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# Novel Reconstruction of Complex Central Venous Occlusion Using Supraclavicular Stent Graft in Hemodialysis Patients

Pablo V Uceda <sup>1</sup>, Robert W Feldtman <sup>2</sup>, Sam S Ahn <sup>3</sup>

Affiliations

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## Abstract

**Background:** Subclavian vein and brachiocephalic vein occlusions are challenging problems in dialysis patients with ipsilateral upper extremity (UE) vascular access or in need of one. HeRO grafts (Hemodialysis Reliable Outflow, Merit Medical Systems, Inc, South Jordan, UT) have been used to manage such occlusions but patients with chronic hypotension treated with HeRO graft may have threatened patency. We describe an alternative technique using a supraclavicular stent graft to reconstruct the venous outflow, evaluate outcomes of this procedure, and discuss its role in complex hemodialysis patients.

**Methods:** From January 2019 to January 2020, we performed open surgical and endovascular dialysis access procedures in 297 patients. Eight patients (2.7%) with failing or failed access and subclavian and/or brachiocephalic vein occlusion were treated with supraclavicular stent graft placement. Mean age was 52 years, ranging from 32 to 70. Five patients had failed access and were dialyzed using catheters (two femoral). Three patients with failing fistulas had severe arm edema. Two patients had recurrent HeRO graft thrombosis. We performed a retrospective review of these 8 patients and evaluated access patency and complications.

**Results:** Technical success and access function were 100% in all patients. One patient developed ischemic neuropathy and underwent proximalization of the arterial inflow with improvement. Already-existing fistulas were used for dialysis the day after the procedure and new grafts within 2-4 weeks. Arm edema resolved within one week after the procedure. Median follow-up was 254.5 days, range 24-408 days, with primary patency rate of 87.5% and secondary patency rate of 100%. Only one patient has required reintervention. Postoperative evaluation with ultrasound has revealed patent stent graft in the area of the subcutaneous cervical tunnel over the clavicle.

**Conclusions:** Supraclavicular stent graft placement to a central vein can be used successfully to reconstruct venous outflow in hemodialysis patients with complex central vein occlusions. A supraclavicular extra-anatomic path can be used safely and effectively to place new UE vascular access or salvage threatened access in this challenging patient population.

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# Endovascular treatment of type 3 and 4 thoracic central vein obstruction in hemodialysis patients

Pablo V Uceda <sup>1</sup>, Robert W Feldtman <sup>2</sup>, Julio Peralta <sup>3</sup>, Sam S Ahn <sup>4</sup>

Affiliations

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## Abstract

**Objective:** Thoracic central vein (TCV) obstruction (TCVO) in the presence of upper extremity (UE) hemodialysis access can present as superior vena cava syndrome (SVCS) and cause vascular access dysfunction and failure. We report the techniques and results of endorevascularization of TCVO in hemodialysis patients, which allowed for long-term functioning vascular access in the UE.

**Methods:** From June 2009 to February 2020, 45 hemodialysis patients underwent TCV endorevascularization. The indications for surgery were TCVO or SVCS that threatened the function of a preexisting upper arm access or contraindicated placement of a new upper arm access. Conventional endovascular techniques were used when feasible. Patients with unfavorable anatomy were treated using a transeptal needle to cross difficult intrathoracic stenosis and occlusions or to facilitate an inside-out central venous access technique. The reestablishment of venous outflow was accomplished with angioplasty, stenting, and/or placement of HeRO conduits. Successful revascularization was followed by hemodialysis access revision or a new UE access placement. We recorded the risk factors and procedural outcomes, patency rates, complications, and mortality.

