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Damage Control Surgery with External Iliac Vein Injury during Extracorporeal Cardiopulmonary Resuscitation: A Case Report

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Abstract

Background: Successful treatment with multiple damage-control surgeries and extracorporeal membrane oxygenation is rare. **Case Presentation:** We report a case of defibrillation-resistant ventricular fibrillation in a 35-year-old man. Veno-arterial extracorporeal membrane oxygenation was initiated immediately, during which left external iliac vein injury occurred, and emergency surgery was performed thereafter. Laparotomy revealed left external iliac vein injury with massive intra-abdominal hemorrhage, and the vascular injury was repaired. However, the patient developed abdominal compartment syndrome, necessitating damage control surgery with open abdominal management. Multiple subsequent surgeries were performed, and abdominal closure was performed on day five. The patient was discharged with complete neurological recovery on day 73. **Conclusion:** Damage control surgery under extracorporeal membrane oxygenation carries the concern of hemorrhagic complications, necessitating careful consideration of its indications. However, this approach remains viable for the treatment of patients with defibrillation-resistant ventricular fibrillation.

Keywords

Abdominal Compartment Syndrome, Extracorporeal Membrane Oxygenation, Hemorrhagic Complications, Open Abdominal Management, Vascular Injury

1. Introduction

Surgical procedures performed under veno-arterial extracorporeal membrane oxygenation (V-A ECMO) require considerable attention to hemorrhagic complica-

tions, particularly when multiple operations are necessary rather than a single intervention. Given this context, reports on successful life-saving treatments with multiple damage control surgeries (DCS) under V-A ECMO are scarce. Here, we report a case in which repeated DCS was performed under V-A ECMO, with positive survival outcomes.

2. Case Presentation

A 35-year-old male with an unremarkable medical history collapsed at work and experienced cardiopulmonary arrest. Resuscitation was initiated by emergency medical services. An automated external defibrillator delivered three shocks, and the patient was transported to our center during continued resuscitation.

2.1. Initial Treatment Course

Upon arrival at the emergency room (ER), the patient's initial cardiac rhythm was ventricular fibrillation (VF). Cardiopulmonary resuscitation (CPR) was continued, and endotracheal intubation was performed. The patient underwent multiple defibrillations before arrival at the ER and was diagnosed with defibrillation-resistant VF. Amiodarone was administered, followed by defibrillation; however, VF persisted. Consequently, refractory VF was diagnosed, and we decided to initiate V-A ECMO.

In the ER, an arterial cannula was inserted into the right common femoral artery (CFA), and a venous drainage cannula was placed into the left common femoral vein (CFV) to establish extracorporeal circulation. However, owing to insufficient venous drainage, extracorporeal circulation was temporarily halted, and chest compressions were resumed while the patient was transported to the angiography room. An additional drainage cannula was inserted into the right CFV to successfully establish extracorporeal circulation. Defibrillation was performed after extracorporeal circulation was established to restore sinus rhythm, and a coronary angiography revealed a 75% stenosis of the left anterior descending artery (#7).

During the procedure, a sudden deterioration of venous drainage was observed, which raised the suspicion of hemorrhagic complications due to injury to the left external iliac vein (EIV). Angiogram revealed an extravascular perforation of the drainage cannula, and angiography confirmed the extravasation of contrast medium from the left EIV (**Figure 1(a)**), suggesting hemorrhagic shock due to vascular injury. Therefore, emergency surgery was planned.

Left inguinal incision and left paramedian laparotomy revealed that the left drainage cannula had perforated the left EIV and migrated into the retroperitoneum, with its tip protruding into the peritoneal cavity, which resulted in a massive intra-abdominal hemorrhage (**Figure 1(b)**).

After clamping both the proximal and distal portions of the EIV penetrated by the drainage cannula, the cannula was removed, and the left EIV was repaired with continuous suturing using non-absorbable thread.

