Dislodged Tip of Damaged Central Venous Catheter After Radiofrequent Cox-Maze IV Procedure

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bilateral ESPB catheters at T7 using an ultrasound-guided (SonoSite X-Porte ultrasound system, L25xp transducer), in-plane, parasagittal approach. Each catheter (18G × 51-mm E-Cath, Pajunk) was bolused with 2.5 mg/kg of 0.5% lidocaine. Intraoperatively, the patient received 106 mg of intravenous ketamine, 40 μg of fentanyl, and 3.6 mg of methadone. Postoperatively, the ESPB catheters were bolused with 5 mL of 0.25% lidocaine (0.75 mg/kg), alternating between left and right catheters each hour.[4] Serum lidocaine levels were drawn pre-bypass, post-bypass, and every 8 hours postoperatively until catheters were discontinued.

The patient was extubated within 1 hour postoperatively. She was treated with oral acetaminophen, as needed, for postoperative analgesia and received no opioids for sternotomy pain throughout her postoperative course. She received a single prophylactic dose of intravenous morphine, 0.86 mg, just prior to chest tube removal on postoperative day 1, after which the ESPB catheters also were removed. Wong-Baker FACES Pain Rating scores were between 0 and 1 throughout hospitalization. The peak measured serum lidocaine level was 2.2 μg/mL. She was discharged home from the cardiac intensive care unit on postoperative day 3.

To the authors' knowledge, this is the first description of a child who required no postoperative opioids for sternotomy pain after surgical repair of congenital heart disease with the use of perioperative ESPB catheters. Erector spinae plane block catheters may be an important component of an enhanced recovery protocol for cardiothoracic surgery. In this case, given that the maximum lidocaine level was 2.2 μg/mL, it is unlikely that its analgesic effects were owing to systemic absorption. Although no opioid was given postoperatively, the patient's immediate postoperative analgesia might have been augmented by intraoperative ketamine[5] and methadone, which have been shown previously in adults to decrease postoperative opioid requirements.[6] Given the morbidity associated with postoperative opioid use, including ileus, nausea, and respiratory depression, the development of preoperative and intraoperative multimodal regimens will continue to be developed. This report highlights that an opioid-free recovery can be achieved in a pediatric patient after sternotomy with cardiopulmonary bypass, using ESPB catheters and intraoperative methadone. Future prospective studies are needed to determine the safety and efficacy of ESPB catheters in this patient population.

Conflict of interest: BCH Tsui is a co-inventor of peripheral nerve catheters used in this case.

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Dislodged Tip of Damaged Central Venous Catheter After Radiofrequent Cox-Maze IV Procedure: An aMAZING Finding

To the Editor:

ABOUT 12% OF PATIENTS undergoing cardiac surgery and 30% of patients undergoing mitral valve surgery experience atrial fibrillation (AF).[1] The current Cox-Maze IV (CM-IV) procedure is the most successful surgical treatment for AF, with an overall freedom from AF of 78% at 5 years.[2] The CM-IV procedure creates transmural ablation lesions in the left and right atria to prevent the initiation or maintenance of AF. The energy sources used are bipolar radiofrequency (RF) energy or cryoablation.[3,4] The CM-IV procedure generally is performed with the patient under general anesthesia in combination with other cardiac procedures and the support of cardiopulmonary bypass (CPB). A central venous catheter (CVC) is an essential part of the anesthetic management and monitoring during cardiac surgery and commonly is placed via the right internal jugular vein with the tip placed into the proximal superior caval vein (SVC).[5] We present a patient who underwent mitral valve replacement (MVR) and a concomitant CM-IV procedure in which the distal end of the CVC was damaged due to RF energy.

A 67-year-old man, height 176 cm, with severe dynamic mitral valve regurgitation and a hypertrophic left ventricle on echocardiography and persistent AF with progressive symptoms of heart failure was scheduled for MVR with a concomitant CM-IV procedure using an AtriCure Isolator Synergy Clamp (Atricure Inc, West Chester, OH).

