Haemodialysis needles: Why do we use metal fistula needles?

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When I was first shown a sharp metal dialysis needle my first thoughts were: "Why don't they have a haemodialysis needle that is like an IV cannula? What if the patient moves their arm?" These are also questions that have been frequently posed to me in the years since. It stemmed from a concern that the sharp metal needle we were using to cannulate arteriovenous fistula's (AVF) and arteriovenous grafts (AVG) carried a risk of infiltration. Over time, I came to accept that the sharp metal needle was a necessary evil required to achieve haemodialysis. I came to expect the shocked look on the faces of new nurses and never thought much more about an alternative because, if there was a better alternative, surely we would have it in Australia!

Background

Infiltrations from fistula cannulation in dialysis units are a common, but likely, under-reported occurrence (Lee *et al*., 2006). An infiltration or "blow" occurs when the tip of the sharp metal haemodialysis dialysis needle passes out of the AVF/AVG and in to surrounding tissue causing bleeding into the tissue and resulting in bruising. Most infiltrations in haemodialysis units occur either; during cannulation as the needle is advanced in the AVF/AVG or; when the patient moves their arm during dialysis and the needle tip is pushed outside out of the AVF/AVG. Replacing the sharp metal needle with a blunt dialysis cannula would reduce the risk of infiltration as the blunt haemodialysis cannula, once inserted, is unlikely to pierce out through the AVF/AVG wall.

Peripheral intra venous (IV) cannulation via a steel needle is not recommended (CHRISP, 2013) so why do we use a sharp metal dialysis needle in Australia? There is very little mention in the literature re: cannula needles for haemodialysis but they do exist (Image 1). The cannula needle for haemodialysis has two parts like an IV cannula. A sharp metal needle serves as a guide to insert a blunt cannula. Once the sharp metal needle and cannula are in the AVF/AVG, the metal needle is removed as the cannula is advanced. This leaves only the blunt cannula in-situ for haemodialysis. Until recently, they were only manufactured and available in Japan (they have been available in Japan for > 20 years) but now they are available in Australia. Cannula needles currently account for approximately 95% of all haemodialysis needles used in Japan, yet outside of Japan they are relatively unknown. The question I pose is, if they are safer and available, why aren't we using them in Australia?

The haemodialysis cannula needle

In August 2013, I spent four days in Tokyo, Japan, visiting haemodialysis units to see the cannula needles in use. My goal was to gain an understanding as to why they have been embraced by Japan and not the rest of the world? Japan has approximately 300,000 patients on dialysis and a large proportion of those are receiving haemodialysis. The two haemodialysis units I saw had close to 1000 and 500 patients respectively and cannulations took less than three minutes from start to finish. They certainly did not have more time for each patient than in Australia. The insertion technique was different to a sharp metal needle but, in these experienced users, was very fast and efficient. In the units I visited, all the needles used were cannula needles. I asked staff why they used cannula needles instead of sharp metal needles. On the whole, my question was met with surprise as they could not imagine why anyone would use sharp metal needles if they had the choice. To them, the risk of infiltration from cannulation with, and leaving a sharp metal needle in situ was too high. I might as well have asked why they didn't use sharp metal needles for peripheral IV cannulation.

I was prepared to find glaring differences between haemodialysis practices in Japan to explain why they were mostly using cannula needles. I did not find anything to explain the difference, other than the Japanese staff being unwilling to accept the risks associated with cannulating with sharp metal needles. The cannula needle is more expensive than the sharp metal needle but the Japanese staff did not consider this reason enough to justify swapping to sharp metal needles. However, there were some differences noted in Japanese haemodialysis practices. They run their pump speeds at 200ml/minute on average (versus 300ml/min average in Australia). There were not many AVGs and

I saw a lot of smaller diameter, shallow AVFs. 16 and 17 gauge needles were more commonly used as they were suitable for the small AVFs and lower pump speeds.

Eventually, I felt a little silly asking the question "why don't you use sharp metal needles". As I watched the cannulations, I noted other benefits that the Japanese staff did not even consider, such as:

CANNULATION SITES: Many patients in Japan were cannulated in or near the elbow crease and close to bends in the AVF. This practice with a sharp metal needle would carry a high risk of infiltration. The ability to cannulate at the elbow crease, or in tortuous sections, allowed for a larger cannulation zone in AVFs. Increased areas for cannulation site rotation may help minimise aneurysm formations (Brouwer *et al*., 2006).

TAPING: Care needs to be exercised when taping or removing tape around sharp metal needles. Taping or removal of tape may lead to the needle tip being pushed in to the vessel wall resulting in abnormal pressures or infiltration. The blunt cannula cannot cut in to the AVF/AVG wall if pressed on or angled towards the wall of the AVF/AVG during taping or removal of tape.

NEEDLE REMOVAL: Removing a sharp metal needle from an AVF/AVG requires extra training to make sure staff or patients do not press on the needle as it is removed. Timing the removal takes practice and skill. Pressing too soon can cause pain and injury to the AVF/AVG or surrounding tissue. Pressing too late can result in blood spurting from puncture site.

The blunt cannula is safer as it can be pressed on as it is being removed. There are also no sharps to be disposed of at time of removal.

