Item S1: Detailed description of the procedure

1) Informed consent and routine work-up of patients for dialysis catheter placement is performed prior to the IOA procedure. This includes a structured assessment of coagulation system (history of bleeding, complications associated with previous surgery, and drugs affecting coagulation).

2) CT scan is required to identify precise anatomy and location of the central venous occlusion.

3) The procedure can be performed in general or local anesthesia based on patient characteristics/wish or planned subsequent procedures after central venous access has been gained (e.g. HeRO graft®). If outpatient setting is chosen, patients receive local anesthesia at the device insertion site at the right groin as well as at the catheter insertion and tunneling site at the right supraclavicular region. No sedation is routinely applied. Patients additionally receive pain medication (e.g. 1 g of Paracetamol and or 1-2.5 g of Metamizole) 30 minutes prior to the start of the procedure. This systemic analgesic therapy is important as advancement of the device through the inferior vena cava at the height of the lumbar lordosis is frequently associated with pain. If pain increases above 3 on the numeric rating scale (NRS), additional analgesic medications is given.

4) The patients are positioned in supine position on an examination table that allows screening of the patient’s entire torso following every step of the IOA procedure using a mobile fluoroscopy system.

5) Both, the right groin (initial access), the right supraclavicular region (catheter entry site) and right half of thorax (tunnel and catheter exit site) are washed with antiseptic solution (e.g. chlorhexidine). The patient is covered in sterile drapes.

6) Vascular access to the right femoral vein is gained and a 0.035” guidewire of choice is introduced. The guidewire is passed through the IVC and the right atrium into the SVC until the central venous occlusion (Figure S5).

7) The workstation (10 Fr outer diameter, 8 Fr inner diameter sheath) is then introduced over the guidewire and passed to the SVC (Figure S6). The guidewire is removed and contrast agent is used to visualize and verify the safe passage of the workstation to the SVC (Figure S7).
8) Through the workstation the IOA device is advanced to the site of TCVO (Figure S8).

9) The device is pushed through the occlusion under constant fluoroscopy monitoring (Figure S9).

10) Once the tip is advanced just above the clavicle, the orientation target is placed at the right supraclavicular region at the desired catheter entry site.

11) The appropriate angle for the exit of the sharp wire from the device is determined by cranial and right anterior oblique (RAO) tilting of the C-arm until the tip of the IOA device and the orientation target are superimposed (Figure S10).

12) Only after the RAO angle is set by rotating the IOA device to the right, the needle-wire guide is pushed out at the cranial angle using the adjusting wheel at the IOA device handle (Figure S11).

13) The 0.024” sharp needle-wire is advanced out of the IOA device using the plunger at the device handle and pierced the skin inside-out in the right supraclavicular region towards the target ring (Figure S12).

14) The needle-wire serves as a guidewire after this step over which a peel-away sheath was introduced (pulled-in by retracting the IOA device, and not pushed from the neck) that allows insertion of the desired catheter.

15) In an outpatient setting patients are discharged following a dialysis session after successful catheter insertion.
Figure S1. The inside-out access (IOA) device consists of a metal pole with a sharp 0.024” needle-wire inside, attached to a handle.
Figure S2. Handle of the IOA device
Figure S3. Tip of the IOA device with needle wire guide placed out to 0 degree and advanced sharp wire
Figure S4. Guidewire in-situ and sheath advanced to site of occlusion
Figure S5. Workstation after removal of dilator and 0.035” guide-wire at site of thoracic central venous occlusion (TCVO) with target ring in place.
Figure S6. Contrast medium is applied to visualize obstruction.
Figure S7. The IOA device is advanced in the sheath up to the occlusion.
Figure S8. IOA device is advanced through the occlusion above the level of the clavicle.
Figure S9. Fluoroscopic alignment of target ring and window in tip of the IOA device.
Figure S10. Wire guide is released after completion of fluoroscopic alignment.
Figure S11. Sharp wire pierces inside-out through the skin in the right supraclavicular region.
Figure S12. Types of TCVO relevant for the applied management algorithm.
Figure S13. Patient with high amputation of the right leg requiring primary vascular access through right external iliac vein in combination with scoliosis and lordosis resulting in an angulation that impeded advancement of the stiff IOA device.