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journal homepage: www.casereports.comEndovascular reconstruction of an interrupted inferior vena cava[☆]Shannon D. Thomas^{a,*}, Adam Ofri^a, Tjun Tang^a, Raymond Englund^{a,b}^a Department of Vascular Surgery, Prince of Wales Hospital, Sydney, Australia^b University of New South Wales, Sydney, Australia

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ABSTRACT

INTRODUCTION: Inferior vena cava (IVC) interruption was established as a procedure to treat refractory venous thromboembolism (VTE) complicated by pulmonary embolism. Ilio-caval thrombosis and lower limb chronic venous insufficiency (CVI) are well known long-term complications of IVC interruption, where subsequent treatments may carry significant morbidity and mortality.

PRESENTATION OF CASE: We present here a case of chronic venous insufficiency resulting from IVC interruption with a vascular clip placed forty years previously. A novel approach utilising endovascular stents was used to reconstruct the ilio-caval confluence and interrupted distal IVC without the need for laparotomy to remove the plicating clip. This procedure was associated with minimal morbidity and resulted with a quick resolution of the patient's CVI symptoms.

DISCUSSION: Endovascular angioplasty and stenting is an alternative to open reconstruction of the interrupted inferior vena cava. We have demonstrated successful opening of a plication vascular clip using only endovascular utilities. Advantages include a shorter hospital stay, and reduced morbidity and mortality when compared to a re-do laparotomy.

CONCLUSION: Endovascular stents may be used safely and effectively to reconstruct the surgically interrupted inferior vena cava in the treatment of chronic venous insufficiency.

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1. Introduction

Inferior vena cava (IVC) interruption procedures were first established for the treatment of venous thromboembolism refractory to anticoagulation and complicated by pulmonary embolism. Now largely replaced by percutaneous filtration devices, these procedures evolved from complete IVC ligation to placement of a circumferential diameter-reducing clip. Chronic lower limb venous insufficiency (CVI) may then present as a late complication of IVC interruption/filtration procedures. We present the novel management of a patient with an infected right lower leg venous ulcer due to CVI in the context of a past history of May Thurner's Syndrome and a clip plicating the IVC. Endovascular stents were used to reconstruct the ilio-caval confluence and disrupt the plicating clip. This led to rapid wound healing and resolution of the patient's venous symptoms.

2. Case report

A 65-year old female was referred to our institution with an infected painful chronic right lower limb venous ulcer. The ulcer had been present for 8 months, with periods of infective exacerbations, where no complete healing was achieved despite appropriate limb compression and wound therapies. The right lower limb revealed typical chronic venous changes with near circumferential ulceration just proximal to the ankle. She had a past history of left-sided deep venous thrombosis and recurrent pulmonary embolism post partum in her late twenties, for which she received an IVC plication clip as an open surgical procedure. She went on to develop bilateral lower limb venous insufficiency and had presented 3 years prior with left leg venous ulceration. At this time venography demonstrated a left common iliac vein (CIV) occlusion, presumed to be due to May Thurner's syndrome, but the plicated IVC was not noticed. At that time she was successfully managed with a Cook Zilver stent (Cook, Bloomington, IN, USA) to revascularise the occluded iliac vein along with the adjuncts of split skin grafting to the ulcer and long term bilateral compression therapy.

A CT venogram (Fig. 1A) demonstrated in stent stenosis of the Zilver stent and a narrowing of the proximal right CIV. The plication clip appeared to be reducing the IVC lumen to 2–3 mm in diameter. Digital Subtraction Venography (Fig. 1B and C) confirmed a severe stenosis of the right CIV ostium with a large filling defect in the proximal portion of the CIV stent. Lateral projections revealed a pin hole stenosis of the IVC, approximately 4 cm proximal to the ilio-caval confluence, presumably due to the encircling clip.

