

Surgical removal of a knotted Swan-Ganz catheter inadvertently placed in the common carotid artery

Marco Coli^{a,†,*}, Federica Ruggiero^{b,†}, Cesare Battocchio^b, Elisabetta Giorni^c,
Adriana Toncelli^b, Giovanni Melina^a, Maurizio Taurino^b, Pasqualino Sirignano^d

^a Cardiac Surgery Unit, Sant'Andrea Hospital of Rome, Department of Molecular and Clinical Medicine, "Sapienza" University of Rome, Rome, Italy

^b Vascular and Endovascular Surgery Unit, Sant'Andrea Hospital of Rome, Department of Molecular and Clinical Medicine, "Sapienza" University of Rome, Rome, Italy

^c Anesthesia and Intensive Care Medicine Unit, Sant'Andrea Hospital of Rome, Department of Clinical and Surgical Translational Medicine, "Sapienza" University of Rome, Rome, Italy

^d Vascular and Endovascular Surgery Unit, Sant'Andrea Hospital of Rome, Department of General and Specialistic Surgery, "Sapienza" University of Rome, Rome, Italy

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ABSTRACT

A Swan-Ganz catheter is an intravenous device used for the invasive measurement of pulmonary capillary wedge pressure and other cardiovascular measurements often utilized in major surgical procedures and critical care units. Several device-related complications were reported in literature - arterial puncture, pneumothorax, inadvertent arterial catheter insertion due to non-ultrasound-guided placement, and formation of knots. This paper presents a case of inadvertent left carotid artery insertion of a Swan-Ganz catheter, complicated by a knot formation requiring surgical intervention to successfully remove the catheter.

Introduction

Intravascular devices are currently used in most cardiac and non-cardiac surgical procedures. Among them, the Swan-Ganz catheter (SGC) is an intravenous device used for the invasive measurement of pulmonary capillary wedge pressure (PAWP-WEDGE) in patients with congestive heart failure and pulmonary hypertension. SGC is usually placed through the internal jugular vein (IJV), and following inflation of its distal balloon, catheter is advanced into distal pulmonary arteries¹⁻³.

Several intravenous devices-related complications were reported in current literature such as arterial puncture, pneumothorax, pulmonary and atrial lesion, infection, arrhythmias and valvular injury. Furthermore, inadvertent arterial catheter insertion due to non-ultrasound-guided placement, and knots formation, independently, represent two of the most described complications⁴.

Despite most case of knotted SGCs may be untied by means manual maneuvers, some cases require more complex endovascular techniques or surgical interventions⁵⁻⁸.

The purpose of this paper is to report the management of a patient with heart failure and indication to myocardial surgical

revascularization presenting a knotted SGC inadvertently placed in the left common carotid artery. Patient provided written informed consent for the report of his case details and imaging studies.

Case report

A 53-year-old man with a medical history of mitral prolapse, dyslipidemia, and smoking habit, was admitted to our Emergency Department due to a syncopal episode, lasting few seconds during physical activity. Vital parameters were normal, with an arterial pressure of 140/90, and a heart rate of 75 beats per minute. The patient did not complain of any chest pain or dyspnea.

Blood tests were normal, with the exception of increased transaminase (250UI), high-sensitivity troponin (873ng/L), and D-dimer (681 ng/mL). An electrocardiogram showed the presence of anterolateral Q waves with intraventricular conduction delay, and abnormalities in the right ventricle suggestive of a previous myocardial infarction, and diffuse acute ischemic signs. A subsequent echocardiographic evaluation revealed a depressed left ventricular ejection fraction of 25%, associated with left ventricular dilatation (left ventricular diastolic

* Corresponding author at: Department of Molecular and Clinical Medicine, "Sapienza" University of Rome, Cardiac Surgery Unit, Sant'Andrea Hospital of Rome, Via di Grottarossa, 1035/1039 00189 Roma, Italy.

E-mail address: marco.coli@uniroma1.it (M. Coli).

† These authors contributed equally to this work.

diameter 61mm). The patient underwent a coronary angiography that shows a critical triple vessel disease with a chronic total occlusion (CTO) of the circumflex artery and posterolateral branch of the right coronary, requiring coronary artery bypass grafting.

Under general anesthesia, an invasive arterial pressure monitoring system and central venous catheterization were routinely performed uneventfully. PAWP-WEDGE via SGC was also required due to severe heart dysfunction. After an unsuccessful attempt to insert the SCG through the right IJV, the catheter was inserted through the left IJV under ultrasound guidance. Upon completion of the catheter insertion, abnormal blood pressure values were suggestive for an arterial catheter insertion.

Multiple attempts were carried out to remove the catheter unsuccessfully, including the introduction of a 18" guidewire into the SGC in order to facilitate its removal, as previously discussed⁴. A chest fluoroscopy revealed a tight bound knot at the distal end of the catheter (Fig. 1), presumably shaped within the aortic arch during catheter manipulation.

Considering the impossibility to untie the knot and the intraarterial catheter insertion, a surgical removal was carried out. A standard left mini-cervicotomy was performed, the left common carotid artery was dissected out followed by systemic heparinization (5.000UI unfractionated heparin). The vessel was clamped proximally and distally from the catheter entry site. An arteriotomy was performed (Fig. 2), and the catheter safely and completely removed (Fig. 3). Finally the arteriotomy was closed with a continuous 6/0 monofilament suture. Cerebral oximetry (INVOS TM 5100C Cerebral/Somatic Oximeter; Medtronic Inc, Santa Rosa, CA -USA) was excellent throughout the procedure.



