Adjunctive Therapies in the Management of Acute Pulmonary Embolism: A Review of IVC Filter and ECMO Utilization

Alivia Jachimiak, MS-IV, Michigan State University College of Osteopathic Medicine, Mohamed Jaber, MD, McLaren Oakland Hospital

Purpose

The goal of this project is to evaluate the adjunctive roles of **extracorporeal membrane oxygenation (ECMO)** and **inferior vena cava (IVC) filter placement** in the management of acute or subacute pulmonary embolism (PE). Specifically, we aim to clarify how veno-arterial (VA) ECMO may provide temporary cardiopulmonary support in high-risk or refractory PE cases—either as a bridge to definitive therapy or as standalone rescue therapy—drawing upon registry data suggesting mortality benefit and protocol refinements in hemodynamic stabilization. Concurrently, we will explore the indications, complications, and evolving utilization of IVC filters when anticoagulation is contraindicated or has failed. As Pulmonary Embolism Response Teams (PERTs) increasingly integrate multimodal therapies—including anticoagulation, catheter-based thrombectomy, ECMO, and IVC filters—understanding the role, timing, and outcomes of these adjunctive interventions is critical. By synthesizing current evidence and expert experience, this project aims to offer practical guidance on incorporating ECMO and IVC filter placement within PERT protocols and acute PE management strategies.

Background

Acute pulmonary embolism (PE) remains a significant cause of morbidity and mortality, particularly in massive and submassive cases where rapid hemodynamic collapse can occur. Standard therapies include systemic thrombolysis, anticoagulation, and catheter-directed interventions. In recent years, adjunctive strategies such as **inferior vena cava (IVC) filters** and **extracorporeal membrane oxygenation (ECMO)** have gained attention within Pulmonary Embolism Response Teams (PERTs). These therapies are typically considered in high-risk patients when conventional measures alone are insufficient—either to prevent recurrent embolic events or to provide cardiopulmonary support during cardiac arrest or circulatory collapse.

While IVC filters can reduce the risk of recurrent embolization, they also carry well-documented complications, including caval thrombosis, migration, and penetration of the vessel wall. Likewise, ECMO can provide lifesaving hemodynamic support but introduces challenges such as bleeding, limb ischemia, and the need for careful coordination with definitive reperfusion therapy. The optimal role, timing, and patient selection for these adjuncts remain controversial, underscoring the need for further investigation and the development of standardized protocols based on PERT.

Methods

A focused literature review was conducted using PubMed and Google Scholar to identify peer-reviewed studies, registry analyses, case series, and society guidelines evaluating the use of **extracorporeal membrane oxygenation (ECMO)** and **inferior vena cava (IVC) filters** in patients with acute or subacute pulmonary embolism. Inclusion criteria emphasized publications that addressed patient selection, timing of intervention, procedural techniques, and reported outcomes associated with these adjunctive therapies. Data were extracted regarding patient characteristics, hemodynamic status, indication for ECMO or filter placement, device type, and complications.

Studies were analyzed for survival outcomes, rates of recurrent embolism, complications such as bleeding or filter thrombosis, and the role of PERTs in guiding decision-making. Representative cases were reviewed to illustrate how ECMO and IVC filter placement were used in real-time clinical practice—whether as bridge therapy to reperfusion interventions, rescue strategies during hemodynamic collapse, or prophylaxis in patients unable to receive anticoagulation.

Results

IVC Filter Outcomes and Complications

IVC filters are primarily used in patients with contraindications to anticoagulation or as a temporary measure in high-risk cases of pulmonary embolism. Short-term benefits include reduced rates of recurrent PE, but long-term data raise concerns. Retrospective studies show recurrent DVT rates approaching 20% and device fracture in over 10% of cases with prolonged dwell time. Caval wall perforation has been documented in up to 40% of patients, depending on filter type, while migration and tilting are also frequent complications. Retrieval rates remain low, with some analyses showing successful removal in fewer than 10% of cases. These findings underscore the importance of using IVC filters selectively and in a time-limited manner within PERT protocols.

