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Case Report

Secondary migration of a pre-existing central venous catheter due to a Swan-Ganz catheter insertion
- A case report -

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Background: The entanglement of multiple central venous catheters is a rare and serious complication. The Swan-Ganz catheter is a responsible for various cases.

Case: A 66-year-old male patient was under general anesthesia for a coronary artery bypass graft surgery. As he had a pre-existing Perm catheter in the right subclavian vein, a Swan-Ganz catheter was inserted into the left internal jugular vein. Chest radiograph after catheter placement revealed that the Perm catheter had migrated to the left brachiocephalic vein. The surgeon attempted to reposition it manually, but postoperative radiograph showed that it had rolled into a loop. On postoperative day 1, radiological intervention was performed to untangle the loop, which was successful.

Conclusions: After placing a Swan-Ganz catheter in patients with a pre-existing central venous catheter, the presence of entanglement should be assessed. In such cases, radiology-guided correction is recommended, as a blind attempt to disentangle can aggravate the condition.

Keywords: Anesthesia, cardiac procedures; Catheterization, Swan-Ganz; Catheters, indwelling; Central venous catheters; Equipment failure; Intraoperative complications.

The role of Swan-Ganz catheterization in cardiac surgery and perioperative intensive care management has come into doubt over the years. Considering its extremely low rate of serious complications, its use in cardiac surgery remains justified [1]. One of the complications is knotting or entanglement of the catheter, which may require radiological intervention or surgical removal. Of the numerous cases of intravascular catheter knotting, more than two-thirds involved pulmonary artery catheters [2]. In contrast, cases of knotting or entanglement of multiple central venous catheters are few. Here, we report the entanglement of a Swan-Ganz catheter with a pre-existing central venous catheter, and the subsequent migration and ultimately looping of the central venous catheter after an attempt to reposition it.

CASE REPORT

Written informed consent was obtained for the publication of this case report. A 66-year-old male patient (weight, 67 kg; height, 173 cm) was scheduled for coronary artery bypass grafting under general anesthesia for the management of 3-vessel coronary artery occlusive disease. The patient

had coexisting end-stage renal disease with regular hemodialysis 3 times a week, dyslipidemia, mildly uncontrolled diabetes mellitus and hypertension. Preoperative laboratory tests revealed mild anemia with a hemoglobin of 9.1 g/dl, an increased white blood cell count of 19.18 × 10^3/μl, a prolonged activated partial thromboplastin time of 54.8 seconds, and elevated blood urea nitrogen/creatinine levels of 26.3/2.36 mg/dl. Results from other laboratory tests, electrocardiography, transthoracic echocardiography, and pulmonary function tests, were within normal limits. Preoperative chest radiograph showed an appropriately positioned HemoSplit (BD, USA) catheter, a split-tip form of the Perm catheter, inserted through the right subclavian vein (Fig. 1).

On arrival in the operating room, general anesthesia was induced and maintained with an effect-site target-controlled infusion of propofol and remifentanil. Atracurium was used for the neuromuscular blockade. To avoid catheter crowding at the entrance of the right brachiocephalic vein, a MAC™ Two-Lumen Central Venous Access Device (Arrow International Inc., USA) for use with 7–8 Fr. catheters, 10 cm in length, was inserted into the left jugular vein using ultrasonography. The Swan-Ganz CCOmbo V (Edwards Lifesciences LLC, USA) was prepared and inserted via MAC catheter. The Swan-Ganz catheter was advanced, considering the curvature of the catheter and the relevant anatomy. In the initial attempt, ballooning was done after advancing the catheter to approximately 20 cm. Even after advancing to 50 cm, no right ventricular pressure wave was observed. Thus, the balloon was deflated, and the catheter was retreated to a 20 cm point. No significant resistance was felt during catheter advancement or retrieval, except for a slight rubbing sensation, which was assumed to be due to minor friction between the previously inserted Perm catheter and the Swan-Ganz catheter. On retreating the Swan-Ganz catheter to a 20 cm point, the tip was ballooned again, and the catheter was advanced once more. At the advancement to the 40 cm point, the same rubbing feeling was evident. Thus, the ballooned tip was deflated, and the catheter was retrieved completely. The retrieved catheter was examined for damage or defects and confirmed to be intact. On the third attempt at inserting the Swan-Ganz catheter, the tip was ballooned at the 20 cm point. As gradually advancing the catheter, the waveforms of the right ventricle and pulmonary artery were observed. After confirming the waveforms of pulmonary capillary wedge pressure, the catheter was slightly retrieved and fixed at 50 cm. A chest radiograph taken to confirm the appropriate positioning of the Swan-Ganz catheter revealed migration of the pre-existing Perm catheter. The mid- to distal portion of the Perm catheter was positioned in the left brachiocephalic vein, with a flexure in the middle and the tip in the superior vena cava (Fig. 2). Being aware of this preoperative catheter migration, the surgeon manually attempted to reposition the catheter during cardiopulmonary bypass. The remainder of the intraoperative period was uneventful. However, a postoperative chest radiograph revealed that manual repositioning of the Perm catheter was incomplete and the tip remained looped (Fig. 3). One day after the operation, the patient underwent a radiology-guided repositioning of the Perm catheter. An Amplatz guidewire was successfully inserted through each lumen of the looped catheter to carefully straighten the catheter and reposition the tip in the right atrium (Fig. 4). The repositioned Perm catheter functioned properly throughout the hemodialysis without further complications.

