

Duplicated Inferior Vena Cava Complicated with Left Iliofemoral Deep Vein Thrombosis: A Case Report

Hu Ruan

ruanhu1986@outlook.com

Anhui No.2 Provincial People's Hospital

Xi Chen

Bengbu Medical College

Dapeng Fu

Anhui No.2 Provincial People's Hospital

Jinhui Ding¹

Anhui No.2 Provincial People's Hospital

Case Report

Keywords: duplicated inferior vena cava, iliofemoral deep vein thrombosis, inferior vena cava filter, percutaneous mechanical thrombectomy, interventional radiology

Posted Date: October 4th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10517322/v1>

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Additional Declarations: No competing interests reported.

Abstract

Background

Venous thromboembolism (VTE) is a prevalent cardiovascular disorder associated with high morbidity and mortality. Duplicated inferior vena cava (DIVC) represents an extremely rare congenital venous malformation, and concurrent symptomatic deep vein thrombosis (DVT) is rarely documented in clinical practice.

Case presentation

A 51-year-old male patient with a medical history of bilateral total hip arthroplasty and left femoral fracture internal fixation presented with acute left iliofemoral deep vein thrombosis. Misrecognition of the DIVC anatomical variant resulted in malposition of the inferior vena cava filter (IVCF).

Interventions

We performed retrieval of the misplaced filter, suprarenal IVCF implantation, percutaneous mechanical thrombectomy (PMT) and catheter-directed thrombolysis (CDT). The retrievable filter was safely removed three weeks after the end of thrombolytic therapy.

Conclusion

This case illustrates common diagnostic pitfalls when identifying inferior vena cava anatomical variants. We summarize practical technical strategies for IVCF deployment in patients with DIVC combined with iliofemoral DVT to guide clinical interventional practice.

Introduction

Venous thromboembolism (VTE), consisting of deep vein thrombosis (DVT) and pulmonary embolism (PE), contributes to considerable global morbidity and mortality [1]. Duplicated inferior vena cava (DIVC, also termed double inferior vena cava) is a rare asymptomatic congenital vascular anomaly, most often detected incidentally during autopsy or cross-sectional imaging.

A single-center cohort study enrolling 32,829 patients over 46 months reported a DIVC incidence of only 0.049%, markedly lower than the previously reported historical range of 0.3%–3% [2]. Symptomatic DVT concurrent with DIVC is exceptionally uncommon, with only scattered isolated case reports published worldwide.

DIVC remodels caval hemodynamics and creates technical challenges for inferior vena cava filter (IVCF) placement. Failure to recognize this venous variant leads to filter malposition, ineffective PE prophylaxis and intraoperative procedural complications. Herein, we report a clinical case of DIVC combined with extensive left iliofemoral DVT, complicated by initial filter misplacement. We describe corrective suprarenal IVCF implantation and complete thrombus resolution, and summarize intraoperative precautions and individualized interventional management regimens.

Case Report

A 51-year-old male patient received bilateral total hip arthroplasty 5 years prior to admission and left femoral fracture internal fixation 6 months before symptom onset. Within 48 hours, he developed rapidly progressive swelling of the left lower limb involving the calf and thigh. Duplex ultrasonography confirmed thrombosis of the left common iliac vein, superficial femoral vein and external iliac vein, with an elevated D-dimer level of 47.52 mg/L. Given the extensive acute thrombus burden, we planned combined percutaneous mechanical thrombectomy (PMT), standby catheter-directed thrombolysis (CDT) and IVCF implantation.

The patient was placed in the supine position, and left lower limb venography demonstrated complete occlusion of the left iliofemoral venous system (Fig. 1a). A 5-Fr vascular sheath was inserted via right femoral venous access. Initial cavography localized the ostium of the right renal vein at the superior margin of the L2 vertebral body. We misidentified the inferior confluence of the duplicated vena cavae at L1 as the ostium of the left renal vein, and deployed a Cordis-Johnson retrievable IVCF at the L2 vertebral level (Fig. 1b).