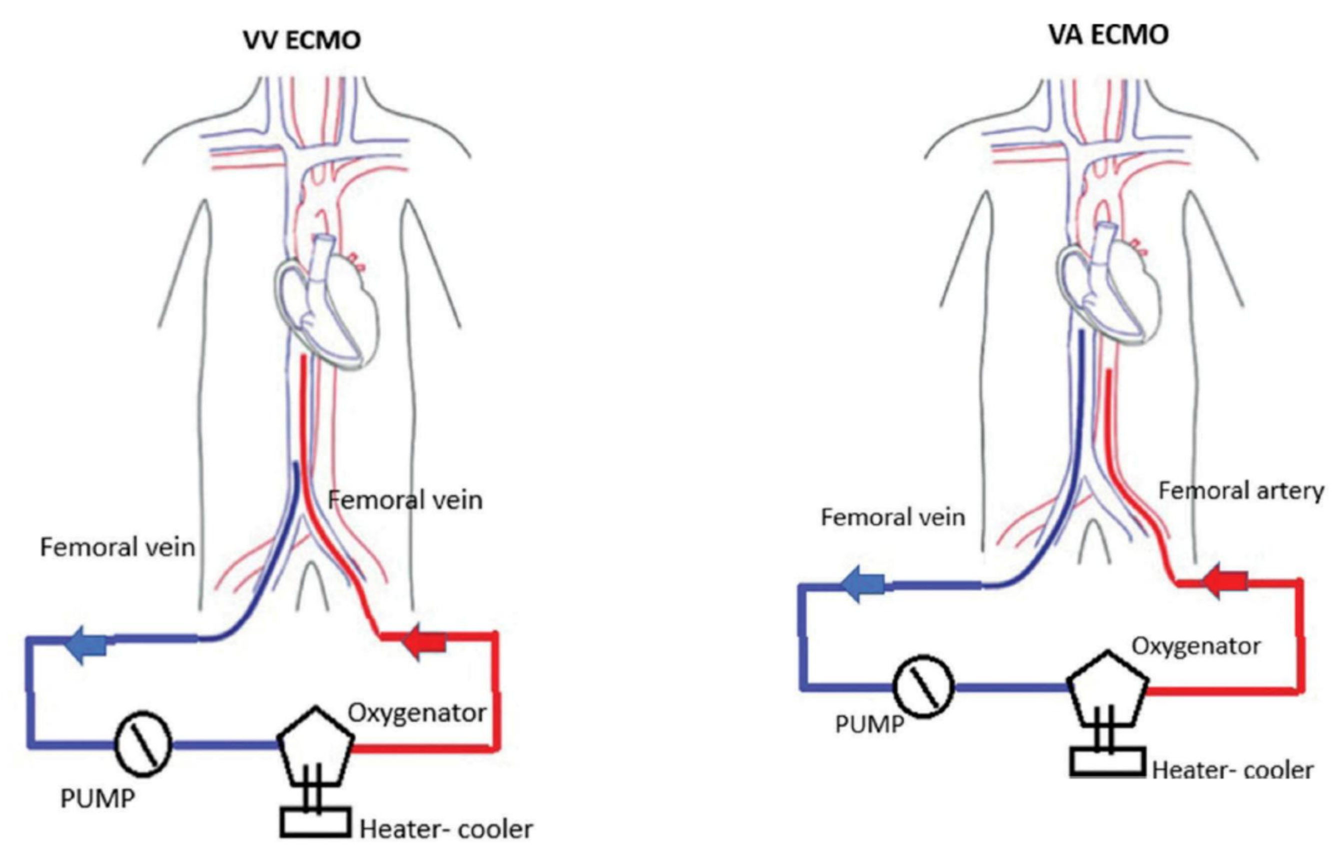

Figure 1. *Schematic representation of veno-arterial extracorporeal membrane oxygenation (VA-ECMO) circuit.* Deoxygenated blood is drained from the venous system, circulated through a centrifugal pump and membrane oxygenator for gas exchange, and returned to the arterial system for cardiopulmonary support. This configuration is frequently employed in cases of massive pulmonary embolism with hemodynamic collapse, serving as a bridge to reperfusion therapies or recovery with anticoagulation.

ECMO in Massive PE and Outcomes

ECMO is most often employed in massive PE with circulatory collapse or severe hypoxemia refractory to conventional interventions. Observational series and registry data suggest that ECMO, particularly when paired with reperfusion therapies such as catheter-directed thrombectomy or surgical embolectomy, can improve survival. Early initiation provides the greatest benefit, especially in centers with experienced multidisciplinary teams. However, ECMO use is limited by access to expertise and carries risks including bleeding, renal failure, limb ischemia, and neurologic complications, emphasizing the need for careful patient selection.

Integration in PERT Framework

In PERT-driven care, IVC filters and ECMO are applied selectively to complement established therapies. Filters offer short-term embolic protection in patients unable to anticoagulate, while ECMO provides critical cardiopulmonary support during hemodynamic collapse. Outcomes appear most favorable when ECMO is used as a bridge to definitive reperfusion, and when IVC filters are promptly retrieved once contraindications to anticoagulation resolve. Together, these data highlight the need for standardized protocols to optimize timing, minimize complications, and individualize therapy in high-risk PE.