**Results:** The mean age was  $53 \pm 16.3$  years, and 51% were women. The most common risk factors were diabetes mellitus (64.2%) and hypertension (56%). Twenty-five patients (55.5%) had symptoms of SVCS. These symptoms resolved after the TCV procedure in all cases. Crossing of the TCV lesion was successful using a conventional catheter and wire in 26 cases (57.8%) and transeptal needle in 17 cases (37.8%), including 12 using an inside-out central venous access technique. Treatment of the TCV lesion included a HeRO conduit in 20 cases (44.4%), stenting in 17 (37.7%), and transluminal balloon angioplasty alone in 7 (15.5%). Other veins were treated in 33 cases (73.3%). The overall technical success rate was 95.5%. Two intraoperative complications occurred, including one case of severe hypotension and one of fatal cardiac tamponade. Of the 16 patients with preexisting UE access, its function was preserved in all 16 (100%). In 24 of 27 patients (85.7%), new arm access was successfully created after the TCV procedure. The overall clinical success rate was 88.9%. The average follow-up was 663.4 days (median, 507 days; range, 0-2679 days). During follow-up, 26 patients had undergone 90 procedures to maintain access function, 21 had undergone repeat endovascular interventions, and 17 had undergone open procedures. Eight patients (17.8%) had developed infection, five involving HeRO conduits that required excision with loss of access. During the follow-up period, 14 patients (31%) had died of unrelated causes, and 34 patients (75.5%) maintained functional access.

**Conclusions:** The results of the present study have shown that endorevascularization of TCVO reconstruction is effective in maintaining function or allowing the creation of UE hemodialysis access, with acceptable complication rates.

**Keywords:** Central venous stenosis; Endovascular treatment; Hemodialysis access; Superior vena cava obstruction; Superior vena cava syndrome.

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# Management of Superior Vena Cava Occlusion Causing Bleeding "Downhill" Esophageal Varices

Pablo V Uceda <sup>1</sup>, Julio Peralta Rodriguez <sup>2</sup>, Hernán Vela <sup>2</sup>, Adelina Lozano Miranda <sup>3</sup>, Luis Vega Salvatierra <sup>2</sup>, Robert Feldtman <sup>1 4</sup>, Sam S Ahn <sup>1 4</sup>

Affiliations

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## Abstract

The health care system in Peru treats 15,000 dialysis patients annually. Approximately 45% of patients receive therapy using catheters. The incidence of catheter-induced superior vena cava (SVC) occlusion is increasing along with its associated significant morbidity and vascular access dysfunction. One of the unusual manifestations of this complication is bleeding "downhill" esophageal varices caused by reversal of blood flow through esophageal veins around the obstruction to the right atrium. Herein is presented the case of an 18-year-old woman on hemodialysis complicated by SVC occlusion and bleeding esophageal varices who underwent successful endovascular recanalization of the SVC. Bleeding from "downhill" esophageal varices should be considered in the differential diagnosis of dialysis patients exposed to central venous catheters. Aggressive endovascular treatment of SVC occlusion is recommended to preserve upper extremity access function and prevent bleeding from this complication.

**Keywords:** endovascular repair; esophageal varices; hemodialysis access; superior vena cava occlusion.

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## Long Term Results of Bypass Graft to the Right Atrium in the Management of Superior Vena Cava Syndrome in Dialysis Patients

Pablo V Uceda <sup>1</sup>, Robert W Feldtman <sup>2</sup>, Sam S Ahn <sup>3</sup>

Affiliations

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### Abstract

**Background:** Superior vena cava (SVC) occlusion in dialysis patients is a serious complication that can cause SVC syndrome and vascular access dysfunction. While endovascular therapy has advanced to become the first line of treatment, open surgical treatment may still be needed occasionally. However, no long term outcome data has been previously reported.

**Methods:** We performed a retrospective review of 5 dialysis patients treated with bypass graft to the right atrium from 2012 to 2014. Four patients had severe dysfunction of their upper arm dialysis access as well as superior vena cava syndrome, and one patient with a femoral tunneled dialysis catheter (TDC) had SVC occlusion. None of the patients were candidates for lower extremity access creation or peritoneal dialysis (PD). Three patients underwent a left brachiocephalic-right atrial bypass and 2 underwent a bypass from the cephalic fistula to the right atrium.