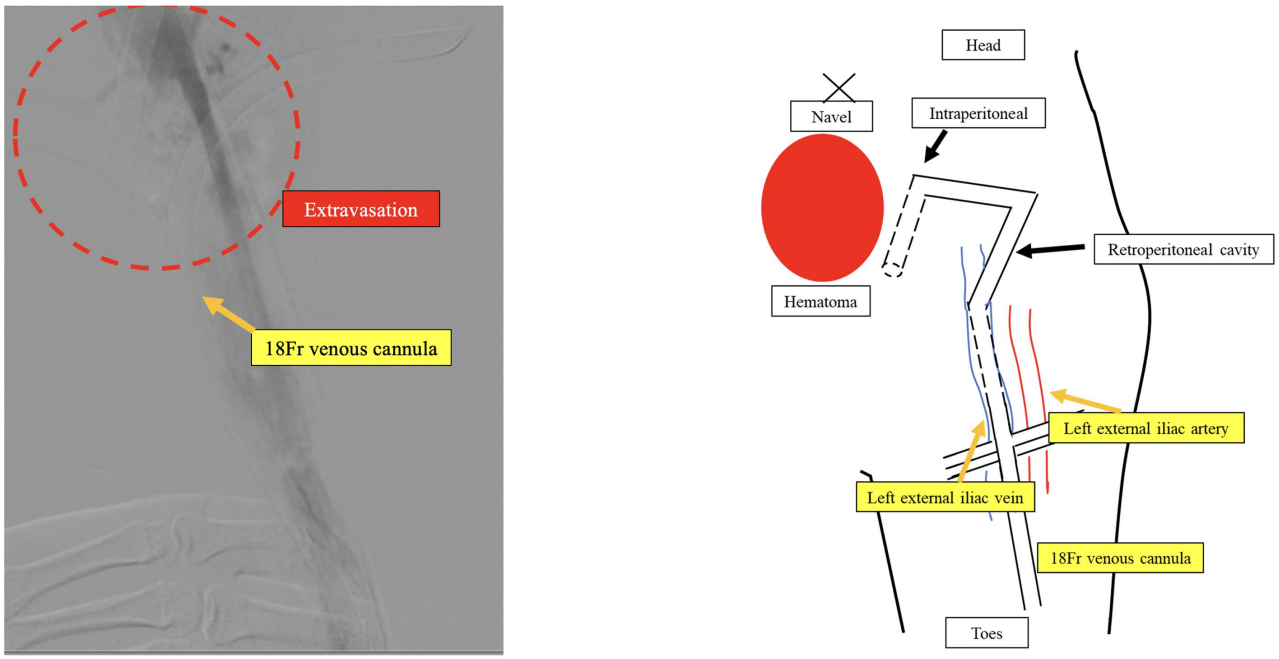

Figure 1. Left common femoral vein angiography and initial surgical findings. (a) Distal tip of the drainage cannula had perforated the vessel, with extravasation of contrast medium observed. (b) Drainage cannula penetrated the left external iliac vein, migrated into the retroperitoneum, and further perforated into the peritoneal cavity, which resulted in massive intra-abdominal hemorrhage.

Although primary abdominal closure was considered, extensive discoloration of the intestine due to ischemic changes from profound shock vital signs raised concerns regarding the potential need for subsequent resection of necrotic bowel and the risk of increased intra-abdominal pressure due to bowel edema. In addition, intra-abdominal bleeding tendency associated with coagulopathy was observed. Therefore, gauze packing and open abdominal management (OAM) were performed as part of the DCS. OAM was performed using the vacuum pack closure technique, and the patient was admitted to the intensive care unit for resuscitation and transfusion.

2.2. Hospital Course (Figure 2)

Despite a massive blood transfusion, the intra-abdominal bleeding worsened, which led to shock and necessitated a second laparotomy on the same day. A puncture site hemorrhage caused by an intra-aortic balloon pumping (IABP) catheter inserted into the left CFA was found to have reached the abdominal cavity and was identified as the source of the bleeding. The IABP catheter was removed, and vascular repair with continuous suturing using non-absorbable thread was performed. The IABP catheter was then reinserted into the left CFA at a more distal site than the previous insertion site and the exposed left common iliac and femoral vessels were repacked. OAM using the vacuum pack closure technique was continued.