The patient was then repositioned prone, and a 6-Fr sheath was introduced into the left popliteal vein using the Seldinger technique. Upward advancement of guidewire and catheter revealed the wire resided within a separate venous lumen independent of the previously deployed filter. Repeat cavography verified the diagnosis of DIVC: the left and right inferior vena cava trunks fused at the inferior margin of L1, cranial to bilateral renal vein ostia (Fig. 1c).

The misplaced filter within the thrombus-free right IVC could not provide effective prophylaxis against pulmonary embolism. The patient was returned to the supine position; the malpositioned filter was retrieved, and a new retrievable IVCF was implanted within the suprarenal common inferior vena cava (upper filter edge aligned with the superior margin of T12). AngioJet mechanical thrombectomy restored partial patency of the occluded iliofemoral veins, though residual thrombus remained within the left iliac vein and left inferior vena cava (Fig. 2a, Fig. 2b). A urokinase thrombolysis catheter was retained for continuous infusion over 3 days.

Interval venography after CDT demonstrated full patency of the femoral vein (Fig. 3a), left iliac vein and left limb of the duplicated inferior vena cava (Fig. 3b). The short-indwelling retrievable filter was successfully extracted 3 weeks post-intervention. Follow-up venography confirmed no residual thrombus within the left iliofemoral venous system.

Discussion

For patients presenting with acute high-burden iliofemoral deep vein thrombosis (DVT), percutaneous mechanical thrombectomy (PMT) is currently the first-line endovascular strategy for thrombus removal [3]. Catheter-directed thrombolysis (CDT) delivers superior clinical efficacy when used as an adjunct to eliminate residual thrombus inaccessible to PMT [4]. Our present case further validates the clinical feasibility of this combined therapeutic regimen.

Four morphological subtypes of duplicated inferior vena cava (DIVC) have been described in the published literature: Type I features confluence of bilateral inferior vena cava (IVC) trunks at the renal vein plane; Type II presents drainage of the left IVC into the left renal vein prior to merging with the right IVC; Type III is defined by left IVC outflow into the superior vena cava via the azygos and hemiazygos venous systems; Type IV is characterized by a left IVC trunk with a larger luminal diameter than its right counterpart, an anatomical feature opposite to that of conventional Type III DIVC [5]. The anatomical configuration of DIVC bears critical clinical implications for diagnosis and intervention; failure to recognize this venous anomaly preoperatively or intraoperatively may precipitate vascular injury or treatment failure.

In terms of preoperative evaluation, computed tomography venography (CTV) provides definitive anatomical imaging evidence to delineate caval variants. Nevertheless, CTV is not adopted as a mandatory preoperative test for acute lower-extremity DVT in routine clinical practice within China. First, intravenous iodinated contrast media administered during CTV carries inherent risks of hypersensitivity reactions and contrast-induced nephropathy. Second, CTV imposes relatively high medical costs. For patients with a confirmed DVT diagnosis via non-invasive lower-extremity duplex ultrasonography scheduled for endovascular intervention, digital subtraction angiography (DSA)-guided intraprocedural venography is generally preferred. Venography remains the diagnostic gold standard for DVT [6] and enables real-time intraoperative guidance for endovascular procedures, accounting for its widespread clinical application.

Notably, cursory evaluation of conventional DSA venography may lead to missed detection of congenital venous malformations. In the initial venographic acquisition of our patient, extensive high-burden iliofemoral thrombus obscured visualization of the left IVC trunk. Furthermore, intraoperative visual estimation misidentified the confluence of the left and right IVCs as the ostium of the left renal vein, resulting in deployment of an inferior vena cava filter (IVCF) within the thrombus-free right IVC segment. This malpositioned filter could not achieve the intended goal of pulmonary embolism (PE) prophylaxis. Accordingly, bilateral selective renal venography should be performed routinely prior to IVCF implantation to rule out congenital IVC anatomical variants, facilitating accurate filter deployment and effective PE prevention [7].

