Case Report

Experience with a triple-lumen catheter for autologous stem-cell transplantation

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ABSTRACT

We relate our experience with the Cook (Cook Medial Inc., Bloomington, IN, USA), triple-lumen hyperalimentation (HAS) catheter for treatment related to autologous stem-cell transplant. Nineteen HAS catheters were implanted in the right jugular vein, and tunneled to the right anterior chest wall, under imaging guidance. Retrospectively, we reviewed each catheter. Three patient’s experienced “ballooning” of the middle (white) lumen of the HAS catheter during routine use. We assessed, time in situ, follow-up imaging, chemotherapy regimen, possibility of systemic or device infection, tissue pathology of the patient’s malignancy, and other factors to attempt to determine if there were any associations that could explain the catheter lumen failure. After this pilot study of the HAS-catheter in these 19 patients, we discontinued use of this device at our facility due to mechanical problems of ballooned and obstructed middle lumens. There was no obvious cause, or association, detected to explain the ballooning identified.

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Introduction

Multilumen venous access devices are extremely helpful for the management of patients undergoing stem-cell transplantation and have been shown to have manageable, if any, side effects. [1] The multiple lumens allow for the dedicated administration of medications, chemotherapy, fluids, blood products, and alimentation when clinically required. Our local stem-cell transplant teams had been using a dual-lumen catheter and were in need of a triple-lumen catheter that would enhance patient management and facilitate medical and nursing care. The Cook hyperalimentation (HAS) catheter was selected by the local Cancer Agency Stem-Cell Transplant team to be trialed as a triple-lumen catheter. We report our experience with this device in 19 patients.

This was a retrospective review of the patient’s imaging and medical history for the purposes of a Quality Assurance project. As such, our local Research Ethics Committee waived the requirement for a full ethical review and approved this project.

Materials and methods

The HAS catheter is described in manufacturer’s product literature to, “provide for the intravenous administration of nutrient fluids, chemotherapeutic agents, therapeutic drugs,
and for blood sampling, blood delivery, and venous pressure monitoring” (Cook Medical Inc., Bloomington, IN, USA). The device used was a triple-lumen, 12.5F with the large lumen of the catheter able to accommodate a 0.038-in guidewire. The lumen configuration of the HAS catheter reveals 2 large, half-moon shaped lumens with a very small third lumen interposed between the 2 large lumens (see Fig. 1).

Sequential patients enrolled in the autologous stem-cell transplant program received the HAS catheter. All of the HAS catheters assessed in this study were implanted by interventional radiology using ultrasound and fluoroscopic guidance for proper catheter positioning with the final catheter tip at the superior vena cava—right atrial junction (see Fig. 2).

Right internal jugular venous access was achieved, with ultrasound and fluoroscopic guidance (see Fig. 3). The HAS catheter was tunneled from an anterior chest wall location to the internal jugular vein access site. The catheter was supplied with a standard 25-cm length, which was cut to a length that suited the patient’s anatomy. Using a 13F peel-away sheath (Cook Medical Inc., Bloomington, IN, USA), the catheter was manipulated to the superior vena cava—right atrial junction using fluoroscopy. The catheters were fixated to the patient by applying 2, nonabsorbable, Prolene skin sutures using the built-in catheter suturing wings (Ethicon US LLC, Somerville, NJ, USA). The 3 lumens of the catheter were flushed and closed with a solution of sterile, heparinized saline (100 IU heparin sulfate/mL, Pharmaceutical Partners of Canada, Richmond Hill, ON, Canada). All implanted catheters were functioning satisfactorily at the completion of implantation.

Results

All catheter implantations were successful at the primary visit, resulting in a 100% technical success rate. The right internal jugular vein and the right anterior chest were used for all patients. No implantation complications were encountered. There was no unusual angulation of any of the catheters at the jugular vein insertion site or in the chest wall.

Nineteen patients received the HAS catheter for treatment. There were 9 females and 10 males. Their age ranged between 30 and 71 years (mean = 53).

Ten of the patients were being treated for Multiple Myeloma, whereas the other 9 had some form of lymphoma.

