Proposal for bail-out procedures - Transplantation

Intraoperative removal of a knotted Swan-Ganz catheter during lung transplantation

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Abstract

We describe the case of a 52-year-old man with end-stage emphysema who underwent a right-sided lung transplantation. During preoperative monitoring an apparently non-functioning Swan-Ganz catheter could not be removed through the insertion site – right internal jugular vein. Another Swan-Ganz catheter was successfully installed through the left internal jugular vein, pulmonary artery pressures could be recorded and the transplant was performed uneventfully. Then, the first catheter was inspected and superior vena cava palpation surprisingly revealed a knot at approximately 25 cm. The catheter was pushed to the azygous vein, proximal and distal controls were obtained and a venotomy was performed. The knotted side was sectioned and removed, while the remaining catheter was removed through the insertion site. Despite being rare, knotted intravascular devices have been increasingly reported. Removal with interventional radiology techniques can be accomplished in most instances, nevertheless, complex knots or knots fixed into cardiac structures require open removal. Since in our case the knot was detected intraoperatively, it was readily removed through the azygous vein. To the best of our knowledge, this is the first report to describe such a route of removal.

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1. Introduction

The first description of a knotted intravascular device is attributed to Johansson in 1954 [1]. However, with the widespread use of the balloon tipped pulmonary artery catheter described by Swan in 1970, this complication has been increasingly reported, with several technical alternatives for device removal [2]. We describe one case in which the Swan-Ganz knot was identified and removed intraoperatively during a right-sided lung transplantation.

2. Case report

A 52-year-old man with end-stage chronic obstructive pulmonary disease due to tobacco smoking was admitted to our institution for lung transplantation. He had been listed for seven months and had no associated illnesses. After selective orotracheal intubation, the right internal jugular vein was punctured and a Swan-Ganz catheter introduced. Pressure monitoring of the distal port showed progress up to the right ventricle with insertion of 40 cm, but after repetitive attempts of balloon inflation, no pulmonary artery waveform was obtained. The initial idea was to replace the catheter, however, a stoppage at the last 25 cm prevented its removal. Since synchronization with the lung extraction team was important, a percutaneous access through the left internal jugular vein was obtained and another Swan-Ganz catheter successfully introduced (with the right one remaining at its last 25 cm). After completion of the anastomoses, the Swan-Ganz issue was addressed and palpation of the superior vena cava revealed a knot. Once the chest was opened, it seemed that the safest route for removal was the azygous vein. Thus, the catheter was carefully guided to the azygous vein by occluding the superior vena cava distally with the surgeon’s right hand (Fig. 1). The azygous vein was ligated close to the spine and its proximal end clamped at the vena cava junction. A venotomy was then performed, the knotted catheter was sectioned and removed and the proximal azygous vein was ligated. The remaining proximal catheter was removed through the neck along with the introducer. Evaluation of the catheter revealed a knot at 25 cm (Fig. 2). The chest was then closed and the patient was sent to the intensive care unit.

3. Discussion

In spite of providing accurate monitoring of pulmonary artery pressure – an essential step for lung transplantation – Swan-Ganz catheters are not free from risks. Major complications such as ventricular perforation, pulmonary artery rupture and knot formation have been reported with an incidence of 0.1% [3].

Regarding knotted intravascular devices, Karanikas and coworkers performed a review which resulted in 113 occurrences [4]. Pulmonary artery catheters accounted for most
of them (53 cases), with the possible explanation being that these catheters are thin-walled, longer and softer, thus more prone to coiling and knotting. Interventional techniques successfully retrieved the catheter in 62% of cases, with only 32% requiring a surgical procedure. As in the report of Bagul and coworkers [5], in which a knotted Swan-Ganz was removed via right internal jugular vein, most of the open procedures consisted of an open venotomy after pulling the catheter to an easily accessible site.

With advances in interventional radiology techniques, most of the knotted devices can be extracted percutaneously. Two simple approaches consist of tightening the knot to a degree that it can be removed through the insertion port; or to use a larger introducer in order to include the knot and then both devices are removed together. More elaborate techniques have been described to unravel complex knots and these include the use of retrieval baskets, endomyocardial biopsy forceps and angioplasty catheters with the knot opened through balloon inflation inside it [6]. However, in our case, since a right thoracotomy was going to be performed and the use of interventional radiology would imply a longer ischemic time, the knotted catheter issue was removed through an open route.

Surgical removal has been reserved for large knots, multiple knots (the so-called bow-tie) and knots fixed within the cardiac chambers. In the report of Georgioui and coworkers, a Swan-Ganz knot was discovered after mitral valve replacement [7]. A reintervention was performed in the immediate postoperative course, the sternum was re-opened and the knotted catheter was removed through the vena cava. Knetted catheters around papillary muscles have also been reported and no operative approach other than a cardiotomy could have been performed [8]. In our case, the knot was neither large nor bow tie, however, since it was detected intraoperatively and the right chest was opened, it seemed that the simplest approach would be through the azygous vein. Removal was uneventful. One should remember that our patient did not suffer from any disease related to azygous anastomotic network, such as portal hypertension or vena cava syndrome, and thus, no complication regarding its ligation was recorded. To the best of our knowledge, this is the first report to describe a knotted catheter removed through the azygous vein.

References


eComment: Double-knotted Swan-Ganz catheter – potential for non-invasive ultrasonic cardiac output monitoring?

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I read with great interest the recent report by Dr. Camargo [1]. Complications using an invasive Swan-Ganz catheter have been encountered since the introduction of the catheter [2]. As early as in 1976 Dr. Block reported the snaring of a Swan-Ganz catheter by a suture to control bleeding in the
right atrium [3]. We encountered a double-knotted Swan-Ganz catheter in a patient following coronary artery bypass grafting with fatal outcome due to pump failure. Therefore, no attempt was performed to retrieve the double-knotted Swan-Ganz catheter percutaneously.

Given the potential fatal complications of invasive Swan-Ganz catheters, non-invasive means of cardiac output monitoring might be considerable. Ultrasonic cardiac output monitoring (USCOM, Sydney, Australia) using CW-Doppler has been reported to correlate highly with invasive Swan-Ganz catheter cardiac output in postcardiac surgery patients with a mean difference of 0.2 l/min and a correlation coefficient $r=0.870$ [4]. A recent comparative study between USCOM and Swan-Ganz catheters in instable ICU patients found acceptable correlations [5].

Thus, in a selected patient cohort, given the potential complications of invasive Swan-Ganz cardiac output monitoring, it might be worth considering non-invasive alternatives for hemodynamic assessment.

References