Plastic (non-metal) fistula cannula: from concept to practice

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In Australia we have seen the introduction of the needleless 'cannula', as opposed to the traditional dialysis steel 'needle', a change that provides us with the challenge of a of transition period in relation to the relabelling of the way we access fistulae to delineate between 'needling' and 'cannulation'. Although principally the techniques are similar there are some differences between fistula cannulation with the new cannula and needling with the traditional dialysis needle that should be discussed. After reading Du Toit's (2013) opinion piece on dialysis cannulas, one would be hard pressed not to wholeheartedly shift from steel needle cannulation towards the needleless plastic cannulas. A trial of Covidien's Argyle™ Fistula cannulas, safety fistula cannula with silicone clamp and safety fistula cannula with anti-reflux valve was undertaken at our major referral hospital in Queensland, with more than 120 cannulations completed in the clinical setting, mainly under ultrasound guidance. Resulting from this trial, some key points were raised and these need to be taken into consideration before using dialysis cannulas.

Review of use:

The Argyle™ Fistula Cannula has been used routinely in Japan for many years. There are approximately 300, 000 patients dialysed every week in Japan, mostly using cannula rather than steel needles with an excellent success rate and minimal complications and no reported medical incidents (Nakai, *et al*., 2012). This data along with the Therapeutic Goods Administration (TGA) approval for use of the cannula in Australia, and a noted gap in cannulation/needling practices that could potentially be filled with a dialysis cannula encouraged Cairns Hospital Renal Departments' purchase of the Argyle™ Fistula Cannula.

One of the issues faced in dialysis units is some of the new and confused patients who, regardless of education and reinforcement still manage to move their arms and inevitably end up with infiltrated vessels. In this instance cannulas are the better choice over steel dialysis needles as there is no 'needle' in the cannula to infiltrate the vessel during the dialysis session. Also on the occasion where an arteriovenous fistula (AVF) has to be accessed for intravenous infusion the dialysis cannulas with the anti-reflux valve or cannulas with silicone valve provide a much safer insertion than regular intravenous cannulas, and have a larger bore size. This is due to the fact it is very difficult to completely occlude flow through the fistula due to the high pressures, therefore the valves and clamps on the cannulas can stop blood refluxing back up the cannula upon removing the stylette. The question is; can we see the use of the dialysis cannula extending further than these scenarios?

In our haemodialysis units there has been an increase in bariatric/obese patients with deeper AVFs. Current practice would be surgical intervention to reposition the fistula closer the surface of the skin as current dialysis needles would not be long enough. The longest needle available for easy purchase through our health system is 32mm. The Argyle™ cannula is available in a range of 25mm to 38mm giving an added variety in cannulation options. Added to this, the increased safety when threading inside the AVF and the longer needle length increases our ability to cannulate these more difficult AVFs. Since the purchase of the Argyle™ 38mm cannula we have had the versatility of removing two permanent tunnelled catheters from patients with excellent AVF's approximately 20mm deep, which has allowed us to avoid a transposition of their vessels, a larger than required surgical procedure and a long scar from wrist to elbow or elbow to upper arm.

We have also seen a rise in numbers of immature AVFs that are less than the recommended 6mm diameter deemed adequate for safe cannulation (The National Kidney Foundation, 2006). This is, despite no evidence of inflow or arterial stenosis and vessel blood flow rates greater then 600ml/minute. Whether these smaller diameter fistulas always existed but are more prevalently recorded because of our bedside ultrasound diagnostic ability, it does not negate that they are often infiltrated and sometimes lack the muscular development in the luminal walls to sustain the downward pressure of the steel needles. This results in "back walling" or cannula infiltration through the bottom luminal wall, causing haematomas and making accessing the AVF more difficult. The haematomas often cause the vessel to move laterally, medially, and/or deeper, restricting the diameter and flow further. Although under observation of ultrasound guided cannulation/needling there is no initial advantage of the cannula over steel needle in this instance. It is when the possibility of mid-dialysis infiltration from the steel needles in these immature fistulas, the new dialysis cannulas have shown success. There have been several instances where re-needling of fistula has been required because of mid-treatment infiltration. On at least three occasions these infiltrations have led to limited puncture zone areas and access has been into the cephalic vein in the cubital fossa with a dialysis cannula. In several instances it has been observed that infiltration of new fistulas occurs within the first hour or two of dialysis, most likely from patient movement or back-walling of the vessel. This issue would be negated by using dialysis cannulas in premature fistulas. Initial needling or cannulation of AVFs in our department is based on the size of the vessel under ultrasound assessment and has been done as early as three to four weeks

post formation to avoid vascular catheter placement. Interestingly DOPPS data out of Japan shows that approximately 90% of fistulas are accessed within the first four weeks of creation, leading to low vascular catheter use (Ethier, *et al*., 2008).