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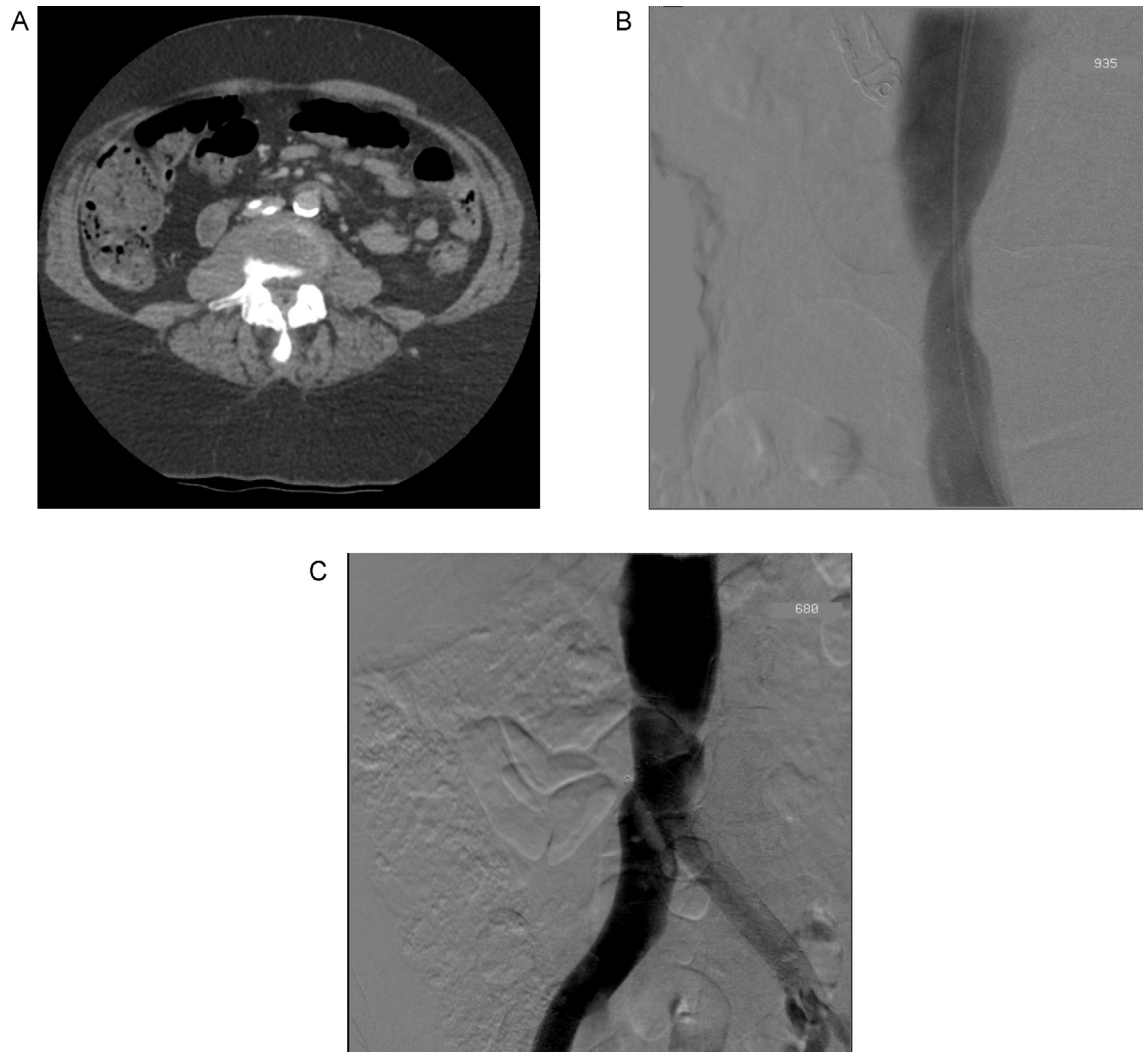


Fig. 1. (A) Computed tomographic scan pre-procedure demonstrating the presence of a plication clip across the vena cava. (B) Digital subtraction angiogram, anterior–posterior projection, demonstrating stenosis of the vena cava and restenosis of the left common iliac venous stent as it crosses the ilio caval confluence thus causing stenosis of the right common iliac ostium. (C) Digital subtraction angiogram, lateral projection, demonstrating a >90% stenosis of the vena cava (arrow).

