



Percutaneous superior vena cava puncture successful recanalization of a long-segment, angled central venous occlusion: a case report

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Background: Multiple complete central venous occlusion (CVO) is rare complication among the hemodialysis population. Percutaneous transluminal angioplasty (PTA) is the recommended treatment for CVO; however, cases with long-segment occlusion remain challenging.

Case Description: We reported a patient who complained of a swollen right arm for 1 month. On admission, his vital signs were within normal limits. The 76-year-old man had been on hemodialysis with a right forearm arteriovenous fistula (AVF) for 4 years with a history of temporizing catheterization and left forearm AVF failure. One year ago, he gradually developed a slight swelling in his right arm and the swelling in his arm was significantly worse one month ago. Digital subtraction angiography (DSA) revealed occlusion in his right innominate vein (IV), proximal subclavian vein (SV), and external and internal jugular veins, as well as stenosis of the ipsilateral cephalic arch and axillary vein (AV). The operation was performed with a pioneered bidirectional approach via ipsilateral superior vena cava (SVC) and AV puncture. The occluded lesions were successfully recanalized, and the patient's symptoms resolved after the operation. The patency of his vascular access was well maintained at the 4-month follow-up.

Conclusions: To the best of our knowledge, this is the first report regarding the application of SVC puncture in PTA for CVO. This technique could be a possible approach when performed by appropriately qualified operators in patients with limited or no other options.

Keywords: Central venous occlusion (CVO); superior vena cava puncture (SVC puncture); endovascular intervention; hemodialysis; case report

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Introduction

Central venous occlusion (CVO) is a well-recognized complication of central venous catheters that occurs commonly in chronic hemodialysis patients. With the number of patients on hemodialysis steadily increasing over the past few years, CVO is becoming more and more prevalent. Untreated CVO can interfere with the patency of vascular access and cause ipsilateral limb symptoms such as edema, leading to suboptimal dialysis or dialysis failure. The current recommended treatment for CVO is

percutaneous transluminal angioplasty (PTA), but 42% of patients fail to use this treatment for complete occlusion or long segment lesions of the central vein (1). In this paper we reported a challenging case of a 76-year-old man with chronic occlusion in his right innominate vein (IV) and right subclavian vein (SV). First, the conventional catheter guidewire technique was performed but failed. The occlusive lesions were successfully recanalized by a bidirectional approach via ipsilateral superior vena cava (SVC) and axillary vein (AV) puncture. We present the



Figure 1 DSA findings about the complicated CVO: (A) superior vena cava venography via the femoral vein approach; (B) distal segment of occluded right SV via the ipsilateral AVF approach; (C) proximal and distal end of the occlusive segment. An obvious included angle could be seen at the right jugular angle. DSA, digital subtraction angiography; CVO, central venous occlusion; SV, subclavian vein; AVF, arteriovenous fistula.

following case in accordance with the CARE reporting checklist (available at <https://apm.amegroups.com/article/view/10.21037/apm-22-529/rc>).

Case presentation

A 76-year-old man on maintenance hemodialysis came to our hospital complaining of swelling of his right arm for 30 days. He had been diagnosed with renal failure 4 years ago at the local hospital and had started regular hemodialysis immediately via a right internal jugular vein catheter, which was then replaced by a temporizing femoral vein catheter with concomitant establishment of a contralateral radiocephalic arteriovenous fistula (AVF) due to infection. The AVF of left upper extremity was occluded two years ago, and thus the central venous catheter was inserted again until a right forearm AVF was created and became mature. One year ago, he had noticed mild swelling of his right arm along with occasionally unsatisfactory dialysis, but no medical service was sought. Eight months ago, he was hospitalized for right upper limb edema but the symptoms did not improve significantly. One month ago, the swelling of his arm had worsened, and new symptoms of motion limitation and acroparalysis had presented. The blood flow of his AVF had increased to 1,300 mL/min, and a preoperative angiogram revealed total occlusion of his right IV and proximal SV. He was diagnosed with CVO and

then subjected to PTA.

During surgery, digital subtraction angiography (DSA) identified total occlusion of his right IV, proximal SV, external and internal jugular veins, as well as stenosis of the ipsilateral cephalic arch and AV (*Figure 1*). The long-segment occlusion with a long duration was refractory to the conventional options of wire traversal or sharp recanalization techniques, thus leading to our adoption of a bidirectional approach via DSA-guided ipsilateral SVC and AV puncture.