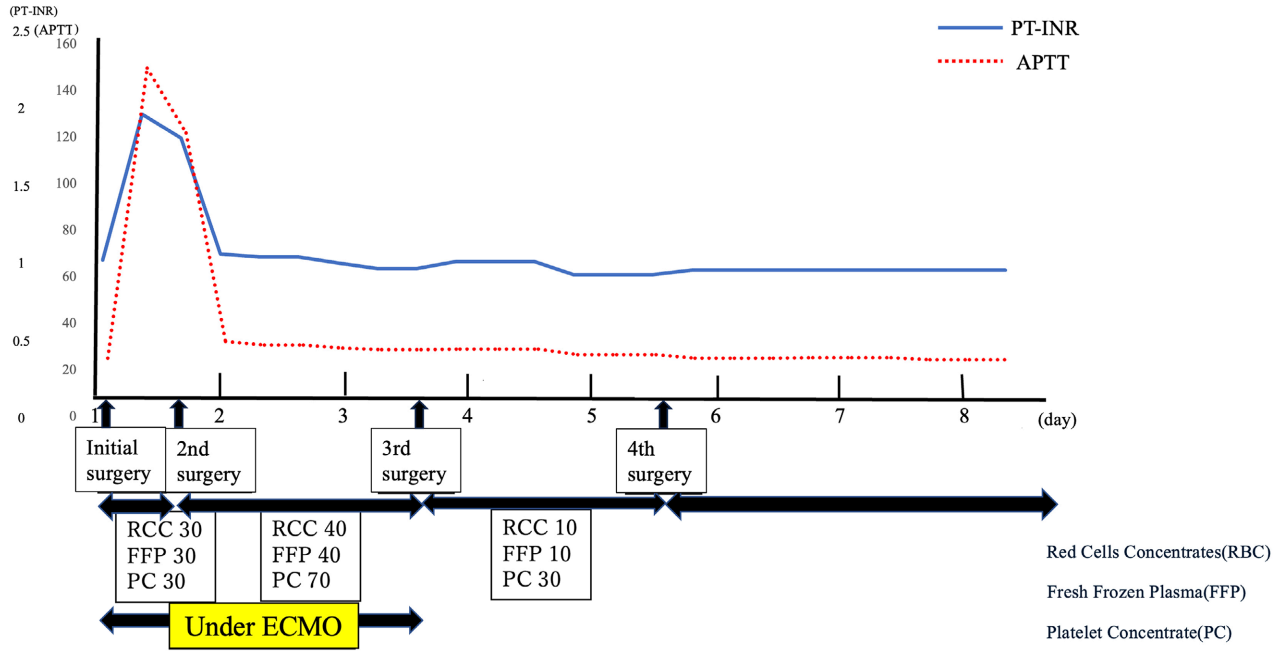

Figure 2. Clinical course after hospital admission. Although a massive transfusion was required under veno-arterial extracorporeal membrane oxygenation (V-A ECMO), the transfusion requirements significantly decreased after V-A ECMO withdrawal.

On the third day, as the patient's cardiac function improved, prompting a weaning test in which V-A ECMO flow was gradually reduced. As no arrhythmia, hypotension, or respiratory failure occurred during the test, V-A ECMO withdrawal was planned. However, another laparotomy was performed because of increased intra-abdominal bleeding. Hemostasis was achieved in the left inguinal region and retroperitoneum. However, persistent coagulopathy-induced bleeding from the right colonic mesentery required additional intra-abdominal packing. Subsequently, vascular plasty of the right CFA and CFV was performed, which allowed for successful V-A ECMO withdrawal (third surgery).

On the fifth day, the planned laparotomy revealed no significant bleeding and allowed definitive abdominal closure (fourth surgery). The patient remained hemodynamically stable, and transfusion therapy was no longer required. The endotracheal tube was extubated on the eleventh day, and the patient was discharged on day 73 with no neurological deficits and was able to ambulate independently.

3. Discussion

The use of extracorporeal cardiopulmonary resuscitation (ECPR) for out-of-hospital cardiac arrest (OHCA) has increased in recent years, with improved survival rates [1]. However, ECPR is associated with numerous complications, the most common of which are bleeding, cannulation failure, limb ischemia, and infection [2]. Among these, bleeding is the most frequently reported complication [3]. Cannulation failure in V-A ECMO occurs in 2% - 51% of cases, with vascular injury occurring in approximately 4% [3]. Cannulation techniques for V-A ECMO in ECPR vary between institutions; in this case, cannulation was performed in the

emergency department under ultrasound guidance. Considering previous reports suggesting that the combination of ultrasound guidance and fluoroscopy reduces cannulation-related complications such as bleeding and malpositioning of the cannula compared to ultrasound guidance alone [2], such complications in this case might have been avoidable. Since this case, our institution has adopted a policy of performing cannulation for all ECPR cases in the angiography room.