The patient was taken to theatre where bilateral antegrade 7 FG (Cordis Corp, Johnson and Johnson, Bridgewater, NJ, USA) common femoral venous sheaths were placed. The stenoses were crossed with a Van Schie 2 (Cook Medical, Bloomington, IN, USA) catheter and an .035 Terumo angled stiff guidewire (Terumo Medical, Somerset, NJ, USA), which was then exchanged for a stiff type Amplatz wire (Cook Medical, Bloomington, IN, USA). The caval stenosis was predilated using two kissing 10 mm × 40 mm Fox PTA balloons (Abbott Vascular, Illinois, USA). The right Amplatz wire was pulled back into the iliac vein and the left sheath exchanged for a short 12 FG sheath (Cordis Corp, Johnson and Johnson, Bridgewater, NJ, USA). A Palmaz balloon expandable stent (Cordis Corp, Johnson and Johnson, Bridgewater, NJ, USA) was placed on a 20 mm balloon into the stenosed IVC and inflated, ensuring enough distal clearance from the ilio caval confluence. The right amplatz wire was then placed through the Palmaz stent and bilateral 14 mm × 140 mm Vena Zilver stents (Cook Medical, Bloomington, IN, USA) were 'kissed' into the Palmaz stent. These were post dilated with 14 mm × 40 mm Fox PTA balloon (Abbott Vascular, Illinois, USA). Final venography did not demonstrate any residual stenosis of the ilio caval confluence, nor of the cava itself (Fig. 2).

The patient made an uneventful post-operative recovery, with significant improvement in her lower limb pain. She was later taken

back to theatre to place a split skin graft over the venous ulceration. Oral anticoagulation was continued and she was discharged home after a 4-week stay in hospital with all wounds healed. Follow up duplex ultrasound at 4 weeks post discharge demonstrated patency of the stents with no evidence of restenosis.

3. Discussion

We have described a novel technique of ilio caval reconstruction after caval interruption. The use of an endovascular technique first has the advantage of avoiding a redo laparotomy and the complications associated with it, particularly deep venous thrombosis. Recovery time from the procedure is also minimised, allowing the patient to return to full function quicker. This is particularly important in a patient with known risk factors for venous thromboembolism.

The use of a Palmaz stent in the plicated vena cava allowed for protection of the segment against elastic recoil. This was particularly important given the external compression of the cava by the clip, and the resultant expectant scarring and remodelling of the cava. There was the concern however that this manoeuvre would tear the cava resulting in a retroperitoneal haematoma. Large V12 covered stents (Atrium Corporation, USA) were thus