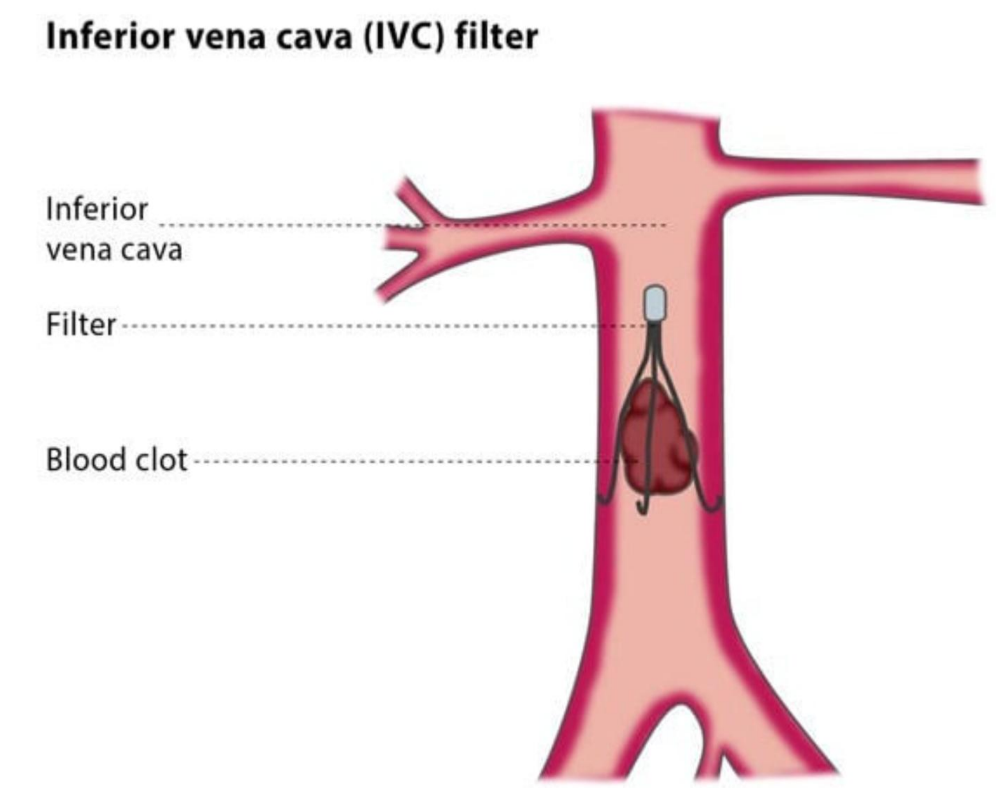

Figure 2. *Inferior vena cava (IVC) filter placement and function.* The filter is deployed in the IVC to trap emboli migrating from the lower extremities, thereby preventing pulmonary embolism. While effective for short-term protection in patients unable to receive anticoagulation, long-term implantation is associated with complications such as thrombosis, migration, and caval wall penetration. Timely retrieval is essential to minimize adverse outcomes.

Conclusion

Both IVC filters and ECMO serve as essential adjuncts in the management of high-risk pulmonary embolism, particularly within the Pulmonary Embolism Response Team (PERT). Their application must be individualized, taking into account patient stability, contraindications, comorbidities, and institutional expertise.

Current evidence supports the **selective and time-limited use of IVC filters** in patients who are unable to receive anticoagulation, with careful follow-up to ensure retrieval once the contraindications resolve. In contrast, **early initiation of ECMO** in cases of massive PE with circulatory collapse may provide a lifesaving bridge to catheter-directed therapy, surgical embolectomy, or recovery with anticoagulation. However, risks such as bleeding and ischemic complications require meticulous management.

Taken together, these findings highlight the value of a **multimodal, team-based approach** to PE care. Future research should focus on refining patient selection criteria, optimizing timing of intervention, and developing standardized protocols for integrating ECMO and IVC filters into PERT-driven management strategies.

References

1. Tsui B, et al. TrapEase filter outcomes: recurrent DVT 18.7%, filter fracture 13.3%—J Clin Intervent Radiol 2022. PMC+14PMC+14BioMed Central+14
2. Johnson MS, et al. Celect/Tulip filter perforation rates up to 43% with prolonged dwell time—AJR study 2010. PMC
3. ntracardiopulmonary migration with megacava or operator error—PMC case reports. PMC+2Endovascular Today+2
4. Retrieval success only 8.5%; thrombosis in 7.8% of cases — JAMA internal medicine. JAMA Network+1
5. ECMO reduces mortality in massive PE; early initiation is beneficial—Front Cardiovasc Med, 2023. PubMed+1
6. Multicenter ECMO bridging shows improved outcomes; combination therapy favored—J Clin Med 2024; Resuscitation registry. MDPI
7. ED Course. (2016, October 19). *CCM: ECMO* [Diagram]. Clinical Monster. Retrieved August 28, 2025, from https://blog.clinicalmonster.com/2016/10/19/ccm-ecmo/