Three patients experienced “ballooning” (see Fig. 4) of the middle (white) lumen of their HAS catheter. The “ballooning” was not a permanent deformity, and was most pronounced during attempts to use the middle (white) lumen. Once the “ballooned” catheters were removed a mild contour bulge was obvious on general inspection. The initial detection of these ballooning events occurred at 15, 19, and 20 days post-HAS-catheter insertion. The ballooned lumens were all occluded, and the deformity of the catheter occurred with forceful flushing by the clinical team. These catheters were not removed after ballooning because the remaining 2 lumens (blue and red) were still functional.

We performed a retrospective review of all 19 patient’s charts to look for any possible explanation for this complication. Ballooning of the white lumen occurred during routine flushing by 3 different nurses assigned to each patient’s care in all 3 cases. A different interventional radiologist implanted each of these ballooned catheters.

All 3-ballooned catheters were implanted in male patients. Seven of the 19 patients had a positive blood culture during the course of their catheter insertion, while receiving stem-cell transplant inpatient treatment. Two of these 7 patients also experienced ballooning of the white lumen.

Patients had anywhere from 0 to 9 chest x-rays, while the catheter was implanted, with patients having an average of 3 (standard deviation = 2.0). One of the chest x-rays revealed
Fig. 3 — Chest x-ray 1-day postcatheter insertion. (A) posterior-anterior view; (B) lateral view.

Fig. 4 — Images of the 3 catheters with “ballooned” middle (white) lumens of the Cook triple-lumen HAS catheter. (A) This image set demonstrates the catheter before injection (left image) and during the injection of saline (right image). (B) Images of catheters from 2 additional patients demonstrating the middle lumen ballooning during the injection of saline.
mild retraction of one of the HAS catheters but the tip of this catheter did not ascend outside the superior vena cava. This partially retracted catheter did not demonstrate ballooning of the middle lumen. There were no other clinically or radiographically demonstrated catheter-migration issues.

Patients were undergoing 1 of 3 different chemotherapy protocols, while they had their catheters in place. All 3 episodes of had catheter ballooning occurred in patients who were being treated for lymphoma.

All results are summarized in Table 1.

### Discussion

Our experience with the Cook, triple-lumen HAS catheter resulted in a 100% catheter implantation success rate. The catheter was used per the manufacturers instructions for use, and there were no off label catheter use. In general, it is expected that complication rates with central venous catheter use is around 15%; however, this includes infection and thrombotic problems, which we did not encounter. [2] The 3 of 19 occurrences of catheter ballooning results in a 15.8% rate for this complication. A detailed review of current literature makes no mention of catheters ballooning as a result of a lumen obstruction.

We failed to find a definitive explanation, or statistically significant association, for this unique and unusual HAS-catheter complication. We investigated a potential infectious cause, finding that 7 of the 19 patients had a positive blood culture during the period of catheter utilization. However, only 2 of the 3 patients with the ballooning complication had a positive culture and 5 other patients had a positive culture, without ballooning. The 3 patients that experienced ballooning of the middle lumen were all on the same chemotherapy protocol, as were 4 other patients who did not experience ballooning.

We examined the clinical scenario for each episode of ballooning by thoroughly reviewing the patient’s inpatient medical record. The common trend, found in the nurse’s notes in the patient’s chart, indicated that the middle lumen would not flush when routine saline flushing was attempted, the lumen would then balloon when additional force was applied, leading to imaging confirming the ballooned lumen during a fluoroscopic assessment of the catheter. None of the ballooned catheters had additional obstructed lumina, nor did they demonstrate evidence of catheter tip fibrin sheath formation. Ballooning occurred at 15, 19, and 20 day’s after implantation, which equates to about the midway point of their time in situ.

This leaves us at a loss to explain this unusual complication that we experienced. This product is manufactured individually, and it is important to note that our request to try the Cook, HAS catheter, required an increase in production. Therefore, this complication may be attributable to a manufacturing problem but more investigation into this theory is required.

The HAS catheter was of benefit to the patients who received it as a part of their stem-cell transplant care, as the third lumen was considered to be of high clinical value. However, these benefits were insufficient in the face of this unique complication we experienced and we discontinued use of this venous access device.

### References

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