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ECMO Beyond Boundaries - Intracranial Bleed Complicating ECMO Management

[1]Garipalli Srinivas Nikilesh Kumar, [2]*Krushna Chandra Misra, [3]A Hari Prasad, [4] D Goutham [5]Viswesvaran Balasubramanian

[1,3,4]Consultant, [2]HOD,
Department of Critical Care Medicine,
Yashoda Superspeciality Hospitals, Somajiguda, Hyderabad, Telangana, India-500082
[5] Consultant, Interventional Pulmonology and Sleep Medicine, Department of Pulmonology, Yashoda Super Speciality Hospitals, Somajiguda, Hyderabad, Telangana, India-500082.

***Corresponding Author:**
Dr. Krushna Chandra Misra
MBBS, DNB, IDCCM, EDIC, CPHCM
HOD Department of Critical Care Medicine, Yashoda Superspeciality Hospital, Somajiguda, Hyderabad, Telangana-500082, India

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Abstract

Extracorporeal membrane oxygenation (ECMO) stands as a pivotal technology in the realm of life-saving interventions, particularly for individuals afflicted with severe respiratory distress syndrome (ARDS) and intracranial bleed. It is unfortunate that the utilization of extracorporeal membrane oxygenation (ECMO) has historically been deemed inadvisable for individuals suffering from hemorrhagic neurologic conditions. Advancements in technology, particularly heparin coated circuits, allowed ECMO application with mild or without systemic anticoagulation regimen in some situations. Additionally, the application of ECMO without systemic anticoagulation has further expanded the potential patients that may benefit from this life-saving technology. We present a case report illustrating the effective application of VV-ECMO therapy with heparin coated circuit and without systemic anticoagulation for the management of severe respiratory failure in a patient experiencing intracranial bleeding.

Keywords: Anticoagulation, bleeding, Extracorporeal membrane oxygenation (ECMO), heparin coated circuits.

Introduction

Extracorporeal life support devices, particularly extracorporeal membrane oxygenation (ECMO) techniques have firmly established as premier methods within intensive care medicine for the management of severe respiratory and cardiorespiratory failure [1]. Nonetheless, the procedure itself is linked with considerable morbidity and mortality rates [2]. In fact, systemic anticoagulation (SA) appropriate for facilitating uneventful contact between blood and foreign surfaces, thereby preventing thromboembolic events and ECMO system malfunctions, is accountable for the majority of hemorrhagic events. Consequently, it has been identified as a contraindication for ECMO application in certain challenging clinical contexts [3]. Intracranial hemorrhage (ICH) represents a grave complication being identified as the primary cause of mortality in both veno-venous (vv) and veno-arterial (va) extracorporeal membrane oxygenation (ECMO) [4]. The incidence of intracranial hemorrhage (ICH) in patients receiving ECMO treatment is inadequately reported and the associated risk factors are poorly comprehended.

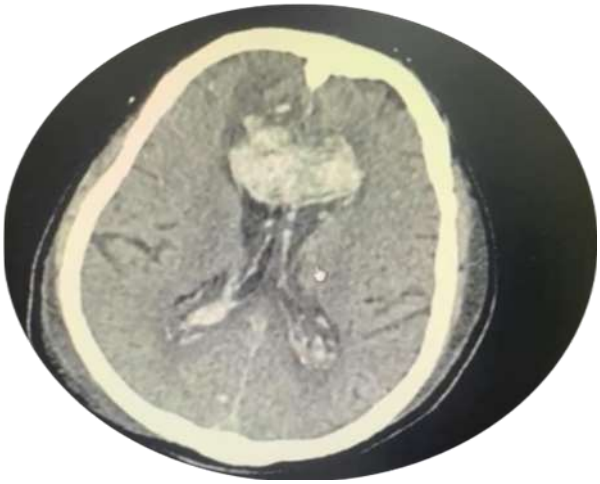
In the present case, we delineated and analyzed the scenario of a patient with severe respiratory distress

and intracranial hemorrhage, who was effectively managed with life support through the veno-venous (VV) extracorporeal membrane oxygenation (ECMO) treatment, without the necessity of parenteral anticoagulation therapy.

Case Presentation

A 65-year-old male patient presented with the complaints of fever, cough and dyspnea for 10 days. He was initially admitted in outside hospital and received noninvasive ventilation (NIV) support and intubated in view of worsening hypoxia and respiratory distress. The requirement of extracorporeal membrane oxygenation (ECMO) was explained to the attenders in view of the severe ARDS and initiated ECMO support in outside hospital which is 300 kms away and transferred to our facility by road by our intensive care team and cardiothoracic team at wee hours of day. Despite acute respiratory distress syndrome (ARDS) ventilation strategies and prone ventilation, his P/F ratio was below 80 and hemodynamics worsened requiring stiff vasopressor support. On examination, the patient's pupils were 3 mm bilaterally and did not respond to light, sensorium was not assessed in view of continuous sedation and paralysis and was sick enough to be shifted for a computed tomography (CT) brain. The patient's hemodynamics improved requiring minimum vasopressor support. CT scan of the brain, indicated an intracranial hemorrhage (Fig 1). We initiated anticoagulation with heparin coated circuit to achieve an activated clotting time (ACT) rate of 160-180 seconds and continued ECMO support without systemic anticoagulation. There was no coagulopathy or deranged liver function test (LFT) and as he was oliguric (200ml/ 24hours) initiated on continuous renal replacement therapy (CRRT). During ECMO support coagulation parameters were monitored for any clots in the oxygenator, in the circuit and for pressure differences pre and post oxygenator. There was no clotting in the circuit and with gradual clinically and radiological recovery ECMO support weaned off and decannulated on day 6. After almost 10 days of ICU stay, patient neurological condition started improving. Patient was eventually discharged with tracheostomy and a GCS of E4VTM5 after an intense battle for 2 weeks.

