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 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 Georgiou 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. Knotted 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