Multiple IVCF placement strategies have been proposed for patients with concomitant DIVC and DVT, including bilateral IVCF deployment, single filter placement within the suprarenal common IVC, unilateral filter implantation limited to the thrombosed caval trunk, and coil embolization of inter-caval

communicating veins combined with unilateral IVCF placement [8]. In our patient, the bilateral IVC trunks converged at the inferior margin of the L1 vertebral body, a level cranial to the bilateral renal vein ostia. After comprehensive clinical deliberation, we elected suprarenal filter placement within the common IVC for three rationales. First, existing clinical studies have verified the safety of suprarenal IVCF deployment and retrieval with a low incidence of procedural complications [9]. Second, intraprocedural angiographic measurements confirmed adequate longitudinal distance between the suprarenal common IVC and the right atrium, and the luminal caliber of the common IVC matched the expanded dimensions of the Cordis retrievable filter. Third, this single-filter approach confers economic benefits; IVCFs represent costly medical devices, and bilateral filter implantation would substantially escalate overall treatment expenditures.

Suprarenal IVCFs are susceptible to displacement induced by respiratory excursion and cardiac pulsation. Long-term indwelling of such filters carries life-threatening risks such as IVC perforation and massive hemorrhage, and the risk of device fracture rises progressively with prolonged retention time [10]. For these reasons, we selected a short-retrieval-window retrievable filter, which was successfully extracted three weeks after intervention without any perioperative complications. The patient received six months of oral rivaroxaban for postprocedural anticoagulation. High-quality randomized controlled trials including the RENOVE trial have demonstrated that extended anticoagulation with low-dose direct oral anticoagulants (apixaban or rivaroxaban) achieves an optimal safety profile for patients at high risk of recurrent venous thromboembolism (VTE) [11, 12].

Conclusion

Duplicated inferior vena cava (DIVC) is easily overlooked on routine cavography and significantly complicates IVCF implantation in patients with concurrent iliofemoral deep vein thrombosis. Preoperative CTV or selective bilateral renal venography during intraprocedural angiography is recommended to identify caval duplication before filter placement. Suprarenal common inferior vena cava filter implantation represents a feasible, cost-effective therapeutic option with low complication rates, provided early filter retrieval is completed within the approved short indwelling window.

Declarations

Conflict of interest

The authors declare that they have no competing interests.

Ethical approval

Formal institutional review board ethical approval was waived for this single-case retrospective report.

Informed consent

Written informed consent was obtained from the patient prior to all interventional procedures.

Consent for publication

The patient provided written consent for the publication of clinical data and angiographic imaging figures in this manuscript.

Funding

This work was supported by the Education Department of Anhui Province, China (Grant No. 2023AH053371).

Author Contribution

HR wrote the main manuscript text, XC, DFP and JDH were responsible for clinical data collection and image sorting. All authors participated in the clinical treatment of the patient, read and approved the final manuscript.

Acknowledgements

No acknowledgements to declare.

