Percutaneous balloon angioplasty (PTA) is widely accepted as the first line treatment of hemodialysis-related venous stenoses. However, in some patients, the venous stenoses can be resistant to conventional PTA due to dense fibrous strands incorporated into the venous neointimal layer or scar tissue from recurrent puncture trauma to the venous wall (1). These lesions are identified as a band-like waist in the balloon despite application of high inflation pressures. Traditional approaches to the problem include prolonged balloon inflations and balloon oversizing. Other less common methods that have been described include the use of atherectomy devices (2), laser angioplasty (3), “parallel-wire” techniques (4) and “infiltrate and perforate” techniques (5). The advent of high-pressure balloons (HPB) capable of delivering inflation pressures of >20 atmosphere (atm) to mechanically disrupt the dense fibrous tissue at the stenotic segment have improved PTA success rates in these lesions (6 - 11).

An alternative to HPB is the use of a cutting balloon (CB). In a CB, 3 to 4 fine cutting blades or atherotomes are incorporated into an angioplasty balloon. The atherotomes, which are exposed when the CB is inflated, cut and disrupt the fibroelastic continuity of the ring of neointimal hyperplasia. This enables effective dilation of the rigid fibrotic stenoses to a larger diameter than is possible with conventional PTA and at a lower inflation pressure. The disruption of the fibroelastic tissue also prevents elastic recoil. The cuts made by the atherotomes are micro incisions into the neointimal hyperplasia and they induce directed and controlled intimal disruption. There is less wall tension when compared to the diffuse hoop stress and haphazard disruption of the intima produced by conventional PTA, and this may result in a decrease in neointimal hyperplastic response and improve patency (12 - 21).

More recently, angioplasty using drug coated balloons (DCB) have been shown to be superior to conventional PTA in terms of prolonging patency (22 - 28). DCBs are a relatively new technology where the angioplasty balloon acts as a vehicle for deposition of an antiproliferative drug onto the vessel wall without leaving a permanent scaffold within the circuit. Paclitaxel is the most common drug used in DEBs, as it is highly lipophilic, being rapidly absorbed and retained in
26. What should be the optimal angioplasty balloon for failing hemodialysis access?
(Kiang Hiong TAY, MD)

...cells following a short contact time. This antimitotic, antiproliferative chemotherapeutic drug promotes tubulin polymerisation; hyperstabilising the microtubules and preventing their disassembly resulting in the build-up of non-functioning microtubules. This halts cell division and protein transport, hence inducing programed cell death (apoptosis). Further, the drug also inhibits platelet derived growth factor (PDGF) mediated VSMC migration into the intima. These processes are thought to prevent neointimal hyperplasia, the main cause of restenosis after PTA (29, 30).

Our institution conducted 2 randomised control trials comparing conventional PTA vs CB angioplasty as well as conventional PTA vs DCB angioplasty in failing hemodialysis access. The trial results will be presented and discussed at SIRAP 2017 to determine what should be the optimal angioplasty balloon for failing hemodialysis access.

References

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