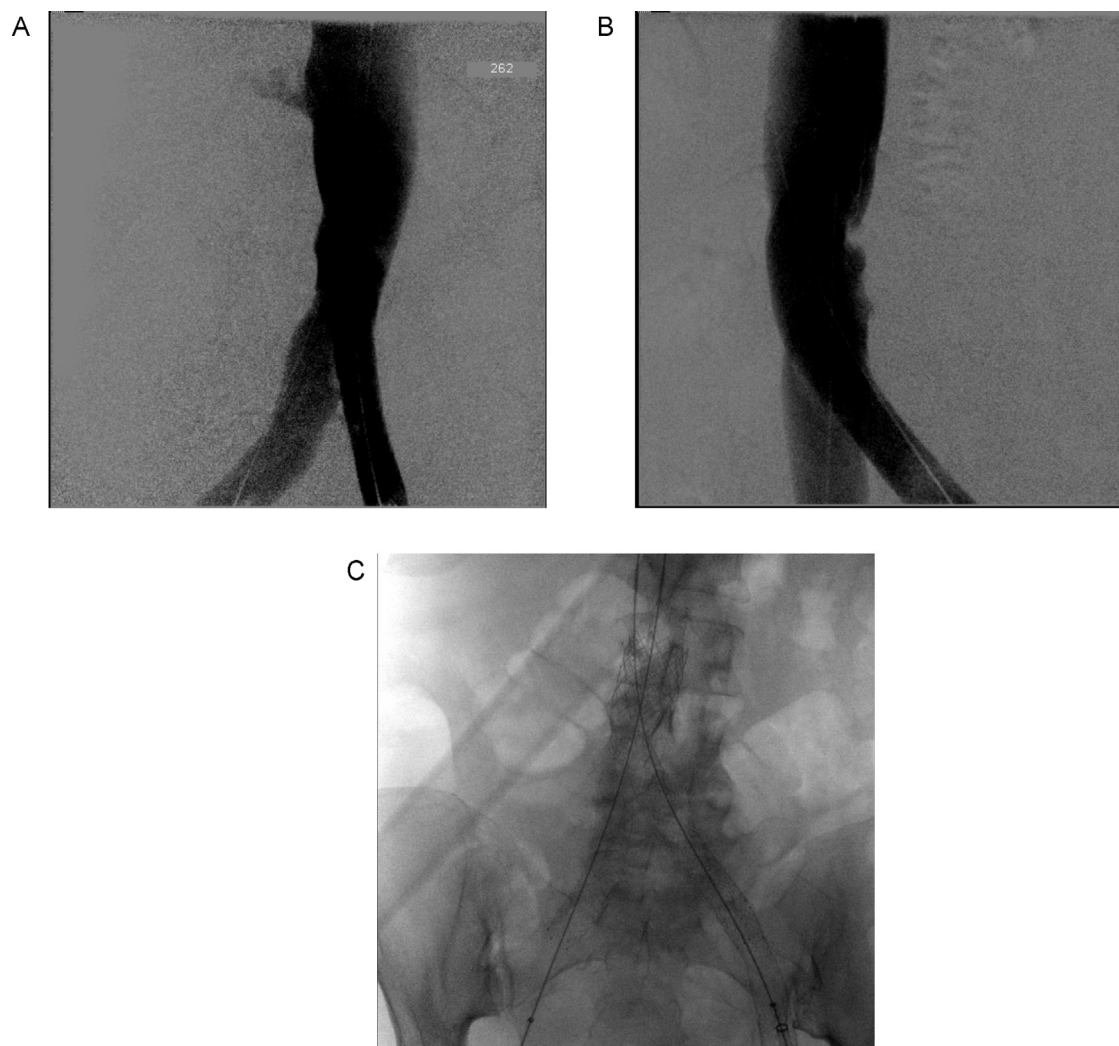


Fig. 2. (A) Digital subtraction angiogram, lateral projection, post endovascular reconstruction of the ilio caval system demonstrating resolution of the stenosis. (B) Digital subtraction angiogram, anterior–posterior projection, post endovascular reconstruction of the ilio caval system demonstrating resolution of the stenosis. (C) Plain fluoroscopy anterior–posterior projection, post endovascular reconstruction of the ilio caval system demonstrating position of the stents.

kept in readiness for this eventuality. However covered stents were not used primarily because of the theoretical increased risk of caval thrombosis as a result of the PTFE covering.

Whilst there was an increased of further venous thromboembolism, particularly pulmonary embolism from the intervention, an IVC filter was not used. We were concerned that placement of a filter, even if in a suprarenal position, could complicate deployment of the Palmaz stent. Furthermore, we felt that by using stents primarily, any luminal clot would be caged by the stent against the caval wall.

The reconstruction of the caval confluence was achieved using the nitinol Cook Vena Zilver stents. We employed a ‘kissing’ stent technique similar to that used to treat aortic bifurcation disease. Again a primary stent and post deployment balloon angioplasty technique was used to incarcerate any clot in the iliac vein, with patency maintained by the stent.

Of historical interest partial caval occlusion techniques were originally developed with the theory that modification of the single large caval lumen into channels of optimum size would prevent the passage of fatally sized emboli without the disabling side effects of total IVC occlusion. This evolved in the 1950s from IVC mattress suture plication,¹ to IVC clip plication.^{2–4} In the 1970s, transvenous IVC filters were introduced by Greenfield and were deemed

superior to all plication techniques available at preventing PE for patient’s refractory to anticoagulation therapy.⁵

The use of endovascular techniques to treat occlusive lesions of the deep venous system has gained traction in the last 5–10 years.^{6,7} There is strong evidence that endovascular recanalization of occluded iliac venous segments reduces pain and swelling, has high patency rates over time and low post-operative complications.⁸ It can also resolve stasis dermatitis and ulceration resulting in greater quality of life.⁹ Evidence for the use of stents in the treatment of May Thurner syndrome is also emerging, with acceptable patency of the stented segment demonstrated.¹⁰ Stent placement is a minimally invasive procedure that has a short hospital admission duration, minimal recovery time and does not preclude the patient from undergoing open surgery at a later date if necessary.¹¹

4. Conclusion

Long term survivors of IVC interruption procedures may present with late lower limb chronic venous insufficiency. We have demonstrated a novel technique to revascularise the plicated inferior vena cava using endovascular stents. This resulted in resolution of the patient’s venous symptoms and ulceration.

Conflict of interest

The authors declare no conflict of interest in the preparation and presentation of this article.

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None.

Ethical approval

Written informed consent was obtained from the patient for publication of this case report and case series and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contributions

Study Design: ST, RE; Data Collection: AO, ST; Writing: AO, ST; Critical Analysis: TT, ST, RE; Overall Responsibility: ST.

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