Hemorrhagic complications associated with V-A ECMO are attributed to the need for anticoagulation therapy and platelet consumption within the mechanical circuit. Additionally, excessive shear stress generated in the cannulated vessels during V-A ECMO leads to the over cleavage of von Willebrand factor multimers, resulting in acquired von Willebrand syndrome (AVWS) [4]. Some reports have suggested that all patients who undergo V-A ECMO developed this condition [5]. Prolonged activated partial thromboplastin time is known as a potential indicator of AVWS; however, in the context of V-A ECMO management, anticoagulant therapy is routinely administered, and similar coagulation profiles may be observed due to the anticoagulants themselves. As a result, identifying AVWS under such conditions can be challenging. In the present case, specific diagnostic tests for AVWS were not performed. It is important to recognize that, during V-A ECMO management, coagulopathic states other than those induced by anticoagulation may also contribute to hemostatic difficulty.

Management strategies for hemorrhagic complications during V-A ECMO include anticoagulant dose reduction and transfusion therapy to improve the systemic coagulation status. Early weaning from V-A ECMO is ideal whenever feasible; however, surgical hemostasis should be considered when early weaning is impossible. As shown in **Figure 2**, a sharp decline was noted in the transfusion requirements after V-A ECMO withdrawal. This suggests that both surgical hemostasis and V-A ECMO withdrawal contribute to hemorrhage control, highlighting the challenges of managing bleeding with V-A ECMO. Therefore, in patients in whom hemorrhagic complications are difficult to control, early V-A ECMO withdrawal should be considered.

In the present patient, DCS was performed as a hemostatic procedure because of the patient's hemodynamic instability and potential risks of rebleeding and abdominal compartment syndrome under V-A ECMO. A literature review of the PubMed and Japan Medical Abstracts Society databases revealed only five reports, aside from this one, in which patients survived beyond 1 month following DCS under V-A ECMO [6]-[10] (**Table 1**).

Indications for V-A ECMO in these patients included hemorrhagic shock (two patients), obstructive shock due to pulmonary embolism (two patients), and cardiogenic shock due to myocardial infarction (one patient). Furthermore, in three of these five patients, DCS was performed for iatrogenic organ injury that occurred during cardiopulmonary resuscitation. Notably, various strategies have been employed in these patients, including early weaning from V-A ECMO, avoidance of anticoagulants, and use of local hemostatic agents during surgery.

Table 1. Previously reported cases of patients surviving over 1 month after damage control surgery (DCS) under veno-arterial extracorporeal membrane oxygenation (V-A ECMO). Only five patients, excluding the present patient, have been reported in whom DCS was performed following extracorporeal membrane oxygenation initiation, and the patients achieved survival durations beyond 1 month.

Author	Year	Age	Sex	Diagnosis	Diagnosis required DSC	Strategies for the management of hemorrhagic complication due to V-A ECMO	Surgical outcomes
Nishimura *et al.* [6]	2017	81	F	Pulmonary embolism	Liver injury induced by chest compressions	• Biological tissue adhesive and sealant • Massive transfusion	After 150 days of hospitalization, undergoing rehabilitation
Lee *et al.* [7]	2017	21	M	Hemorrhagic shock	Rupture of the inferior thoracic aorta, mesenteric injury	• Discontinuation of anticoagulant therapy	Discharged at 44th hospital days
Nagashima *et al.* [8]	2020	34	M	Pulmonary embolism	Liver injury induced by chest compressions	• Early weaning from V-A ECMO	Discharged 1 month after surgery
Wada *et al.* [9]	2022	53	F	Acute myocardial infarction	Liver injury induced by chest compressions	• Biological tissue adhesive and sealant • Massive transfusion	Transferred on the 73 days for rehabilitation
Matsuda *et al.* [10]	2023	48	M	Hemorrhagic shock	Ruptured iliac artery aneurysm, mesenteric injury	• Discontinuation of anticoagulant therapy • Massive transfusion	Discharged at the 41st hospital day
Current case	2025	35	M	Acute myocardial infarction	Intraperitoneal perforation of venous outflow cannula	• Massive transfusion • Early weaning from V-A ECMO	Discharged at the 73th hospital day

As performing surgical hemostasis under V-A ECMO poses significant challenges, DCS should be limited to the minimum number of necessary interventions. The scarcity of reports on DCS with V-A ECMO may reflect the fact that this approach has traditionally been avoided owing to its difficulties. However, as demonstrated in our patient, if early weaning from V-A ECMO, avoidance of anticoagulants, and use of local hemostatic agents can be applied, DCS under V-A ECMO must be a viable option when its benefits outweigh the risks.

