Antithrombotic measures for indwelling intravenous haemodialysis catheters—Columbus’ egg yet to be found

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Catheter thrombosis—the Achilles heel

Few expressions are used more often in haemodialysis literature than that vascular access is essential for adequate extracorporeal renal replacement therapy. In the absence of an arteriovenous access site it is common practice to use indwelling venous catheters, usually inserted in the jugular, femoral or subclavian vein. Scribner shunts appear to be used much less frequently than in the early years of dialysis. Usually catheters contain a single or double lumen, are cuffed or non-cuffed to help prevent catheter-related infection, and consist of polyurethane, polyethylene or silicone, the latter being more flexible and less thrombogenic, at least in the laboratory. While dialysis via these catheters may be less effective than dialysis via a native fistula or graft because of recirculation, the main concern for nephrologists treating their patients via an intravascular catheter are complications associated with the insertion and residence of these catheters, the latter including infection, thrombosis and stenosis of central veins. Complications and malfunction of indwelling catheters carry the burden of considerable loss of efficiency of treatment, financial expenses and patient morbidity and mortality.

While there is quite some literature on how to treat malfunctioning catheters, it is remarkable how little can be found on ways to prevent catheter thrombosis. Furthermore, catheter patency can hardly be a single aim since risk of infection and other complications, including those resulting from systemic effects of instilled anticoagulants as well as financial considerations should all be included in an evaluation of catheter care strategies. The DOQI guidelines do not give evidence-based or even opinion-based advice on measures to prevent catheter thrombosis [1].

Heparin—how much, how often?

The use of heparin in peripheral venous and arterial catheters has recently been reviewed [2]. Intermittent
heparin flushes every 6 or 8 h at 10 U/ml have been shown to have no benefit over flushing with saline, while flushing with 100 U/ml is associated with a significantly lower loss of catheter patency and possibly with a decrease in catheter related phlebitis. Heparin flushes are potentially hazardous regarding the 3% risk of autoimmune mediated thrombocytopenia occurring in patients exposed to unfractionated heparin.

Haemodialysis catheters are usually locked with concentrated heparin, the volume corresponding to the catheter priming volume. The practice of flushing dialysis catheters three times daily with heparin is unpractical and has been shown to increase the risk of bacteraemia [3]. There is evidence that the lock can also be used as a loading dose for treatment [4]. Advantages of this method include decreased blood wastage, heparin cost savings and at least one less connection per catheter lumen, the latter possibly reducing infection risk.

Removing the catheter content rather than flushing may decrease the risk of systemic effects of heparin, at least when anticoagulants other than non-fractionated heparin are used for dialysis anticoagulation. Theoretically, installing a locking volume larger than the catheter volume increases the risk of systemic effects of heparin, while installing a smaller volume may promote clotting risk. The risk of administering an inadequate heparin volume may not be negligible, if only regarding the various catheter types used in many clinics.

Alternatives to heparin?

There are only a few studies comparing heparin with a non-heparin catheter lock. Buturovic et al. compared heparin with citrate or polygeline locks and found no difference regarding catheter patency and clot volume between the groups [5]. Possible advantages of non-heparin catheter locks include reduced cost, absence of systemic effects of heparin and absence of interference with specific laboratory studies performed on blood taken from the catheter. The volume of the catheter locks does not need to be accurately adjusted to the catheter type with these types of anticoagulants. Another alternative for the use of heparin was studied by Takeda et al. [6]. Single-lumen femoral catheters were immobilized with a urokinase plug with apparently excellent results (84% catheter survival at 34 days). Both studies mentioned here deserve confirmation with attention to other aspects of catheter functioning.

Anti-coagulation to prevent peri-catheter thrombosis?

One other issue which deserves attention is whether the use of oral anticoagulants is in place to help prevent peri-catheter thrombosis. The formation of thrombus outside the catheter has been described [7] and may play a role in catheter malfunction, formation of stenosis and may cause embolization during the presence of the catheter or after its removal. Infection of the thrombus may give rise to endocarditis and septic pulmonary infection. We know of no controlled randomized study describing the effect of oral anticoagulants on thrombus formation outside of the catheter and its complications. Further, it may be that the location of the tip of the catheter is a factor of importance in thrombus formation. A location in the right atrium has been suggested to make catheter thrombosis less likely than a location in the superior vena cava where the tip could make contact with the collapsible vessel walls [7].

Finally the risk of developing stenosis after subclavian catheterization for haemodialysis is considerable [8]. Stenosis may result from endothelial irritation by rigid catheter material in the curved subclavian trajectory, and is not necessarily accompanied by thrombosis. Subclavian stenosis may result in painful swelling of the arm, especially when an arteriovenous fistula or graft is established. There has been a plea for abandoning the practice of subclavian catheterization favouring jugular or femoral access for longer or shorter period of need of catheter use, respectively [8].

Studies required to resolve these issues

Preventive measures for thrombotic complications of the use of indwelling intravenous catheters for haemodialysis appear to be understudied. The general consensus on the primary importance of establishing a safe and well-functioning vascular access in haemodialysis patients should lead to an effort to clear the present day dilemmas associated with the use of these indwelling catheters.

References

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