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Figures

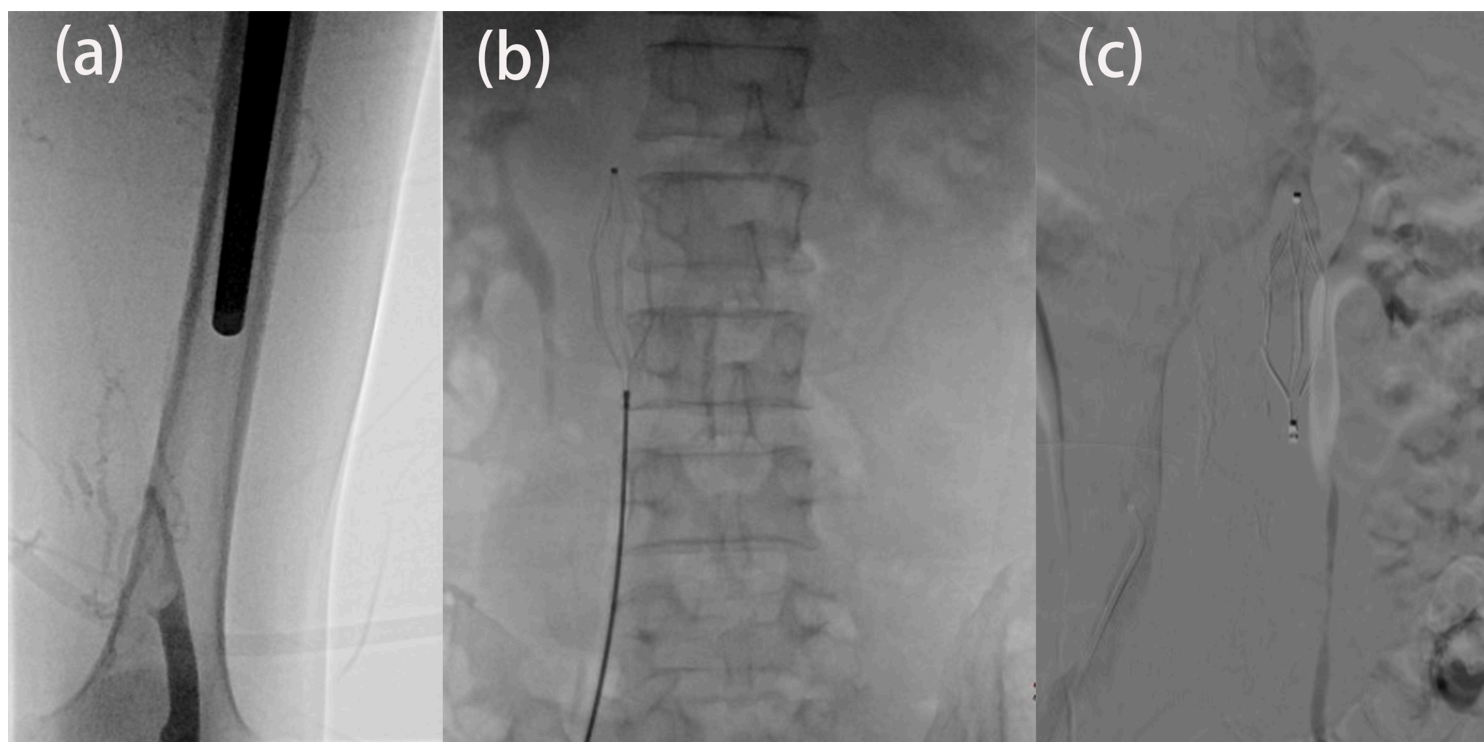


Figure 1

Digital subtraction venography and fluoroscopic images of inferior vena cava anatomy. (a) Digital subtraction venography of the left lower limb showing complete iliofemoral venous occlusion. (b) Fluoroscopic view demonstrating initial malpositioned inferior vena cava filter deployed within the right-sided trunk of duplicated inferior vena cava. (c) Prone-position fluoroscopy confirming duplicated inferior vena cava anatomical variant, with filter retained in the right caval trunk.

