A Comparative Evaluation of Rotational Thrombectomy and Vacuum Aspiration for Management of Chronic Thrombosis: A Case Study

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Introduction
Inferior vena cava (IVC) filters have been instrumental in decreasing the incidence of pulmonary embolism, particularly in patients with contraindications to anticoagulation or following major surgeries (1). However, these filters pose potential complications such as thrombosis, filter migration, and caval penetration (2). The management of thrombus formation, particularly the collagenized or chronic thrombus, is challenging due to its intrinsic characteristics (3).

Case Presentation
A 61-year-old female, with an indwelling Cook Celect IVC filter, was originally placed five years prior due to an impending orthopedic procedure. She was not on anticoagulation therapy post-operatively and was unaware of the filter’s existence. She presented with bilateral lower extremity swelling, pain, and pelvic varicosities indicative of chronic venous insufficiency.

Ultrasound and a non-contrast CT scan revealed a significant volume of thrombus in the bilateral iliac veins and IVC distal to the filter. Additionally, a superior thrombus collection extending from the IVC apex hook was noted.

Intervention
Given the thrombus’s significant burden and its extension both distal and proximal to the filter, a 22 French Angiovac from AngioDynamics was chosen for vacuum thrombectomy. The device was deployed via jugular access placed superior to the thrombus. However, the aspiration proved unsuccessful due to the thrombus’s resistance to vacuum force, which could be attributed to its chronic nature and collagenous structure.

As an alternative, a 7 French, 135 cm Cleaner™ 15 Thrombectomy System from Argon Medical was utilized. This device was inserted via femoral access and actuated from the iliac veins to above the IVC filter. The high-speed (4000 rpm) rotational action facilitated mechanical maceration of the thrombus, converting it into smaller fragments that could be effectively aspirated through the 22 french angiovac.

Outcome and Follow Up
The alternative approach led to the successful aspiration of the thrombus, with full restoration of antegrade flow in the IVC, crucial for reducing symptoms and preventing further thrombus propagation. The total thrombus aspirated amounted to 145 ml, collagen-banded, with a limited blood loss of 275 ml. The blood was subsequently reinfused via a cell saver and venous catheter. Follow-up imaging confirmed the maintenance of the patency of IVC and the absence of any new thrombus formation.

Discussion
The failure of the initial vacuum thrombectomy approach and the subsequent success of the rotational thrombectomy approach highlight the intrinsic properties of the chronic, collagenized thrombus. Chronic thrombi are characterized by an increased proportion of collagen and fibrin, contributing to their hardness and resistance to conventional vacuum aspiration (4).

Additionally, the chronic thrombus’s embedding within the venous wall further increases the resistance to vacuum force (5).

The use of the Cleaner™ 15 rotational thrombectomy device allowed mechanical disintegration of the thrombus, making it susceptible to aspiration. This modality of mechanical thrombectomy for treating chronic thrombus has been validated in previous studies (8).

Clinical Implications and Future Directions
IVC filters, though effective in preventing pulmonary embolism, may lead to chronic thrombosis over time, presenting clinical challenges. Current vacuum thrombectomy techniques often struggle to remove the hardened, collagenized thrombus associated with these cases, necessitating alternative treatment strategies.

In this case, rotational thrombectomy proved to be an effective treatment strategy for aspirating a consolidated, collagenized thrombus. The rotating movement at high speed appears to break down the thrombus structure, making it easier to aspirate. Further clinical trials are warranted to validate these findings. A direct comparison of rotational thrombectomy versus vacuum thrombectomy in randomized controlled trials would provide valuable evidence to inform treatment protocols for patients with chronic thrombosis.

In addition, further mechanistic studies are required to understand how rotational thrombectomy disrupts the thrombus structure and why this technique is more effective for chronic, collagenized thrombi. This could involve histological studies of thrombi before and after treatment, or in vitro experiments with artificial thrombi.

Overall, this case study suggests that rotational thrombectomy may be a valuable addition to the armamentarium of interventions for managing chronic thrombosis associated with IVC thrombosis.

References