Another issue with traumatised vessels is the presence of haematomas around the exterior luminal walls. Often vascular access nurses are called to the bedside to troubleshoot the fistula with "clots" in it. Although internal vessel thrombosis can occur, it generally results in completely occluded fistulas. The clots perceived to be in the fistula are often picked up extra-vascularly and cored and carried into the fistula by the dialysis needle, creating a plug over the end of the needle that often results in an inability to flush saline into to the fistula. Whilst usually this area would be avoided, there have been occasions when a heavily haematosed vessel from previous treatments has required access for dialysis due to excessive fluid gain and/or biochemical reasons. These patients can often require two or three needles for successful access. Fortunately haematoma and trauma can often be seen under ultrasound. In the presence of haematoma I now find myself routinely reaching for a dialysis cannula. Position is often confirmed under ultrasound and once the stylette is removed the core of haematoma will often be removed, leaving a functional cannula and no requirements for re-puncturing the access.

Points of consideration

In my opinion the dialysis cannulas deserve a space in the haemodialysis nurse's cannulating arsenal and although there are many positives there are a few points that nurses need to consider before reaching for a dialysis cannula**.**

Personally I discovered early with the use of the cannulas there was an increase in tamponading or "over-tenting" of the upper vessel wall. This was more prevalent with new users of the cannula. On analysis with ultrasound, this was often due to caution and time taken for the needle to infiltrate the luminal wall. Although a 15 gauge Argyle™ cannula has a finer stylette (17 gauge) than the 15 gauge dialysis needle, you could argue they are less likely to tamponade the vessel because of a finer point. In the few instances that tamponading occurred with the cannulas, it was observed that the cannulater was often slower/more cautious, in this case the vessel wall is more likely to carry through with the cannula and needle. A confident ultrasound user who is more proficient and dexterous with cannulating while holding a probe is less likely to see the over-tenting occur.

There have been some technique failures with nurses not inserting the needle far enough into the vessel before advancing the cannula resulting in concertinaing of the cannula exterior to the luminal wall and aborting of the attempt. This occurred on initial insertion or early exposure to the cannula. This was recorded on four of eight failed insertions. Although cannulation and needling share similar concepts, the insertion technique is very different. The cannula has a much longer hub and held further back than a dialysis needle. Therefore any horizontal or vertical movement is often exaggerated at the end of the stylette in the vessel. A sensible recommendation is to use the cannulas on vessels that you are initially more confident with if you have not done any cannulation recently. This allows you to be more comfortable with changes in technique such as different insertion angles, longer cannula and threading the sheath off the end of the stylette. Reaching for a cannula in a difficult fistula as your initial experience is setting yourself up for failure.

Due to the cost conscious nature of health it is probably best to mention the elephant in the room. Obviously there is a price variation across health services and needles that are used. The Argyle™ cannulas may have an initial increase in unit outlay. The question comes down to a cost verses risk analysis for your unit. In saying this, the Argyle™ cannulas have been used several times to access fistulas that were not accessible through conventional dialysis needling and prevented hospital admissions as the patient was able to receive full dialysis treatments, avoid surgical procedures and insertions of permanent vascular catheters; already improving their cost effectiveness.

Within the Australian vascular access nurses group there have already been discussions about the use of the dialysis cannulas compared to dialysis needles. The most prevalent of those is on dialysis pressures and what blood flow rates they can tolerate. In our experience in Cairns with over 120 cannulations we have had an average pressure with the cannulas of 140mmHG on both arterial and venous insertions. A majority of these effective blood flows have been in excess of 300ml/minute with both haemodiafiltration and haemodialysis. We will also be unable to reasonably compare against our Japanese counterparts as it is rare for their patients to achieve over 300ml/minute blood flow with over 80 percent of patients on less than 250ml/minute flow rates (Arbor Research Collaborative for Health, 2014 (a); Arbor

Research Collaborative for Health, 2014 (b)). Although data on regular vascular pressures is kept every treatment in most dialysis centres, there are too many subjective factors influencing these pressures, cannulation technique, puncture zone, angle of needle and so forth, that a comparison between dialysis needle and cannula would be very difficult in a patient trial and in my opinion would be something that could be better carried out in a laboratory setting. Also the nature of physics dictates that the longer the lumen of a cannula then the higher the pressures are going to be.

The impression is that Japan has been using these cannulas or variations of them for the last 40 years while the rest of the world has been persisting with steel needle cannulation. Given today's technology and information flow there is a wonder why the cannulas have not been more accepted previously. Is this because we have a resistant culture to change because of our comfort of what we know? Is this always the best for our patients? There is very little evidence in a hospital environment where most subspecialties have removed as many needles as possible, yet haemodialysis remains resistant regardless of the alternatives and has persisted with dialysis needles. Given the regularity and success of use throughout Japan and with recent experience the dialysis cannula is a good product that increases the versatility of access. As product popularity increases then so will the range to adapt to the evolving dialysis culture.

Conflict of interest declaration

Although this appears in a sponsored supplement no financial payment or gifts have been received by the author from either cannula companies.

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