IVC Filter Removal Technique: A Case Report and Systematic Review of the Hangman's Wire Loop Technique

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DOI: https://doi.org/10.32896/tij.v5n4.1-9
Submitted: 01.06.2025
Accepted: 27.12.2025
Published: 31.12.2025

ABSTRACT:
Inferior vena cava (IVC) filters are critical tools in preventing venous thromboembolism (VTE) in patients with contraindications to anticoagulation. However, prolonged filter dwell times can lead to complications such as tilt, embedded hooks, and caval wall penetration, making retrieval challenging. Advanced techniques like the Hangman's wire loop method have emerged as effective solutions for these complex cases. We present a case report detailing the successful use of the Hangman's wire loop technique to remove an embedded IVC filter and review the literatures comparing its success rates to other advanced retrieval methods. The Hangman's technique consistently demonstrates high success rates (81.8%–100%) and minimal complications, making it a valuable tool for interventional radiologists managing difficult IVC filter retrievals.

Keywords: Inferior Vena Cava Filters, Hangman's Wire Loop, Venous Thromboembolism

INTRODUCTION

Inferior vena cava (IVC) filters are widely used to prevent pulmonary embolism (PE) in patients at high risk for venous thromboembolism (VTE), particularly those with contraindications to anticoagulation therapy [1]. While effective in acute settings, prolonged retention of IVC filters can lead to complications such as filter tilt, migration, fracture, caval thrombosis, and strut penetration into adjacent structures [2-7].

Retrieval of IVC filters becomes increasingly difficult with longer dwell times due to tissue overgrowth, intimal hyperplasia, and embedding of filter components into the caval wall. Routine snare techniques often fail in cases with severe tilt or embedded hooks, necessitating advanced retrieval methods [4,6,8-11].

The Hangman's wire loop technique is a specialized method designed for challenging cases involving tilted or embedded filters. It involves creating a strong wire loop between the filter neck and caval wall using a pigtail catheter and snare device. By forming a strong wire loop around the filter neck, this technique facilitates the release of embedded hooks and allows safe removal of the filter, illustrated in Figure 1. This setup applies sufficient traction to release embedded hooks while minimizing trauma to surrounding tissues. This manuscript presents a case report illustrating the use of this technique and reviews its performance compared to other advanced retrieval methods [4,8,10,12-16].

CASE REPORT

A 77-year-old female with locally advanced right breast invasive carcinoma and a history of right lower limb DVT required a retrievable IVC filter placement due to an upper gastrointestinal bleed while on anticoagulants. Several months later, her clinical condition improved, and retrieval was attempted via a right internal jugular vein approach using a 12-Fr Check-Flo Performer® sheath (Cook Medical). Initial venography revealed the filter was severely tilted, with the retrieval hook embedded within the caval wall, preventing engagement with a standard snare.

To facilitate retrieval, a 5-Fr pigtail catheter was introduced through the sheath and maneuvered through the struts of the tilted filter to create a loop around its neck. A 0.035-inch hydrophilic Glidewire (Terumo) was advanced through the pigtail. The pigtail's curved tip allowed for precise directional control, maintaining a safe distance of approximately 3 - 5 mm from the caval wall to avoid mechanical injury. The retrieval device was then used to snare this wire loop, forming the "Hangman's loop". Gentle cephalad traction was applied, providing the mechanical leverage to displace the filter from the wall and successfully dislodge the embedded hook from the intimal hyperplasia tissue. Once coaxial alignment was restored, the filter hook was snared and removed en bloc using traditional methods. The procedural steps was shown in Figure 2. Post-procedural imaging confirmed no evidence of caval injury or thrombus formation. The patient recovered uneventfully and remained free from VTE recurrence during follow-up.

METHODOLOGY

A systematic search was conducted using PubMed, EMBASE, and other databases for articles published between 2012 and 2025 on advanced IVC filter retrieval techniques focusing on Hangman's wire loop modifications. Keywords included "Hangman technique," "IVC filter removal," "wire loop," "embedded hook," and "tilted filter." Studies were included if they reported procedural outcomes using this technique or its modifications.