**Results:** All procedures were technically successful and maintained function of the arteriovenous fistulas or allowed creation of a new upper extremity dialysis graft. One-year secondary patency rate of the bypass was 100%. Longer follow up revealed that one patient died of leg sepsis and another one of a stroke within 14 months after the procedure. Another patient did well for 16 months when recurrent graft thrombosis occurred; and ultimately the graft failed after 31 months despite multiple interventions. Two patients maintained bypass graft patency during a follow up of 78 months; however, they underwent multiple endovascular interventions (23) and open vascular access procedures (4) to maintain hemodialysis function.

**Conclusion:** Bypass grafts to the right atrium in dialysis patients with SVC occlusion are successful in maintaining function of already existing vascular access or new ones. Long term secondary patency can be achieved but requires strict follow up and a proactive endovascular strategy to treat lesions in the access and or the bypass graft.

**Keywords:** Endovascular treatment; Hemodialysis access; Superior vena cava obstruction; Superior vena cava reconstruction; Superior vena cava repair; Superior vena cava syndrome; Thoracic central vein occlusion.

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## Long-term results and patient survival after first rib resection and endovascular treatment in hemodialysis patients with subclavian vein stenosis at the thoracic outlet

## Abstract

**Objective:** Hemodialysis patients with upper extremity vascular access and subclavian vein stenosis at the thoracic outlet can present with significant arm edema and threatened dialysis access that is frequently refractory to endovascular therapy without bone decompression. We have presented our long-term results of first rib resection, followed by endovascular therapy.

**Methods:** We performed a retrospective review of 15 consecutive hemodialysis patients with subclavian vein stenosis treated with first rib resection and endovascular therapy from 2013 to January 2021. The diagnosis was confirmed by ultrasound and venography. Bone decompression was performed with transaxillary or infraclavicular rib resection.

**Results:** During the study period, we treated 1440 unique dialysis patients. Of these 1440 patients, 346 had undergone subclavian vein angioplasty. Of the 346 patients, 15 had undergone first rib resection and were the subject of the present report. Of the 15 patients, 10 were women and 5 were men. Their mean age was 56.4 years (range, 30-82 years). The most commonly associated medical conditions were hypertension and diabetes. The mean previous hemodialysis duration was 5.4 years (range, 1-13 years). Fourteen patients had preexisting functioning access and severe arm edema. Nine patients (60%) with subclavian vein occlusion had undergone vein recanalization before the bone decompression procedure. Of the 15 patients, 5 had undergone transaxillary and 10 had undergone infraclavicular first rib resection. In addition, nine patients had undergone simultaneous vein stenting, six had undergone vein stenting within 4 weeks, and one had undergone stenting at 13 months. A stent-graft was used in eight patients and a bare metal stent was used in seven. All preexisting dialysis access sites were used the day after the procedure. The average postoperative stay was 2.6 days (range, 1-8 days). No complications developed. The average follow-up was 35.13 months (range, 4-86 months). The freedom from any subsequent intervention was 50% at 10.5 months. The average number of endovascular procedures per patient during follow-up was 4.6. Ten patients had required access surgery during follow-up. Secondary patency was 100%. The median patient survival was 69.3 months.

**Conclusions:** Symptomatic hemodialysis patients with threatened vascular access caused by subclavian vein stenosis at the thoracic outlet were safely and successfully treated with first rib resection, followed by endovascular techniques. The procedure resulted in no morbidity and preserved dialysis access function in all patients during follow-up. Our experience has confirmed that excellent secondary patency and long-term clinical success can be obtained with regular follow-up, although with multiple secondary interventions. The median survival of 69 months after the procedure suggests it is worthwhile to expend this effort to maintain the hemodialysis access function of these patients.

**Keywords:** Central vein stenosis; Hemodialysis; Rib resection; Subclavian vein; Thoracic outlet.

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