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HOW I DO IT

Insertion of Inferior Vena Cava Filter Prior to Removal of Prolonged Indwelling Extracorporeal Membrane Oxygenation Catheters

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ABSTRACT

Venous thromboembolism and pulmonary embolism are potentially fatal complications that could occur after extracorporeal membrane oxygenation (ECMO). Prophylactic insertion of inferior vena cava filters prior to decannulation of prolonged indwelling ECMO catheters is a sound approach to lower the risk of these complications. We present the cases of two patients for whom inferior vena cava filter was prophylactically inserted prior to removal of ECMO catheter; details of the technique are described.

Key Words: *Extracorporeal membrane oxygenation; Pulmonary embolism; Vena cava filters; Venous thromboembolism*

中文摘要

移除長時間留置的體外膜肺氧合導管前先插入下腔靜脈濾器

陸嬈、馮啟雄、梁錦榮

靜脈血栓栓塞和肺栓塞均為體外膜肺氧合療法（ECMO）後可能發生的致命併發症。長時間留置體內的ECMO導管在拔管前預防性放置下腔靜脈濾器為減低這些併發症風險的有效方法。本文報告兩個病例，他們均於移除ECMO導管前預防性放置下腔靜脈濾器。本文會詳細描述該技術的細節。

INTRODUCTION

Venous thromboembolism and pulmonary embolism are potentially fatal complications that can occur after extracorporeal membrane oxygenation (ECMO).[1-4] These complications can develop in patients with inadequate anticoagulation due to clinical bleeding.[5] The risk of developing these complications is also potentially increased in cases which require prolonged use of ECMO. Prophylactic insertion of inferior vena cava (IVC) filters prior to removal of the ECMO catheters is a sound approach to lower the risk of venous thromboembolism and pulmonary embolism. This technique has not been well documented in the literature. We present the cases of two patients for whom IVC filter was prophylactically inserted prior to ECMO decannulation, and describe the details of the technique.

CASE 1

A 73-year-old woman, who enjoyed good past health,

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was admitted for severe pneumococcal pneumonia, multiple organ failure, and septic shock. She underwent veno-venous (VV) ECMO due to persistent desaturation despite mechanical ventilation. The ECMO cannulation was performed via the right internal jugular vein and right femoral vein. Due to a prolonged course of recovery, the ECMO cannulation was kept in use for 3 months and she subsequently developed deep venous thrombosis in the left common and external iliac veins. In view of potentially increased risk of pulmonary embolism, an IVC filter was inserted prior to decannulation of ECMO. The IVC filter was removed 1 month later and the patient recovered uneventfully.

CASE 2

A 48-year-old woman, with a history of anxiety disorder, was admitted for pneumococcal pneumonia with septic shock. She underwent VV ECMO for management of severe hypoxaemia refractory to mechanical ventilation. The right internal jugular vein and right femoral vein were used for ECMO cannulation. Insertion of the ECMO catheter via the right femoral vein was complicated by IVC perforation, haemoperitoneum, and a large retroperitoneal haematoma. Perforation of the posterior wall of the lower IVC was surgically repaired and the right femoral vein ECMO catheter was withdrawn to the level of the right iliac vein during the operation. Another ECMO catheter was subsequently inserted via the left common femoral vein. As the patient had a prolonged course of recovery, ECMO was kept in use for 1month. In view of the potentially increased risk of venous thromboembolism and pulmonary embolism, an IVC filter was inserted prior to decannulation of the ECMO. The procedure was uneventful.

PROCEDURE

Indications and contraindications

Venous thromboembolism and pulmonary embolism are known potentially fatal complications in patients requiring ECMO support. For those who require prolonged ECMO support due to severe respiratory or cardiac failure, the risk of developing these complications is potentially increased. Thus, prophylactic insertion of IVC filter prior to removal of the ECMO catheters is a sound approach to lower the risk of these complications. The definition of 'prolonged ECMO support', that is, the need for IVC filter insertion prior to ECMO catheter removal, has not been well documented in the literature. In our first case, ECMO cannulation was retained for 3 months, and in the second case, it was retained for 1 month prior to IVC filter insertion.

The only absolute contraindication to the procedure is the absence of central venous access, such as in cases with occluded jugular or femoral veins. Relative contraindications include skin infection at the jugular and femoral catheter insertion sites, and severely impaired coagulation profile.

Pre-procedure

The patient is instructed to fast for 6 hours, and coagulopathy and thrombocytopenia are corrected, if possible.

The Procedure

The procedure is performed under aseptic technique. The jugular and femoral ECMO catheters are clamped simultaneously and the ECMO machine is turned off. The jugular ECMO catheter is cut superior to the site of the clamp (Figure 1a). A rotating haemostatic valve with continuous saline infusion is connected to the jugular ECMO cannula via an adapter (Figure 1b). The femoral ECMO cannula is withdrawn till the level of common iliac vein. It is then cut distal to the clamp and is connected to a syringe via an adaptor for continuous infusion of saline (Figure 1c).