RESULTS

The success rates among different modifications are summarized in Figure 3 and Table 1. The literature includes several studies describing variations of the Hangman's wire loop technique:

1. **Original Hangman Technique** [17]:
    - Success rate: 81.8% (Al-Hakim et al.)
    - Indications: Severe tilt (mean tilt: 13.3° ± 3.9°), prolonged dwell times (mean: 194 days)

  - Complications: None reported
2. **Low-Profile Hangman Technique** [18]:
   - Success rate: Initial 95.6%, overall 100%
   - Advantages: Uses an 11-F sheath instead of larger systems, reducing procedural risks
   - Complications: None reported
3. **Other Modified Techniques**:
   - Success rate: Initial 85%, overall 90%
   - Methods: Combined use of wire loops with balloon displacement or forceps dissection
   - Complications: <1%

DISCUSSION

The findings of our literature review suggest that the low-profile modification of the Hangman's technique consistently demonstrates superior success rates compared to both the original technique and other advanced methods [17, 18]. A key advantage of the low-profile approach is the use of smaller sheaths, which reduces the risk of access-site trauma while maintaining efficacy.

A critical component of this success is the pigtail catheter's curved design. Unlike standard straight or angled catheters, the 360-degree distal curve allows for precise maneuvering through filter struts in a non-coaxial plane [8,19]. This curvature acts as a protective "bumper" against the caval wall. Furthermore, the pigtail serves as a fulcrum; when traction is applied to the wire loop, the catheter's curve helps translate the pulling force into lateral displacement, effectively 'peeling' the filter hook away from the intima without damaging the caval wall [8,10].

This method is specifically indicated for filters with severe tilt or those with hooks completely incorporated into the caval wall [12, 13]. However, in cases of extreme strut penetration into adjacent structures (e.g., aorta or vertebrae), alternative methods like balloon-assisted displacement might be preferable to avoid excessive focal force on the venous wall [16]. Additionally, acute thrombus within the filter remains a relative contraindication [5, 6].

Other methods, such as endovascular forceps dissection, often require specialized equipment available only at quaternary referral centers [9,11]. In contrast, the Hangman's technique is a 'real-world' solution utilizing standard pigtail catheters and snares [8,10,17], making it accessible and cost-effective for standard interventional practices.

CONCLUSION

Advanced techniques like the Hangman's wire loop method provide effective solutions for retrieving challenging IVC filters complicated by tilt or embedding within caval walls. The low-profile modification offers significant advantages in terms of safety and feasibility while achieving high success rates comparable to other advanced methods.

Future research should focus on multicenter trials evaluating long-term outcomes post-retrieval using these techniques to refine clinical guidelines for complex IVC filter removal scenarios, which in turn will benefit the patients.

CONFLICTS OF INTEREST

The authors have no potential conflicts of interest to disclose and are in agreement with the contents of the manuscript.

FUNDING

This article did not receive specific funding.

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TABLE LEGEND:

Table 1: Success rates across Hangman's Wire Loop Technique Modifications

Technique	Initial Success Rate (%)	Overall Success Rate (%)	Complication Rate (%)
Original Hangman Technique	81.8	81.8	0
Low-Profile Hangman Technique	95.6	100	0
Other Modified Techniques	85	90	<1

FIGURE LEGEND:

