

Accidental insertion of a percutaneous venovenous cannula into the persistent left superior vena cava of a patient undergoing liver transplantation

Insertion accidentelle d'une canule veino-veineuse percutanée dans la veine cave supérieure gauche persistante d'un patient subissant une greffe hépatique

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Received: 19 January 2011 / Accepted: 18 April 2011 / Published online: 7 May 2011
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Abstract

Purpose *Persistent left superior vena cava (PLSVC) is a rare congenital vascular abnormality found in 0.3% of the general population. We report herein a rare complication involving the accidental insertion of a large bore cannula into the PLSVC during liver transplantation (LT).*

Clinical features *A 63-yr-old man with primary sclerosing cholangitis presented for LT. Given the existence of a tunneled dialysis catheter in the right internal jugular vein (IJV) and a triple lumen catheter via the left IJV, insertion of an 18 French cannula for venovenous bypass (VVB) was performed via the left IJV using the existing triple lumen cannula as a conduit for a guidewire. Upon initiation of VVB, profound systemic hypotension occurred, and liver transplantation was completed without the further use of VVB. A chest x-ray confirmed a malposition of the VVB cannula with a large left hemothorax. A mini-sternotomy was performed for removal of the VVB cannula, which was found*

to be inserted in the PLSVC. Retrospectively, the presence of PLSVC was not anticipated due to a normal superior vena cava and a left innominate vein, as revealed by the course of a pre-existing left internal jugular vein triple lumen catheter on a preoperative chest x-ray, and due to a normal-sized coronary sinus on preoperative echocardiography.

Conclusion *Malpositioning of a venous cannula in a PLSVC should be anticipated as one of the potential complications of vascular access via the left internal jugular vein.*

Résumé

Objectif *La veine cave supérieure gauche persistante est une anomalie vasculaire congénitale rare qu'on retrouve chez 0,3 % de la population générale. Nous rapportons ici une complication rare survenue lors de l'insertion accidentelle d'une canule de grand diamètre dans la veine cave supérieure gauche persistante pendant une greffe hépatique.*

Éléments cliniques *Un homme de 63 ans souffrant d'une angiocholite sclérosante primitive s'est présenté pour une greffe hépatique. Étant donné l'existence d'un cathéter tunnellisé de dialyse dans la veine jugulaire interne (VJI) droite et d'un cathéter à triple lumière via la VJI gauche, l'insertion d'une canule de 18 French pour une dérivation veino-veineuse a été réalisée via la VJI gauche en utilisant la canule à triple lumière en place comme conduit pour la broche-guide. À l'amorce de la dérivation veino-veineuse, une hypotension systémique profonde est apparue, et la greffe hépatique a été réalisée sans utilisation de dérivation veino-veineuse. Une radiographie des poumons*

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a confirmé le mauvais positionnement de la canule de dérivation veino-veineuse avec un important hémithorax à gauche. Une mini-sternotomie a été réalisée pour retirer la canule de dérivation veino-veineuse, et il a été découvert qu'elle avait été insérée dans la veine cave supérieure gauche persistante. Rétrospectivement, la présence d'une veine cave supérieure gauche persistante n'a pas été anticipée en raison d'une veine cave supérieure et d'une veine innominée gauche normales, comme l'a révélé le parcours d'un cathéter à triple lumière pré-existant dans la veine jugulaire interne gauche sur une radiographie pulmonaire, et en raison d'un sinus coronaire de taille normale à l'échocardiographie préopératoire.

Conclusion *Le mauvais positionnement d'une canule veineuse dans une veine cave supérieure gauche persistante devrait être anticipé comme l'une des complications potentielles d'un accès vasculaire via la veine jugulaire interne gauche.*

Issues specific to venous cannulation via the left internal jugular vein (IJV) in comparison with the right IJV include presence of a thoracic duct orifice, higher lung cupola, smaller vascular size, and a greater tendency for the left IJV to lie anterior rather than lateral to the carotid artery.¹ More importantly, when inserting larger less pliable catheters, the more angulated path from the left IJV to the right atrium can potentially cause the cannula to migrate to the other vessels or even to perforate the venous wall.