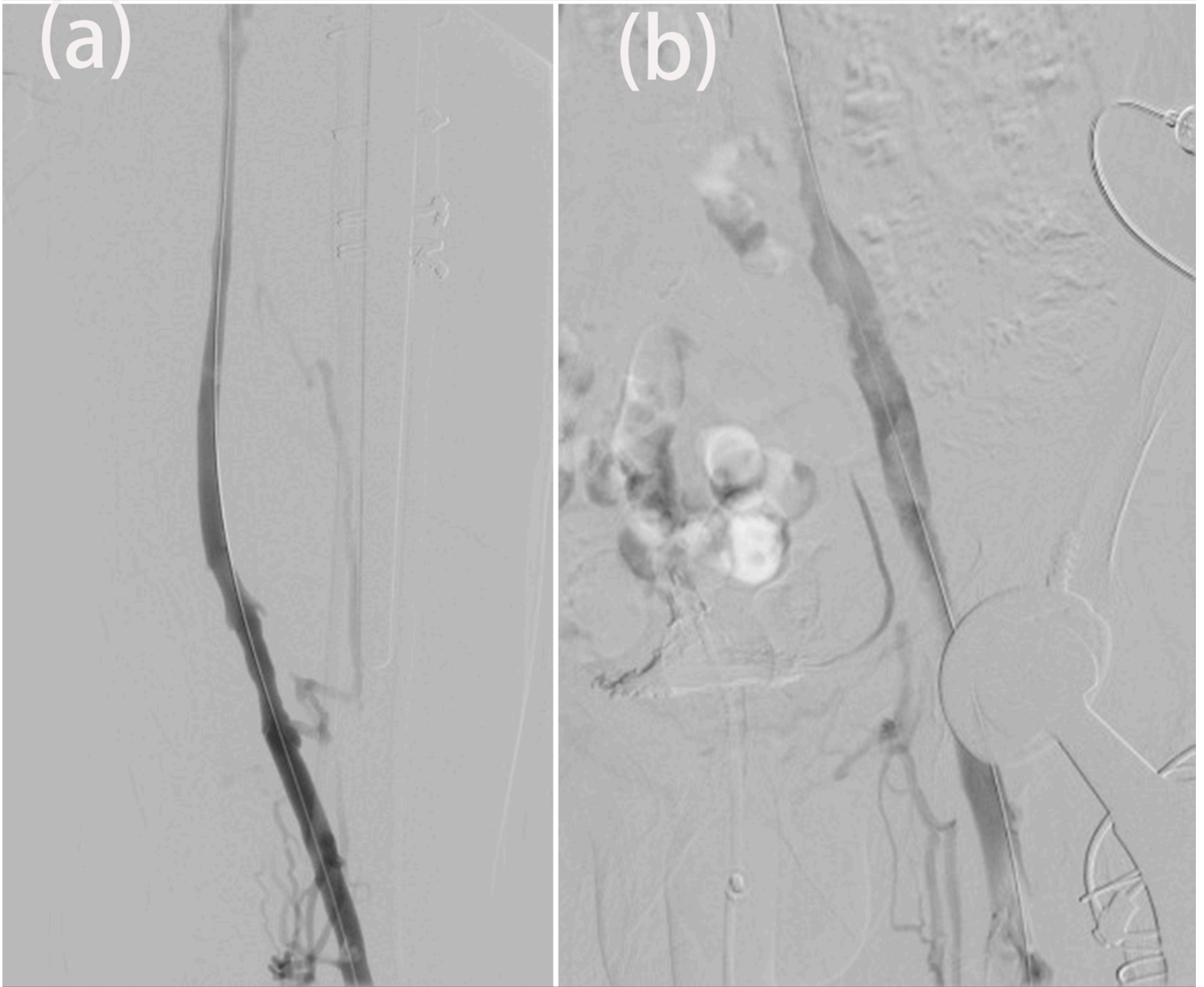


Figure 2

Venography following AngioJet percutaneous mechanical thrombectomy. (a) Post-thrombectomy femoral venography. (b) Venography of the left iliac vein and left duplicated inferior vena cava after mechanical thrombectomy.

