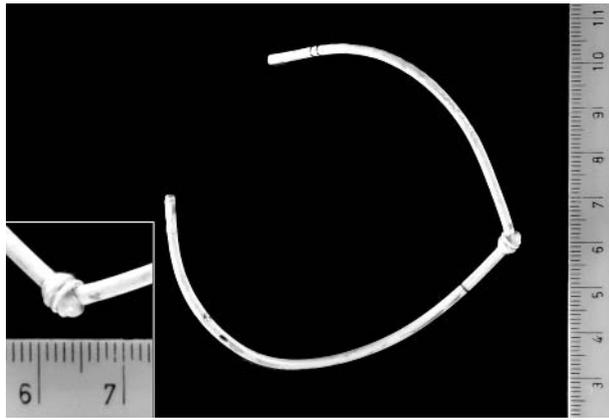


Figure 2 Knot in the removed pulmonary artery catheter.

In summary, the use of pulmonary artery catheters in the intensive care unit has proved to be extremely helpful in managing patients after cardiac surgery. Nevertheless, there is a risk of serious complications, such as knotting within a central vein. The physician should be aware of this complication, especially when resistance is encountered during catheter removal. Extra soft pulmonary arterial catheters, despite their clear technical advantages, often tend to follow the curvature of the cardiac chambers and, therefore, coil and knot. Knotting can be avoided by continuous visual control of the catheter tip during its insertion and by careful manipulation of the catheter during placement. If knotting occurs and cannot be undone by interventional radiological techniques, surgical removal of the catheter may be the safest option to avoid aggressive manipulation.

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