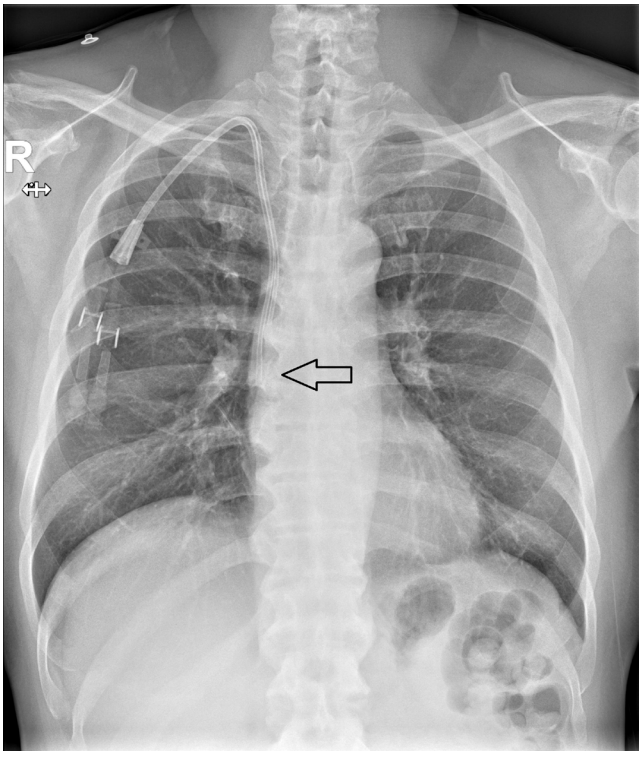

Fig. 1. Preoperative chest radiograph with Perm catheter tip in place (black arrow).

DISCUSSION

The entanglement of the central venous catheter causing a loop or knot has been repeatedly reported over the years.

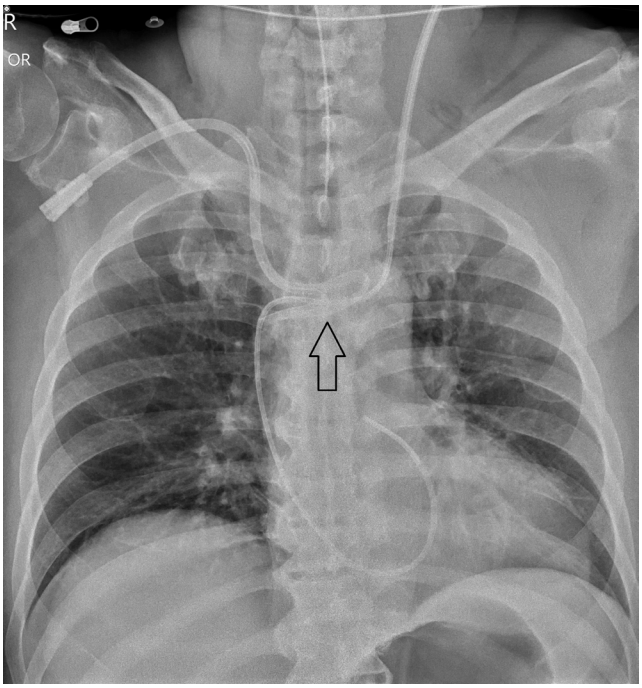

Fig. 2. Intraoperative chest radiograph after Swan-Ganz catheter insertion. The mid to distal portion of Perm catheter was positioned in the left brachiocephalic vein, with a flexure in the middle and the tip in superior vena cava (black arrow).