Directed at the distal end of the SVC, a 0.5 cm secondary puncture was first introduced below the lateral head of the sternocleidomastoid muscle via the right neck area. An 8-French sheath was then inserted into where a transfemoral guidewire (Terumo, Tokyo, Japan) was snared. Second, with the assistance of an 8-French sheath and a RUPS-100 catheter (Cook Incorporated, Bloomington, USA), a 0.035-inch hard wire along with a coudé catheter (4-French) penetrated through the occluded SV via AV access and met with the transfemoral guidewire at the SVC puncture site and was snared. A 6.0 mm balloon (Cordis Corp., Santa Clara, CA, USA) was then delivered through the guidewire to recanalize the occluded IV. After that, we entered a loop snare via the AV approach and snared the temporal guidewire to make a femoral–axillary pull through. Lastly, balloons of different sizes (8.0 mm × 60 mm and 10.0 mm × 10 mm; Cordis Corp.) and a following stent

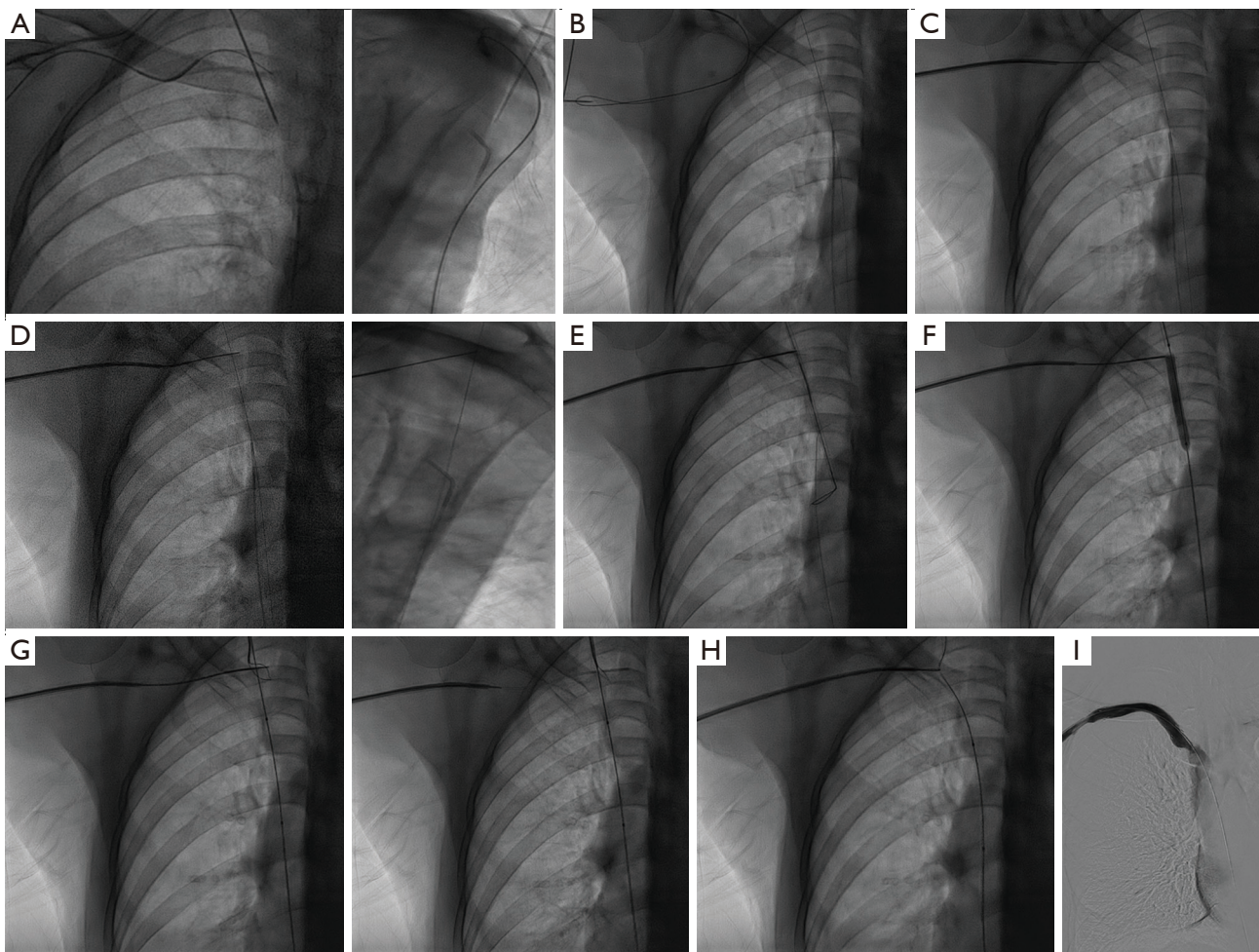


Figure 2 The bidirectional approach procedure: (A) superior vena cava puncture introduced below the lateral head of the sternocleidomastoid muscle via the right neck area, (I) the anteroposterior projection, (II) the lateral projection; (B) DSA-guided AV puncture; (C) the 0.035-inch hard wire that penetrated through the occluded SV; (D) confluence of 2 guidewires, (I) the anteroposterior projection, (II) the lateral projection; (E) the transfemoral guidewire was snared out of the superior vena cava; (F) a coudé catheter (4-French) was introduced via the hard wire, and a 6.0 mm balloon was used for recanalization of the occluded IV; (G) the coudé catheter was snared out of body; (H) a loop snare was introduced via the AV approach and snared the temporal guidewire; (I) graded dilation by balloons and a stent was placed. DSA, digital subtraction angiography; AV, axillary vein; SV, subclavian vein; IV, innominate vein.