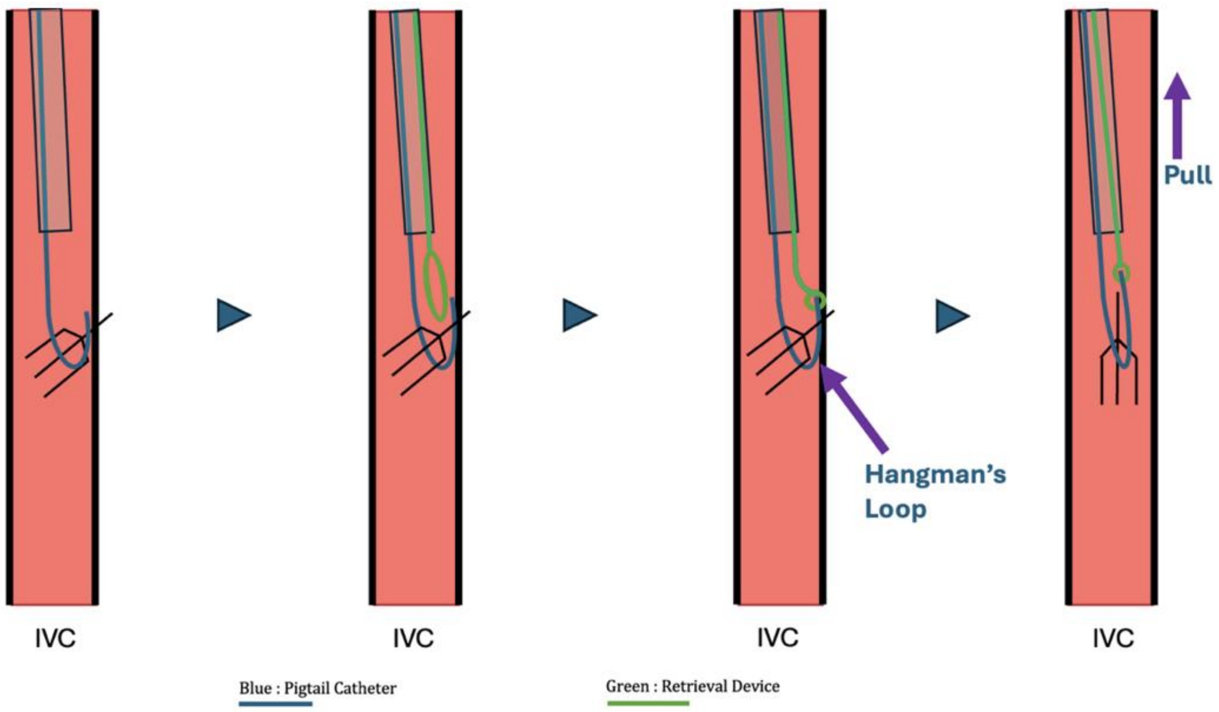

Figure 1: Schematic Diagram showing step by step of Hangman's wire loop technique for IVC filter removal