We report herein a rare complication which occurred during left IJV cannulation, namely, accidental insertion of an 18 French (Fr.) cannula for venovenous bypass (VVB) into a persistent left superior vena cava (PLSVC) during liver transplantation (LT), which resulted in a left hemothorax and required surgical repair.

The patient gave his consent for publication of this case report.

Case report

A 63-yr-old man with primary sclerosing cholangitis presented for LT. His medical condition was complicated with a recent history of sepsis and renal failure requiring hemodialysis. His model for end-stage liver disease score was 37. Prior to the LT, transthoracic echocardiography (TTE) showed a normal left ventricle with ejection fraction of 55-60%, mild left atrial enlargement, and normal right cardiac chambers. Notably, his coronary sinus was not enlarged. His preoperative vascular access included a tunnelled dialysis catheter via the right IJV and a triple

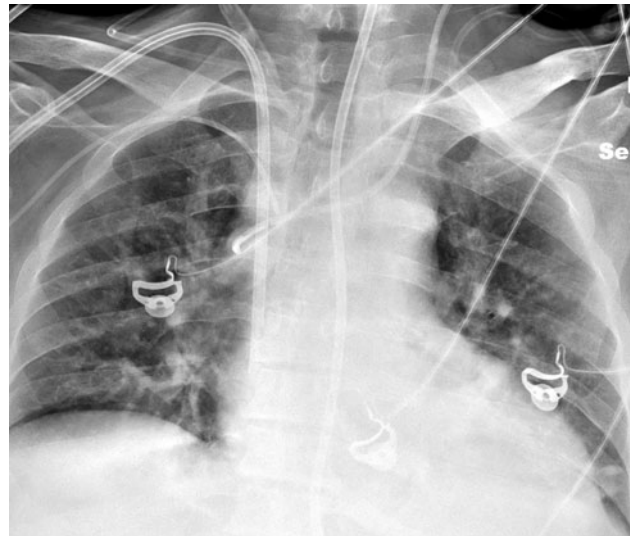


Fig. 1 The preoperative chest x-ray showed a tunnelled dialysis catheter via the right internal jugular vein and a triple lumen central line via the left internal jugular vein. The latter was observed in the left innominate vein with its tip in the superior vena cava

lumen catheter (7 Fr.) via the left IJV. A preoperative chest x-ray demonstrated that both catheter tips were in the superior vena cava (Fig. 1).

After induction of general anesthesia, a central venous line with a Swan-Ganz catheter was inserted via the right IJV. Standard practice in this institution was to place a percutaneous VVB return cannula for LT cases.² Given the potential difficulty of inserting the return cannula via the right IJV in the presence of the tunnelled dialysis catheter, the cannula was placed via the left IJV. An 18 Fr. Fem-Flex Duraflo Treated Femoral Arterial Cannula® (Baxter, Irvine, CA, USA) was inserted via the left IJV in the following manner: a long guidewire was first inserted through the existing triple lumen catheter in the left IJV. After the removal of the triple lumen catheter, the VVB cannula was inserted using the guidewire. No difficulty was noted in exchanging the triple lumen catheter for the VVB cannula. After the insertion, smooth blood withdrawal as well as smooth infusion of normal saline was observed via the VVB cannula. Vital signs were stable throughout this process.

The surgery commenced. To facilitate the hepatectomy, decompression of the portal venous system was attempted with VVB. The surgical team placed a 26 Fr. drainage cannula directly into the stump of the portal vein and another 17 Fr. cannula percutaneously via the left femoral vein. The heparin-coated bypass circuit was established; however, upon initiation of VVB, the patient's systemic mean blood pressure dropped suddenly from 60 mmHg to 30 mmHg. The end-tidal carbon dioxide monitor showed a decrease from 35 mmHg to 25 mmHg. The VVB cannula

was clamped immediately, and then hemodynamic parameters returned at once to baseline. The VVB circuit was found to be negative for air entry. Multiple attempts to resume VVB resulted in similar hemodynamic derangements despite blood transfusion and repositioning of the drainage cannula in the portal vein and in the inferior vena cava. Negative aspiration through the VVB return cannula yielded blood flow without resistance; however, transesophageal echocardiography (TEE) revealed a new large collection of pleural fluid in the left chest cavity. The LT procedure was then performed using a piggyback technique without VVB. No hemodynamic derangement occurred throughout the remainder of the case. The patient received a total of nine units of packed red blood cells, three units of fresh frozen plasma, and ten units of pooled platelets.