Fig. 1. Chest fluoroscopy showing the knot at the distal end of the Swan-Ganz catheter.

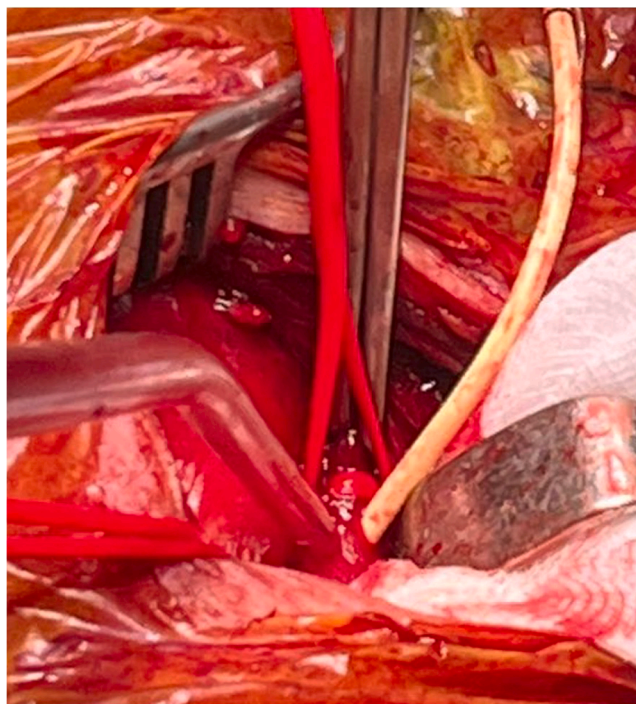


Fig. 2. Intraoperative findings showing the intraarterial placement of the knotted Swan-Ganz catheter.



Fig. 3. Removed Swan-Ganz catheter with direct evidence of the bounded knot at its distal end.

The planned cardiac surgery was postponed. The patient was operated after seven days. Surgery was carried out offpump using left internal mammary artery to the anterior descendant artery, a right internal mammary artery to the circumflex artery, and the left great saphenous vein to the right coronary artery. The post-operative course was uneventful, and the patient was discharged home in good general condition on postoperative day 8.

At 2 months follow up, the patient is still asymptomatic, with no need

for hospital any cause readmission. Echocardiographic exam showed an improved ejection fraction of 40% and blood tests exam were unremarkable. Carotid ultrasound documented the good left common and internal carotid arteries patency.

Discussion

The arterial insertion of intravenous devices, such as the carotid insertion of SGC, remains a rare but potentially serious complication with significant implications for patient safety. This present case report highlights the challenges encountered in managing a patient with a knotted SGC inadvertently placed in the left common carotid artery, necessitating prompt and decisive intervention to mitigate associated risks.

Given the impossibility of loosening the knot due to the multiple attempts performed and the consequent narrowing of the tangle, an open surgical access was mandatory in order to reduce the risk of vessel damage. To avoid this complication, an early echocardiographic or angiographic assessment may be useful to implement the likelihood of percutaneous removal by inserting a metal wire, pulling back the tip thanks to a snare passed through the knot with a rotational angiography-guided procedure⁹, or by loosening it with an expandable balloon¹⁰.

Our experience underlines the importance of standardized SGC placement and heightens the awareness of catheter related complications during insertion procedures, particularly in patients with complex cardiovascular pathologies requiring invasive monitoring. We encourage the use of the ultrasound guidance, enhancing the safety and accuracy of catheter placement, as guidelines suggest, helping to minimize the risk of inadvertent arterial insertion and its associated complications.

Knots formation during catheter placement is a rare and unexpected condition. However, it must be suspected as early as possible so as not to compromise the percutaneous removal of the device.

Furthermore, the success of surgical extraction of the knotted device confirms the importance of multispecialistic collaboration and expertise to deal such challenging cases. Close coordination between anesthesiologist, vascular surgeon, and cardiac surgeon is essential to ensuring optimal patient outcomes.

While the management of inadvertent arterial catheter insertion remains a complex and potentially daunting task, this case demonstrates that with careful planning, appropriate technical expertise, and timely intervention favorable outcomes can be achieved. Continued surveillance, ongoing training, and adherence to best practices in intravascular device insertion are essential to reduce the incidence of such complications and safeguard patient well-being in clinical practice.

Patient consent statement

The patient provided written consent for the publication of this case

report.

CRedit authorship contribution statement

Marco Coli: Writing – original draft, Supervision, Project administration, Methodology, Investigation, Conceptualization. **Federica Ruggiero:** Writing – original draft, Project administration, Methodology, Conceptualization. **Cesare Battocchio:** Supervision. **Elisabetta Giorni:** Investigation. **Adriana Toncelli:** Resources. **Giovanni Melina:** Writing – review & editing, Validation, Supervision. **Maurizio Taurino:** Writing – review & editing, Visualization, Supervision. **Pasqualino Sirignano:** Writing – review & editing, Visualization, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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