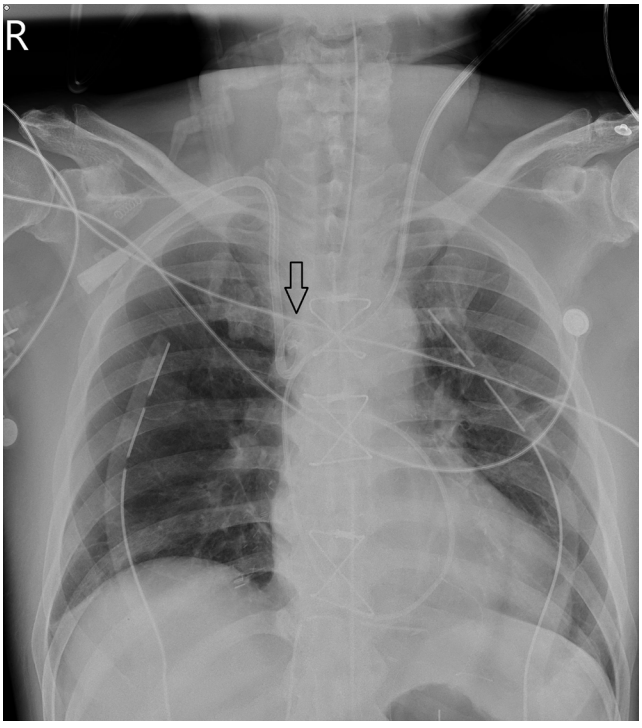

Fig. 3. Postoperative chest radiograph showing intraoperative manual repositioning of Perm catheter had resulted in looping of the catheter tip (black arrow).

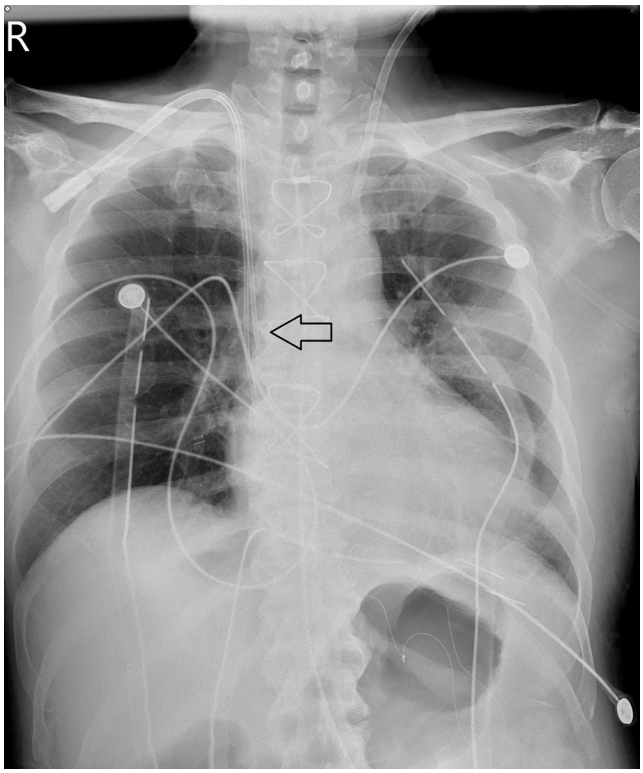

Fig. 4. Chest radiograph after successful radiologic procedure to reposition the Perm catheter, showing the tip back in the original place (black arrow).

Its incidence has increased with the increased use of intravascular devices, such as inferior vena cava filters, indwelling catheters, and pacemakers [1,2]. Over two-thirds of the reported entanglements are attributed to Swan-Ganz catheters [3]. While entanglement was limited to the catheter itself in most cases, eight existing reports have described the entanglement of a Swan-Ganz catheter with at least one other central venous catheter. The form of the entanglement varied from case to case. There were four cases of tight knots [4–7], two reports of a loose knot [8,9], and one case of a catheter transecting the other [10].