Fig 1: CT scan showing intracranial hemorrhage



Discussion

We discovered from this case how crucial it is to use a multidisciplinary approach when managing this sophisticated technology in a patient who is at high risk. Furthermore, the necessity to plan for transport throughout the hospital during ECMO therapy, particularly in areas not traditionally utilized by patients with ECMO and the feasibility to use VV-ECMO for an extended period of time without the need of systemic anticoagulation.

Despite considerable preclinical and clinical research efforts aimed at developing novel therapies for acute respiratory distress syndrome (ARDS), the management of patients with ARDS predominantly relies on supportive care [5]. Present acute respiratory distress syndrome (ARDS) support therapies encompass the implementation of lung protective

Volume 7, Issue 5; September-October 2024; Page No 226-229

ventilation strategies, the utilization of prone positioning, meticulous monitoring of fluid balance, and the early identification and mitigation of secondary injuries [6]. In 2009, the CESAR trial, for the first time, demonstrated the potential benefits of employing extracorporeal membrane oxygenation (ECMO) as an early rescue therapy in patients with severe acute respiratory distress syndrome (ARDS) [7]. Further research, including the latest published EOLIA trial, has consistently refined the understanding and clinical experience in the application of veno-venous extracorporeal membrane oxygenation (V-V ECMO) in patients with ARDS [8]. As the research is in progress, it is becoming more evident that ECMO represents a viable alternative for a broad spectrum of patients with ARDS. In the present case ECMO was used to treat our patient's ARDS because of the respiratory distress.

Bleeding is identified as the most prevalent complication among ECMO patients and is often linked to a higher mortality rate [9]. However, the maintenance of ECMO necessitates a delicate equilibrium between the requirements for anticoagulation and procoagulant factors (Balle CM). As per the extracorporeal life support organization (ELSO) guidelines, the anticoagulation utilization range during ECMO is delineated as an activated clotting time (ACT) of 180 to 220 seconds [10]. The guidelines recommended reducing the infusion rate of anticoagulants until the anti-coagulation time (ACT) is approximately 1.4 to 1.5 times of standard range, while concurrently managing bleeding during ECMO support [11]. According to data derived from a recent international survey, the target ACT for VA- and VV-ECMO ranged from 140 to 220 seconds. The standard ACT, which is between 160 and 200 seconds is used by most institutions [12]. In our case, systemic anticoagulation was not used and heparin-coated circuit anticoagulation was started to meet an ACT target of 160-180 seconds while on ECMO.

The cause of acute respiratory distress syndrome (ARDS) is brain trauma injury (BTI) and associated intracranial hemorrhage (ICH), which necessitated extracorporeal membrane oxygenation (ECMO). To achieve an activated partial thromboplastin time (APTT) range of 40-60 seconds, unfractionated heparin (UFH) is used as an anticoagulant in the circuit [13]. Sklar etal., described a case, who required ECMO for ARP treatment over a period of 17 days initially presented with a CT scan indicating cerebral edema, ECMO was started due to severe ARDS, necessitated by anticoagulation with UFH administered at a targeted activated clotting time (ACT) of 150 second [14]. However, on the second day, the CT scan revealed the presence of a significant brain hemorrhage, which may have been exacerbated by anticoagulation. Here in our case report, CT scan showed intracranial hemorrhage then we initiated heparin coated circuit anticoagulation to achieve an ACT target of 160-180 seconds and then continued ECMO without systemic anticoagulation and we have not observed the formation of any clots within the circuit over the duration of six days. After 15 days, our patient was successfully discharged, awake, responsive, and free of cognitive and memory issues.

In this case report, we highlighted the effective application of VV-ECMO to support respiratory failure with severe ARDS, in a patient with intracranial hemorrhage. Furthermore, it highlights the growing experience in employing VV-ECMO in patients suffering from hemorrhagic neurologic diseases. Future cases are encouraged to incorporate these insights and implement ECMO in suitable patients, supported by a multidisciplinary team, to maximize patient benefits.

Conclusion

The utilization of extracorporeal membrane oxygenation (ECMO) in patients with acute respiratory distress syndrome (ARDS) and intra cerebral hemorrhages concomitant ICH is complex and challenging. A multidisciplinary team working together to manage the patient and stressing the value of customized treatment plans and close monitoring of respiratory and neurologic parameters would result in a successful outcome.

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Volume 7, Issue 5; September-October 2024; Page No 226-229

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Volume 7, Issue 5; September-October 2024; Page No 226-229