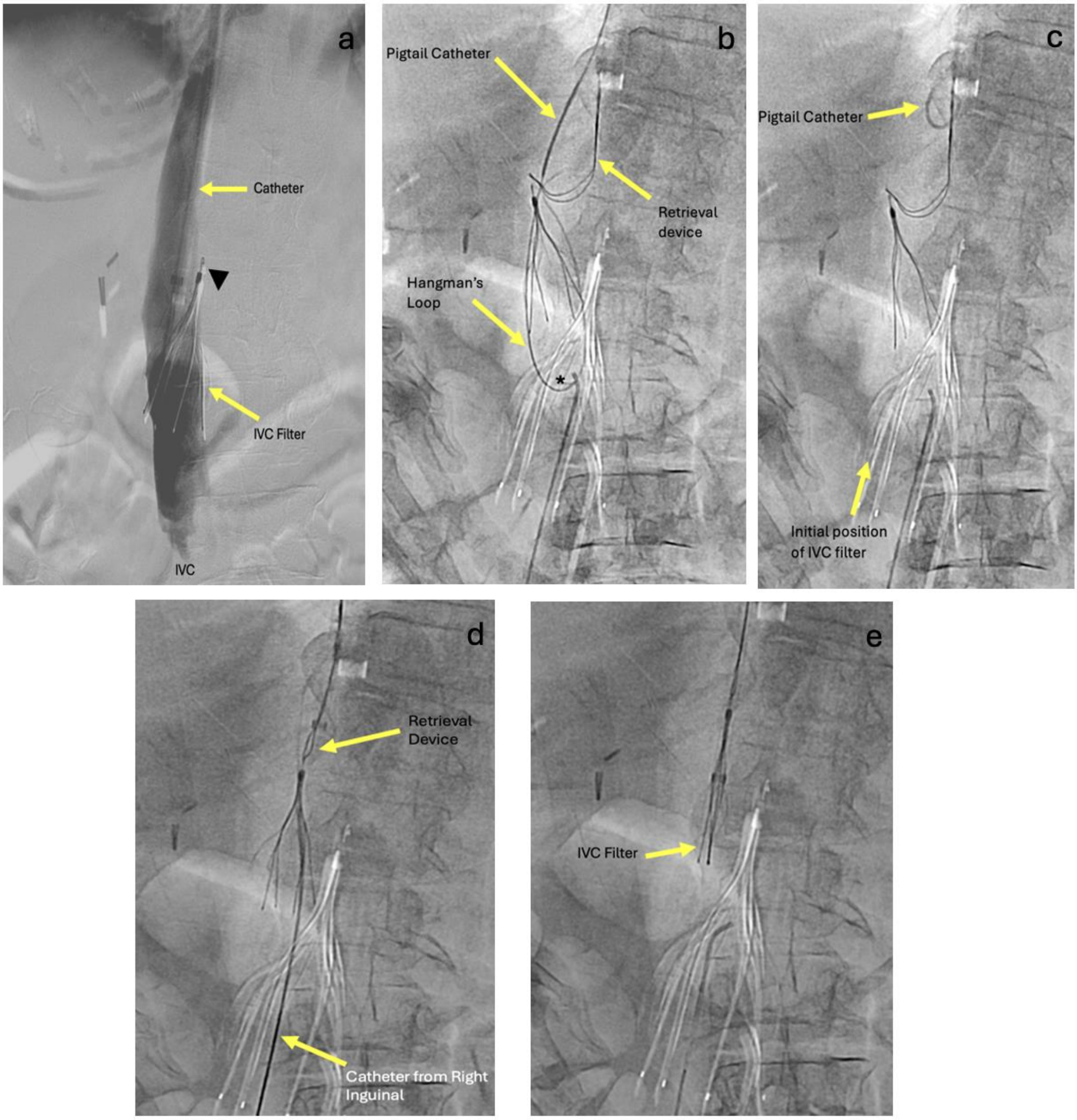

Figure 2: Procedural steps of the Hangman's wire loop technique. DSA showing the IVC filter in situ with the hook embedded within the caval wall (arrowhead) **(a)**. Formation of the Hangman's loop **(*)** by snaring the pigtail catheter tip **(b)**. Position of the filter before and after the application of the technique, demonstrating restoration of coaxial alignment **(c)**. Following the release of the filter from the caval wall using the Hangman's loop, the hook is successfully captured and retrieved via standard snaring **(d–e)**

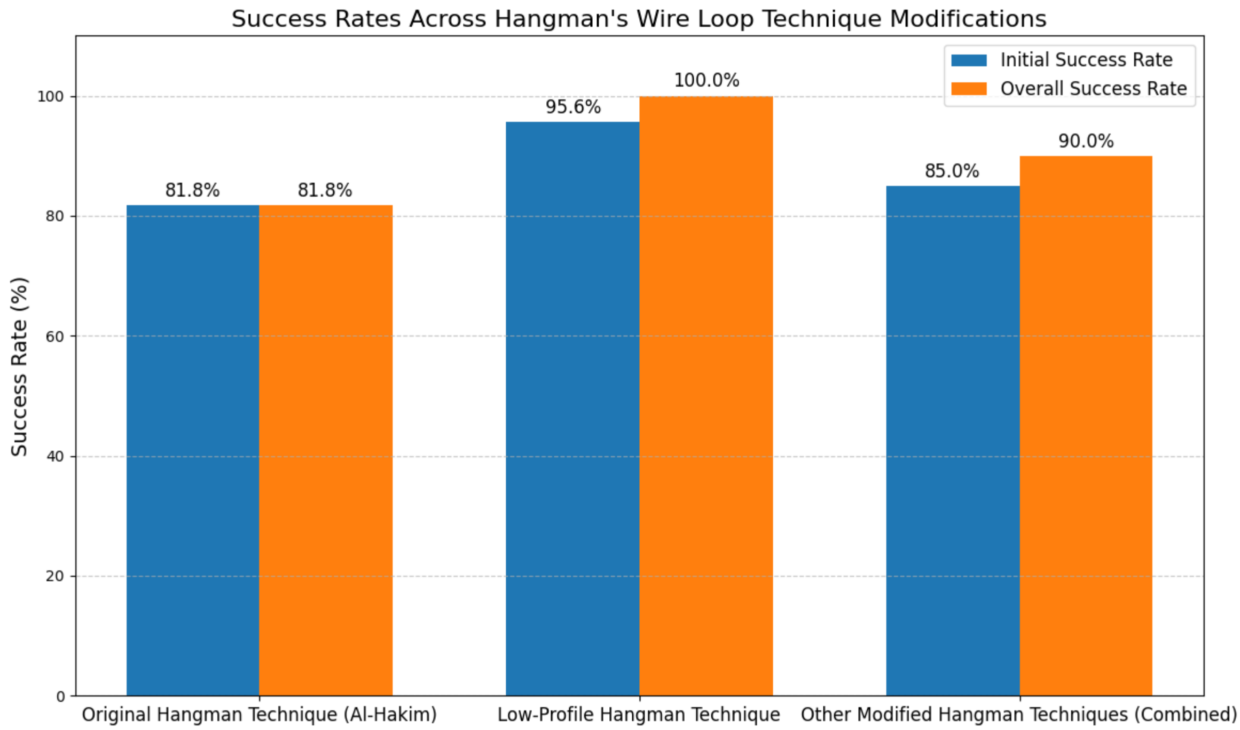

Figure 3: Success rates across Hangman’s Wire Loop Technique Modifications