A multi-sidehole catheter is inserted via the rotating haemostatic valve into the jugular ECMO catheter and an inferior vena cavogram is performed to localise the renal veins. A filter deployment sheath is then inserted after removal of the multi-sidehole catheter (Figure 1d). An IVC filter (Cook Celect, Denmark) is deployed at the infrarenal portion of the IVC under fluoroscopic guidance. IVC venogram is performed afterwards to confirm the position of the IVC filter (Figure 2).

The filter deployment sheath, internal jugular and femoral ECMO catheters are removed. Haemostasis of the neck and femoral wounds is achieved by manual compression.

DISCUSSION

The patient in case 1 developed deep venous thrombosis despite being on anticoagulation medical therapy during the 3 months when the ECMO cannula was retained. As she gradually recovered from severe pneumococal pneumonia and no longer required the use of ECMO, IVC filter was inserted prior to decannulation of ECMO as there was risk of dislodgement of the venous thrombi

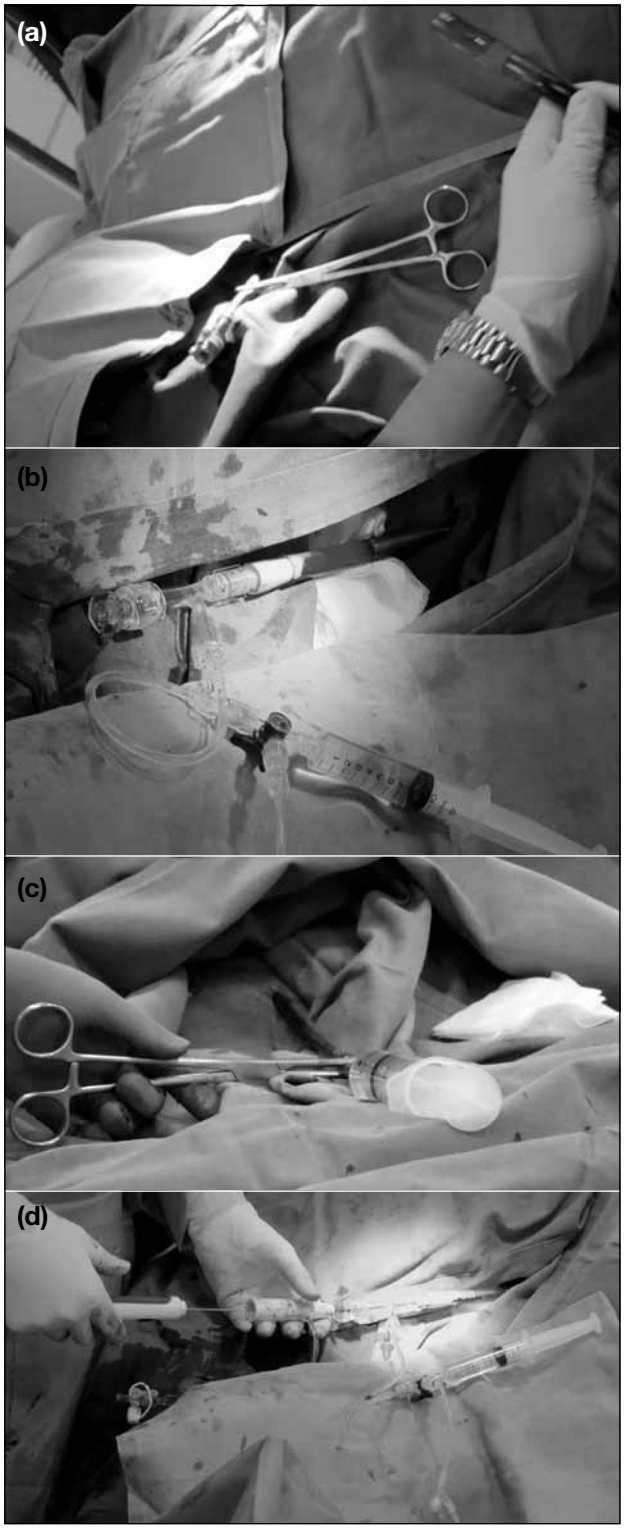

Figure 1. (a) The jugular extracorporeal membrane oxygenation (ECMO) catheter is clamped and cut superior to the site of the clamp. (b) A rotating haemostatic valve with continuous saline infusion is connected to the jugular ECMO cannula via an adapter. (c) The femoral ECMO catheter is clamped and cut distal to the clamp, and is connected to a syringe via an adaptor for continuous infusion of saline. (d) Filter introducer and delivery sheath assembly are inserted through the rotating haemostatic valve into the jugular ECMO catheter.