(10 mm × 80 mm; Fluency, Bard Inc., Karlsruhe, Germany) were placed to provide graded dilation of the SV occlusion (Figure 2). Additionally, as the patient had a high AVF blood flow, his right AVF was operated on banding, and the flow decreased to 700 mL/min. No complication was noticed during or after operation. The patient's postoperative angiography confirmed satisfactory dilation lesions, and the symptoms were largely ameliorated. At the 8-month follow-up, the patency of his AVF had maintained well

with satisfactory blood flow, but mild swelling of his right arm was noticed again. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

Discussion

A common complication of central venous catheterization, CVO presents as a headache that can lead to decreased quality of life and longevity in the hemodialysis population if not treated in a timely manner (2). Patients with CVO often develop symptoms of limb edema and reduced patency, as presented by our patient. A more severe outcome of CVO is the loss of vascular access, as once the central veins are occluded, the creation of an arteriovenous access in the arms or thighs would be futile, even with available peripheral veins and/or arteries (3). Previous studies have indicated that prior ipsilateral central venous catheterization that result in endothelial injury are common risk factors of CVO (4,5). Specifically, the side of the temporizing catheter and the subsequent AVF should be carefully chosen, as ipsilateral catheterization can negatively affect the cumulative AVF survival (6). Our patient had 2 records of right internal jugular access and 1 previous femoral catheter, putting him at high risk of CVO. Because his first left AVF had failed, it was imperative to recanalize his venous occlusion.

Currently, the preferred treatment for CVO in dialysis patients is PTA, which is recommended by the guidelines. The technical success rate of PTA is high, with an estimated range of 70% to 90% (7). PTA and stent placement can restore most of the functionality of the vascular access and alleviate symptoms. In complex cases when PTA has failed, surgery is considered the treatment of last resort (8). For our patient, the first consideration for his therapy was PTA. However, the patient had a long-segment occlusion including the whole IV and proximal SV, and the chronic lesion in the SV made it difficult for a wire to traverse via a brachial access. It was obvious that a conventional technique with single-direction and single approach would not be successful. Therefore, based on the patient's vascular condition and our experience, we developed a novel strategy of bidirectional approach with DSA-guided SVC and AV puncture. The guidewire introduced via the SVC and AV access successfully penetrated the occluded veins and enabled the dilation of the IV and SV lesions, respectively. Postoperative angiography and medication observation confirmed that the patency of vascular access was well-maintained and the symptoms had resolved.

The conventional PTA technique with 1 access is more appropriate for vein stenosis or short occluded lesions. In complicated cases with long-segment occlusions, a flossing wire technique with 2 accesses, which is also

called the through-and-through wire technique, shows superiority. According to a retrospective study, the flossing wire technique was correlated with a higher success rate, a shorter fluoroscopy time, and fewer short-term complications compared to the conventional technique (9). The 2 accesses needed in the flossing wire technique are the femoral vein for the introduction of the balloons and stents and either the proximal or distal end of the occluded segment for working the guidewire. In our patient, the wire failed to penetrate the occlusive SV via the fistula access, so we tried SVC puncture. Use of SVC puncture in endovascular interventions is rare but possible if all conventional options fail. The key of SVC puncture is to use a catheter or a guide wire from femoral approach as a target, which greatly increases the technique success and reduces procedure-related complications. It is a well-controlled and relatively safe approach and is within the skill set of most interventional radiologists in this field. Its use has been reported in the resumption of a tunneled hemodialysis line, and we have previously employed this technique to insert a successful cuffed tunnel catheter in a patient with vascular access exhaustion (10,11). No prior study has reported its use in treating CVO, but it is theoretically and practically feasible.

It is worth noting that despite the success of his surgery, the patient noticed mild swelling of his right arm again during follow-up. This might be attributable to the fact that he had an untreated high AVF blood flow for a long time and that recanalization of his CVO is difficult. Therefore, in the case of patients with increased AVF blood flow and swollen arms, AVF constriction should be conducted as early as possible to improve their prognosis.

In conclusion, we presented a challenging case of severe CVO that was refractory to conventional endovascular techniques. We performed a pioneered bidirectional approach by SVC and AV puncture and successfully recanalized his vascular access. We believe that our experience could provide an alternative for clinicians when treating similar patients.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist Available at <https://apm.amegroups>.

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://apm.amegroups.com/article/view/10.21037/apm-22-529/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

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