After completion of the LT, a chest *x-ray* confirmed a large left pleural fluid collection. The position of the VVB return cannula via the left IJV was found to be coursing straight down toward the mediastinum (Fig. 2). A chest tube was inserted in the left chest, and 1,000 mL of dark blood drained over the course of several minutes. Extravasation of the VVB cannula into the left chest cavity was strongly suspected. Since the patient remained hemodynamically stable and there was no active bleeding via the chest tube, the patient was transferred to the intensive care unit (ICU) in stable condition with the VVB return cannula in place to be surgically removed at a later time.

The day after LT, the patient electively underwent chest exploration via mini sternotomy. During exploration of the left mediastinum, a 5–6 cm length of the VVB cannula was found inserted in an anomalous vein (originating from the

caudal aspect of the left innominate vein at the level of the junction of the left IJV and the left subclavian vein) and progressing along the left aspect of the mediastinum. These anatomical findings were compatible with a PLSVC. No bleeding was observed along the PLSVC, and no obvious rupture, laceration, or puncture wounds were found in the vessel wall. Given the massive bleeding into the left chest cavity after the VVB, injury of the venous wall clinically manifested during the high pressure and high flow conditions resulting from the VVB. The patient's stable overnight hemodynamics together with minimal drainage from the left chest tube supported the possibility of spontaneous hemostasis of the injured site of the vessel wall. During the exploration of the mediastinum, no attempt was made to identify the site of the vessel injury using infusion of the fluid via the VVB cannula. Both the proximal and the distal portions of the PLSVC were ligated upon removal of the VVB cannula. The patient remained hemodynamically stable.

The postoperative course was complicated with Klebsiella infection of the wound and the urine, acute respiratory failure, and renal failure, which necessitated hemodialysis for two weeks postoperatively. On postoperative day 37, the patient was transferred from the ICU to a floor unit, and on postoperative day 64, he was discharged from the hospital.

Discussion

Persistent left superior vena cava is the most common vascular anomaly of the thoracic venous system. Since the original description in 1950,³ over 200 cases have been reported.^{4,6} This anomaly has been found in 0.3% of the general population, while a higher incidence (4.5%) has been noted in patients with congenital heart disease.⁷ Persistent left superior vena cava is often discovered when an enlarged coronary sinus is seen on echocardiography, since the sinus is the routine drainage route of PLSVC. Gonzalez-Juanatey *et al.* found that ten in 9,075 patients (0.11 %) examined by TTE had a PLSVC along with a dilated coronary sinus.⁵ In rare cases, however, direct drainage into the left atrium has been reported.^{8,9} There was some variability in the thoracic vasculature, most notably the absence of the left innominate vein in 50–65% of PLSVC cases.^{1,5}

Although some reports have associated PLSVC with sinus bradycardia and sinus arrest,¹⁰ the discovery of a PLSVC is primarily incidental. The presence of a dilated coronary sinus with echocardiography in the absence of elevated right atrial pressure would raise the suspicion, and further investigation using venography via the left jugular vein or the peripheral vein of the left arm would confirm diagnosis of a PLSVC.⁶