Anesthetic preparation included 2 large-bore peripheral intravenous catheters and an intra-arterial radial catheter for measuring blood pressure and for blood sampling. After

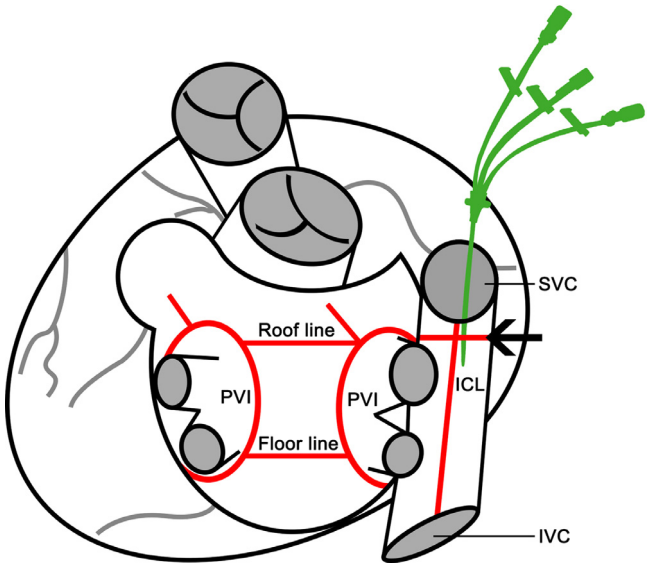

Fig 1. Schematic posterior view of the heart. The *red lines* are the main lines of the lesions set during the Cox-Maze IV procedure. The central venous catheter is shown in *green* with the tip in the superior caval vein. The *black arrow* points to the relationship between the intercaval line and the central venous catheter. Floor line, right pulmonary vein isolation to the left pulmonary vein isolation; ICL, intercaval lines; IVC, inferior caval vein; PVI, pulmonary vein isolation; roof line, right pulmonary vein isolation to left pulmonary vein isolation; SVC, superior caval vein.

induction of anesthesia and intubation of the trachea, a triple-lumen 7F catheter, 16 cm long CVC (REF CS-12703-E; Arrow International Inc., Reading, PA) was placed via the right internal jugular vein at a depth of 15 cm under ultrasound guidance according to the 6-step systematic approach for ultrasound-guided central venous access.[5]

Before performing the MVR a standard lesion set for the CM-IV (Fig 1) was performed via a left atrium approach, which included bilateral pulmonary vein isolation (PVI); roof line (right PVI to left PVI); floor line (right PVI to the left PVI); and coronary sinus, tricuspid annulus, right atrial appendage, and intercaval lines (atrial para-septal lines to both vena caval directions).

Shortly after the CM-IV procedure a sudden occlusion of the distal lumen of the CVC was noticed. The other lumina were flushing properly and were further used for administration of medication. After weaning the patient from the CPB circuit, the tip of the CVC was found by chance in the venous reservoir of the CPB (Fig 2, A). Because of this the CVC was removed and replaced without further consequences according the previously described method. Inspection of the removed CVC showed melting damage with total occlusion of the distal lumen. The CVC tip was examined and it was observed that no part of the line was missing (Fig 2, B).

Even though the MVR was successful, with decreased symptoms of heart failure after revalidation, the CM-IV procedure did not eliminate the patient's AF.

We hypothesize that the melting of the CVC line and the dislodging of its tip occurred during the creation of the intercaval lines (Fig 1).

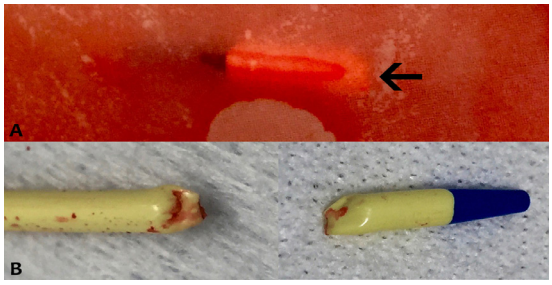

Fig 2. (A) The *black arrow* points to the caught central venous catheter tip in the venous reservoir. (B) The line and the tip with melting damage and total occlusion of the distal lumen.

The CURE-AF trial, which examined the efficacy and safety of the CM-IV procedure, showed that the procedure has no association with device-related complications.[6] There is one report describing a partially damaged CVC during the CM-IV procedure.[7] Erroneously grabbing the CVC while clamping the SVC to create the intercaval lines easily goes unnoticed. Moreover, to create reliable transmural lesions, the RF clamp needs to be repositioned frequently with the increased risk of damaging the CVC.