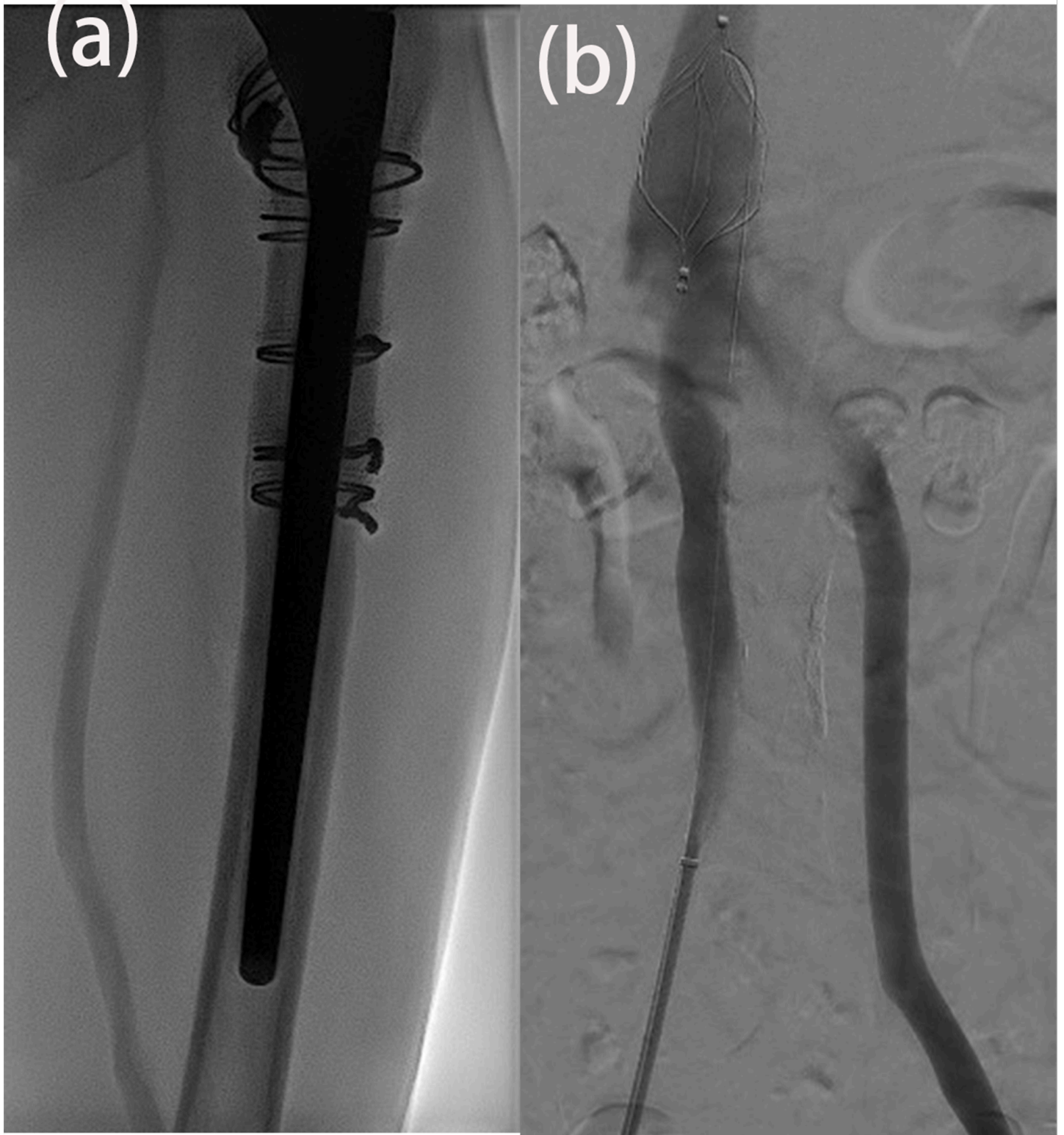


Figure 3

Venography after catheter-directed thrombolysis (CDT). (a) Femoral venography showing full recanalization. (b) Combined iliac and duplicated inferior vena cava venography confirming complete thrombus clearance.