In our patient, we suspect that entanglement occurred by a loop in the Swan-Ganz catheter, formed by its course in the right ventricle, encircling the central venous catheter during the retrieval attempt. The angle between the catheters was suggested to be a contributing factor in creating a knot. Although the role of angulation between catheters is unclear, it has been reported that central venous catheter misplacement can often occur when inserted from the left side [11]. We also assumed that the loose knot in our case may have untangled spontaneously during the advancement and retrieval of the Swan-Ganz catheter for proper placement.

However, the maneuver of unaware loose knot resulted in secondary migration of the previously well-positioned Perm catheter. According to other reports, initial suspicion of entanglement is usually associated with resistance during an attempt to remove the catheters after malfunctioning. In our case, there was little evidence to suspect entanglement except for a minor rubbing sensation. Thus, when handling a Swan-Ganz catheter in the presence of multiple central venous catheters, one should be aware of the possibility of multiple catheter entanglement, as well as the risks of inserting the Swan-Ganz catheter itself.

With the occurrence of catheter entanglement, forceful maneuvers to untangle the catheter may result in lethal conditions, such as vascular tearing or catheter rupture, leading to a remnant foreign body within the venous system [1]. Thus, various methods using interventional radiological or surgical approaches have been developed to safely remove the entangled catheter [1,2,12]. When entanglement occurs between multiple central catheters, attempts to untangle it may become much more complicated. A tight knot can make it impossible for radiologic intervention to untangle, and surgical removal may be required [4,5,7]. In one reported case, a tight knot was successfully removed through the insertion site after spontaneous breakage at the knot [6]. In two other cases, the catheters were freed apart using an introducer with a larger lumen [10,13], whereas loosely knotted catheters were untangled with gentle maneuvers [8].

Contrary to the previously reported cases, in our patient, both catheters were left in place after freeing the entanglement, as we were under the impression that the function of both catheters was still intact. Although the Perm catheter was not used during the operation to confirm this, we suspected that its function did not deteriorate, considering that the knot was loose, and the tip of the catheter remained within the vascular lumen. Were it not for the postoperative chest radiograph, the Perm catheter loop formed by the surgeon may have gone unnoticed and could have been used postoperatively, remaining to be potentially hazardous. Importantly, when placing multiple central venous catheters, radiographs should be taken between handling catheters, even if they are functional, to ensure that the catheters are not entangled.

The fact that the tip of the central venous catheter was rolled into a loop after the surgeon's blind maneuver to reposition it must also be considered. We suspected that the tip of the catheter was pressed against the vascular wall and subsequently rolled into a loop. This could have been potentially harmful, and may have led to vascular damage. In such cases, it may be advisable to leave the migrated catheter in place until interventional radiologic procedure can be performed. As our case demonstrated, a blind maneuver to reposition the catheter did not resolve the problem successfully, nor did it prove to be safe.

As shown in Fig. 1, the hemodialysis catheter was split. A split catheter with unequal lengths may increase the risk of entanglement, especially if the entanglement involved another guidewire or if the catheter was passing through the space between the split catheters. In our patient, both tips were displaced in unison. Therefore, we suspect that entanglement did not occur between the split catheters.

In conclusion, although the incidence may be low, the insertion of a Swan-Ganz catheter can lead to entanglement, a potentially serious complication, especially when there are also multiple central catheters present. It should be noted that the entanglement of catheters can be present even when they are functional. Therefore, proper placement should be radiographically verified before and after handling the catheters. In addition, when an entangled or looped catheter is present, it may be advisable to disentangle it using interventional radiology, as blind attempts may be potentially harmful.

FUNDING

None.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this published article. This is a case report.

AUTHOR CONTRIBUTIONS

Conceptualization: Joonho Cho. Project administration: Byung Hoon Yoo. Writing - original draft: Joonho Cho. Writing -review & editing: Joonho Cho, Byung Hoon Yoo, Jihwan Park, In-jung Jun, Kye-min Kim. Resources: Joonho Cho, Jihwan Park, In-jung Jun, Kye-min Kim. Supervision: Byung Hoon Yoo, Yun Hee Lim, In-jung Jun, Kye-min Kim.

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