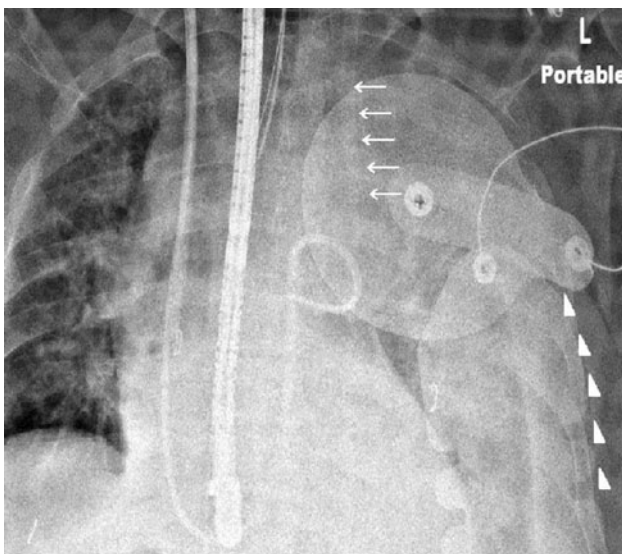


Fig. 2 The postoperative chest *x-ray* demonstrated a large left pleural effusion (dots). The position of the venovenous bypass return cannula (squares) via the left internal jugular vein was coursing through the left internal jugular vein and straight down toward the mediastinum

In our case, the index of suspicion for a PLSVC was extremely low given the normal left innominate vein, which accommodated a triple lumen catheter via the left IJV (Fig. 1), and a non-dilated coronary sinus seen during echocardiography.

We chose the left IJV for VVB return cannula placement due to the presence of a pre-existing hemodialysis catheter in the right IJV. Interestingly, insertion of the VVB cannula was accomplished without apparent difficulty using a guidewire through the pre-existing triple lumen catheter. Even in the absence of any of these warning signs, however, malpositioning of the VVB cannula did occur and resulted in significant morbidity in the form of a defect which caused a large left pleural fluid collection and necessitated a surgical repair. In this case, we considered the guidewire as a potential mechanism of catheter malposition, as it had initially been inserted toward the superior vena cava via the pre-existing left internal jugular catheter. In our view, the guidewire would be retracted somehow during the procedure, well enough to allow the tips of the relatively stout three step dilators and the 18 Fr. cannula to be pushed along with the guidewire into the PLSVC, which was anatomically straighter from the left IJV than from the left innominate vein.

This case emphasizes the risk of central line insertion via the left IJV. The safety of inserting such a large bore VVB cannula via the left IJV rather than via the right IJV has not been fully established.¹¹ Alternate management options might have included placement of the VVB cannula via an axillary venous cut-down or elimination of the VVB with a piggyback method. Recently, the need for the VVB for LT has been questioned,¹² and authors of a large retrospective case series suggested the potential benefit of the retrohepatic caval preservation technique (or piggyback technique) without VVB over the use of VVB.¹³

Furthermore, the placement of the VVB cannula should be confirmed either by direct TEE visualization of the VVB cannula tip or by performing a “bubble test” through the VVB cannula.² The latter test would have demonstrated the immediate appearance of bubbles in the right atrium via the coronary sinus instead of via the superior vena cava and ultimately would have led to the diagnosis of a malpositioned cannula in the PLSVC. In this particular case, we acknowledge that we could have prevented the malposition of the cannula in the PLSVC by placement of TEE prior to the line exchange via the left IJV and identification of the guidewire in the superior vena cava throughout the VVB cannula placement. We also recognize that an attempt to identify the tip of the VVB cannula in the left innominate vein using the upper esophageal sagittal view of TEE could have suggested a potential malposition of the cannula. In addition, we acknowledge that the bubble test was not performed in this case.

In conclusion, all anesthesiologists should be aware that inadvertent placement of a catheter into the PLSVC is a potential complication when using the left IJV as an insertion site particularly when larger more rigid catheters are used. Placing a large bore cannula for VVB via the left IJV should be attempted only in rare cases and should be performed with extreme caution.

Acknowledgement The authors thank Christine M. Heiner BA (Scientific Writer, Department of Anesthesiology/Department of Surgery, University of Pittsburgh School of Medicine) for her editorial assistance with the manuscript.

Research/Financial Support Support was received solely from the above institutional and departmental sources.

Conflict of interest None declared.

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