This case report highlights the feasibility of multiple surgical interventions, including DCS for V-A ECMO, ultimately leading to improved patient survival.

4. Conclusion

Here, we report a patient in whom DCS was successfully performed under V-A ECMO, which led to improved survival. Although DCS with V-A ECMO carries a high risk of severe hemorrhagic complications, careful consideration of its use is necessary. Nevertheless, in patients in whom DCS is deemed essential, appropriate modifications to the surgical approach may make this strategy feasible.

Informed Consent

Written informed consent was obtained from the patient for the publication of this case report and accompanying images.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Inoue, A., Hifumi, T., Sakamoto, T., *et al.* (2022) Extracorporeal Cardiopulmonary Resuscitation in Adult Patients with Out-of-Hospital Cardiac Arrest: A Retrospective Large Cohort Multicenter Study in Japan. *Critical Care*, **26**, Article 129.

[2] Suga, M. and Inoue, A. (2022) Mastering Cardiovascular Emergency Care and Intensive Care ECPR: Introduction of ECMO for Cardiac Arrest Patients. *Japanese Circulation Journal*, **70**, 538-542.

[3] Inoue, A., Hifumi, T., Sakamoto, T. and Kuroda, Y. (2020) Extracorporeal Cardiopulmonary Resuscitation for Out-of-Hospital Cardiac Arrest in Adult Patients. *Journal of the American Heart Association*, **9**, e015291. https://doi.org/10.1161/jaha.119.015291

[4] Horiuchi, H. (2019) Various Conditions Associated with ADAMTS13 Acquired von Willebrand Syndrome Caused by Excessive Cleavage of ADAMTS13. *Thrombosis Medicine*, **9**, 230-234.

[5] Kalbhenn, J., Schmidt, R., Nakamura, L., Schelling, J., Rosenfelder, S. and Zieger, B. (2015) Early Diagnosis of Acquired Von Willebrand Syndrome (AVWS) Is Elementary for Clinical Practice in Patients Treated with ECMO Therapy. *Journal of Atherosclerosis and Thrombosis*, **22**, 265-271. https://doi.org/10.5551/jat.27268

[6] Nishimura, T., Okamoto, A., Fujisaki, N., *et al.* (2017) Liver Injury Caused by CPR in a Patient with Cardiac Arrest. *The Japanese Association for The Surgery of Trauma*, **31**, 17-23.

[7] Lee, S.K., Gongora, E., O'Donnell, S., Carrillo, E.H., Sanchez, R., Kiffin, C., *et al.* (2017) Intraoperative Rescue Extracorporeal Membrane Oxygenation and Damage Control during Repair of a Traumatic Aortic Injury. *Journal of Surgical Case Reports*, **2017**, rjx022. https://doi.org/10.1093/jscr/rjx022

[8] Nagashima, F., Inoue, S. and Ohta, M. (2020) A Patient with Severe Polytrauma with Massive Pulmonary Contusion and Hemorrhage Successfully Treated with Multiple Treatment Modalities: A Case Report. *Journal of Medical Case Reports*, **14**, Article No. 69. https://doi.org/10.1186/s13256-020-02406-9

[9] Wada, H., Takasu, Y., Nagashima, T. and Kobayashi, M. (2022) A Case of Damage Control Surgery under ECMO for Liver Injury Caused by Chest Compression. *Journal of Acute Care Surgery*, **12**, 127-132.

[10] Matsuda, T., Takamatsu, J. and Sakamoto, Y. (2023) A Case of Right Common Iliac Artery Aneurysm Rupture Complicated by Mesenteric Injury and Abdominal Compartment Syndrome, Diagnosed after ECPR, and Successfully Treated with Multidisciplinary Management. *Journal of Japanese Association for Acute Medicine*, **34**, 1-5.