Entrapment and disruption of a CVC during a CM-IV procedure are conceivable complications that may compromise the hemodynamic monitoring and management of the patient. If the occlusion of 1 or more lumina goes unnoticed, medication such as vasopressors or inotropes given via these lumina will not reach the patient, resulting in possible deleterious consequences.

Fortunately the tip of the CVC was detected in the venous reservoir of the CPB circuit. If the tip was not drained in the venous reservoir, the embolic tip could have led to embolic events such as pulmonary embolism.

Furthermore, entrapment of the CVC in the ablation clamp theoretically could prohibit the creation of transmural scar tissue, resulting in an unsuccessful block of the fibrillatory wavefronts.[7,8] Creating transmural lesions can be challenging, especially in hearts with atrial fibrosis. Repeated ablations of the same line can be necessary to gain transmurality. Therefore, in contrast to a previous report,[7] it is unlikely that there were gaps created in the ablation line in the presented case.

According to the guidelines,[9] upper body CVCs in adults should be positioned with the tip usually in the lower SVC or the upper part of the right atrium. A more peripheral positioned CVC tip carries the risk of internal repositioning and thrombosis.[10] However, the unlikely chance of occurrence of these risks during short-term perioperative use does not weigh up against the risk of unintentional catheter damage and dislodgement during the CM-IV procedure.

In order to prevent unintentional catheter damage, we suggest limiting the catheter insertion depth during CM-IV procedures, aiming to place the tip at the level of or just beyond the innominate vein. In addition, we recommend confirming the catheter position with transesophageal echocardiography. As an alternative, an introducer sheath with a sliding locking device can be used to allow for changing the depth of the CVC or pulmonary artery catheter during the procedure, if

indicated, or these catheters could be introduced after the CM-IV procedure is finished.

Conflicts of Interest: There are no conflicts of interest for any of the authors.

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LMA Gastro Airway Seen Through the Eyes of a Cardiac Anesthesiologist

To the Editor:

In 2018, Blamforth et al. reported the use of supraglottic airway devices (SAD) with transesophageal echocardiography (TEE) in patients undergoing atrial fibrillation ablation procedures as an alternative to endotracheal intubation.[1] A few other authors also have described alternative airway management techniques consisting of combined oral placement of a first-generation SAD and a TEE probe. However, the overall success rates of these techniques are questionable because they rely entirely on favorable buccal anatomy of the patient.[2-5]

LMA Gastro Airway (Teleflex Medical Europe Ltd, Athlone, Ireland) is a second-generation SAD featuring a channel for esophageal intubation and a separate channel with a terminal cuff for lung ventilation. This particular SAD already has proven efficacy in upper gastrointestinal endoscopy procedures.[6]

We report the successful insertion of a TEE probe in the channel for esophageal intubation of the LMA Gastro in 9 patients undergoing percutaneous patent foramen ovale (PFO) closures, a short procedure done with increasing relevance and frequency.[7-12] Written informed consent was obtained from patients.

We prepared for our anesthetic technique by lubricating the inside of a transparent TEE probe cover (Probetection) utilizing a gel-filled syringe. The TEE probe was then inserted into the cover. We used the same gel-filled syringe to slightly lubricate the channel for esophageal intubation of the LMA Gastro. Before inserting the SAD into the patient's airway, we slid the TEE probe into the lubricated channel to ensure its smooth passage (Fig 1).

As the internal diameter of this esophageal channel is 14 mm, we used a TEE probe (GE Healthcare 6T probe) with a cross-sectional dimension of 14 × 12.5 mm at the tip.

We have successfully tested this technique on 9 patients (both male and female with body mass indexes ranging from 22.6-37.3 kg/m^2) who underwent percutaneous PFO closures performed by the same cardiologist from October 2018 to February 2019. In these procedures, no adverse incidents were reported regarding anesthetic technique, including airway management, or TEE image quality. A notable benefit that we observed was that the overall design and curve of the SAD allowed the passage of the TEE probe quite easily into each patient's esophagus.

In conclusion, we report the novel use of the channel for esophageal intubation of the LMA Gastro Airway for TEE probe placement, making endotracheal intubation and muscle relaxation in percutaneous PFO closures unnecessary.

Fig 1. The passage of a TEE probe into the lubricated channel of the LMA Gastro before inserting the SAD into a patient's airway.