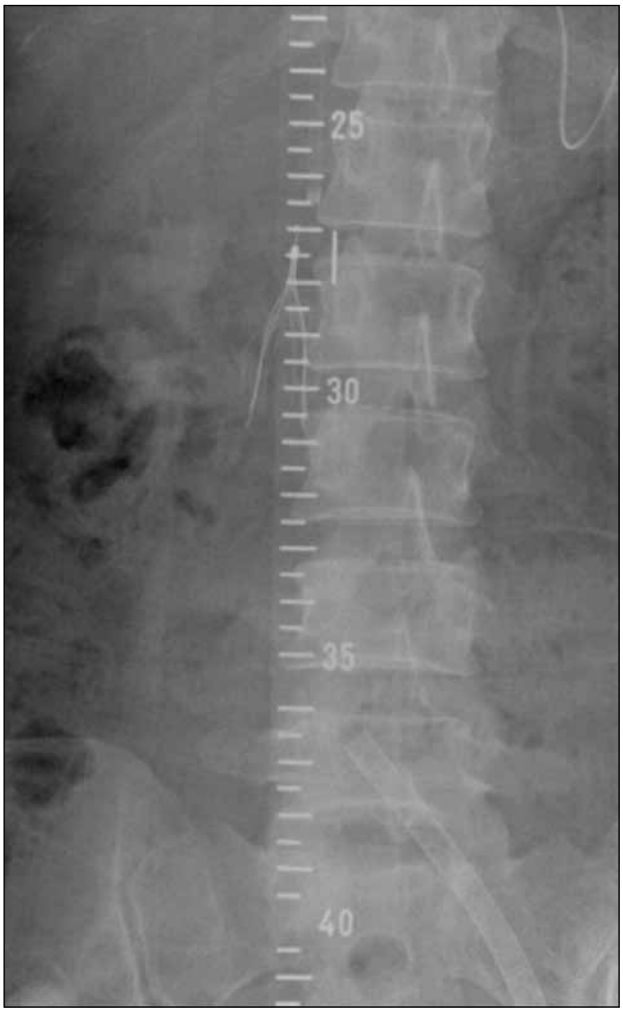

Figure 2. A final fluoroscopic image shows inferior vena cava filter in-situ with left femoral extracorporeal membrane oxygenation catheter pulled back to the left common iliac vein.

during ECMO catheter removal and increased risk of pulmonary embolism.

During the preparation stage of the procedure, extra care must be taken to ensure that the size of the adapter chosen is compatible with that of the jugular ECMO cannula. Any significant size discrepancy such as a relatively small-calibre adapter and a relatively large-bore ECMO cannula could produce a gap in between, allowing continuous substantial leakage of blood throughout the whole procedure. Plastic Multipurpose Tubing Adapter (Cook, US) was used by the authors in both cases.

It is also important to ascertain the length of the femoral

ECMO cannula that can be withdrawn during the procedure to make way for the infra-renal deployment of the IVC filter, while at the same time ensuring that the side-holes of the femoral ECMO cannula are not exposed to prevent unnecessary blood loss during the procedure.

An alternative method for IVC filter insertion prior to ECMO decannulation has been reported.[6] The alternative method described is to insert a working catheter for IVC filter deployment via guidewire exchange after removal of the femoral venous ECMO cannula. One major difference in the method used in our cases is that the ECMO catheters were kept in situ during the whole procedure and were only removed after successful deployment of the IVC filter, thus, minimising the risk of embolism of thrombus dislodged from the ECMO catheter before deployment of the IVC filter. Theoretically, the procedure can also be done from the femoral ECMO cannula. However, it is important to ascertain the length of the femoral ECMO cannula that could be withdrawn during the procedure to make way for the infra-renal deployment of the IVC filter, while at the same time ensuring that the side holes of the femoral ECMO cannula are not exposed to prevent unnecessary blood loss during the procedure.

CONCLUSION

Prophylactic insertion of an IVC filter prior to removal of a prolonged indwelling ECMO catheter is a sound approach and a safe procedure to lower the risk of venous thromboembolism and pulmonary embolism.

REFERENCES

1. Beurtheret S, Mastroianni C, Pozzi M, D'Alessandro C, Luyt CE, Combes A, et al. Extracorporeal membrane oxygenation for 2009 influenza A (H1N1) acute respiratory distress syndrome: single-centre experience with 1-year follow-up. Eur J Cardiothorac Surg. 2012;41:691-5. cross ref
2. Rastan AJ, Lachmann N, Walther T, Doll N, Gradistanac T, Gommert JF, et al. Autopsy findings in patients on postcardiotomy extracorporeal membrane oxygenation (ECMO). Int J Artif Organs. 2006;29:1121-31.
3. Camboni D, Philipp A, Lubnow M, Bein T, Haneya A, Diez C, et al. Support time-dependent outcome analysis for veno-venous extracorporeal membrane oxygenation. Eur J Cardiothorac Surg. 2011;40:1341-7.
4. Bisdas T, Beutel G, Warnecke G, Hoeper MM, Kuehn C, Haverich A, et al. Vascular complications in patients undergoing femoral cannulation for extracorporeal membrane oxygenation support. Ann Thorac Surg. 2011;92:626-31. cross ref
5. Aigner C, Wisser W, Taghavi S, Lang G, Jaksch P, Czyzewski D, et al. Institutional experience with extracorporeal membrane oxygenation in lung transplantation. Eur J Cardiothorac Surg. 2007;31:468-74. cross ref
6. Obi A, Park PK, Rectenwald J, Novelli P, Waldvogel J, Haft JW, et al. Inferior vena cava filter placement before ECMO decannulation. ASAIO J. 2012;58:622-5. cross ref