Thinking back to my own experience with haemodialysis patients, I have quite a few examples where this type of cannula needle may have improved a patient's outcome. I think that most haemodialysis nurses can relate to these examples below:

Case study 1

Patient V is an elderly lady with CRF. She was admitted with a sudden decline in renal function and acute confusion. She required urgent haemodialysis via an un-used, 1 year old, well matured radiocephalic AVF. She was admitted into the haemodialysis unit and successfully cannulated with two sharp metal needles. During the haemodialysis session, she became very agitated and moved her arms continuously, thus resulting in the sharp metal needle tip infiltrating out of the AVF wall and into the surrounding tissue. The infiltration was not immediately recognised by haemodialysis staff as the patient was unable to verbalise pain and the venous pressure change on the haemodialysis machine was slow. The infiltration resulted in a large haematoma covering her forearm. Haemodialysis was ceased due to concerns about the risk of further needle infiltrations. Use of a cannula needle in this patient may have reduced the risk of needle infiltration as the blunt cannula, once inside the AVF vein, would not have punctured the vessel wall when the patient moved.

Case study 2

Patient J is a 65 year old man who commenced haemodialysis with a tunnelled catheter as he had no permanent access. An AVF was created but took six weeks to mature enough to be cannulated with sharp metal needles. Patient J spent six weeks having the use of both arms whilst on haemodialysis with his tunnelled catheter. Once his AVF was mature, it was cannulated with two sharp metal needles and he was required to keep his AVF arm still to reduce the risk of needle infiltration. On his second haemodialysis session, he "forgot" about his needles and reached up to scratch his nose with his AVF arm. This resulted in a large painful infiltration. Staff had to resume haemodialysis with the tunnelled catheter for one week whilst the haematoma resolved. The resulting delay in catheter removal exposed patient J to an increased blood stream infection risk. Use of cannula needles may have reduced the risk of infiltration when Patient J moved his arm.

Case study 3

Patient P is an obese diabetic man with a deep upper arm AVF. He was on warfarin for past medical history of deep venous thrombosis and pleural embolism. The deeper AVF required a needle insertion angle of 35 degrees in order for the sharp metal needle to reach the AVF vein. During a routine haemodialysis session, his AVF was successfully punctured with good flash back into the tubing. An attempt to advance the needle resulted in pain

and loss of flash back. The nurse withdrew the needle slightly and successfully advanced it again at a reduced angle. The nurse was unaware that a small puncture was made in the back wall of the AVF which continued to slowly bleed in to the surrounding tissue. Haemodialysis was commenced and anticoagulation was given to prevent the circuit clotting. Thirty minutes in to the haemodialysis session, Patient S complained of increasing pain and a large swelling was noted at the cannulation site despite acceptable haemodialysis machine pressures. A bedside ultrasound noted the needles were in the fistula but a large haematoma had formed underneath his AVF from the needle tip puncture. In order to provide compression to stop the bleeding, haemodialysis was ceased and the metal needles were removed. Patient S had pain and extensive bruising to his arm which took three weeks to resolve. The extrinsic compression from the haematoma resulted in the AVF thrombosing. It was unable to be salvaged. He required a temporary haemodialysis catheter for haemodialysis until a new AVF was created. If a cannula needle was used, the metal needle tip would have been retracted inside the blunt cannula as soon as the AVF was punctured. This may have protected against infiltration in this case.

Case study 4

Patient O is an obese lady who had a mid forearm radiocephalic AVF created as her wrist arteries were too small for a wrist anastomosis. Her AVF matured well but she only had a short segment of fistula in the forearm that was suitable for cannulation. Her upper arm fistula vein was 1.5 – 2.5 cm deep. Haemodialysis staff experienced difficulties with such a short suitable segment to cannulate. On her third haemodialysis session, Patient O had a small infiltration and this only left room for one needle to be placed in the forearm. Patient O's AVF vein at the elbow was shallow and well matured. Staff were not prepared to cannulate there with a sharp metal needle as it carried a high risk of needle infiltration if Patient O bent her elbow. While the haematoma resolved, Patient O had one week of single needle haemodialysis. She had reduced dialysis adequacy as a result. A cannula needle could have been used as a second needle in the elbow region with much reduced risk of infiltration.

Discussion

A sharp metal needle left inside an AVF/AVG places the patient at risk of infiltration if the needle tip is moved (By the patient moving or the needle being moved e.g. during taping or accidentally pressing over the tip). The risk of infiltration associated with using a sharp metal needle is minimised by adopting practices to prevent the tip being pushed through the AVF/AVG wall. Some of these practices include: staff and patient education about keeping the arm still; careful taping and removal of tape; avoiding cannulation in to joint areas like the elbow crease; avoiding cannulation in to tortuous segments. Whilst these practices certainly minimise the risk of infiltration, the risk of infiltration is always there. The case studies above demonstrate some examples of infiltrations with a sharp metal needle where the preventative measures failed or could not be used. Use of a cannula needle in the same scenarios would have been unlikely to cause infiltration. Would it not be better to remove the infiltration risk by only having a blunt cannula in situ during the haemodialysis session? Prevention from infiltration would then be due to removing the risk (swapping to a blunt cannula needle) rather than reliant on managing the risk.

Many of us have felt the frustration of not having enough space to place two needles in an AVF. Case study 4 shows an example where practices adopted to minimise infiltrations with sharp metal needles have led to under utilisation of an AVF for cannulation. Changing to a cannula needle means our current beliefs about safe cannulation zones will be challenged. Cannulation in areas usually avoided (e.g. in or near the elbow crease) would be possible.

There is little strong evidence in the literature to guide us with regards to dialysis needles and infiltrations but, anecdotally, most dialysis nurses and patients have experienced infiltrations with minor and major complications. How common are infiltrations in our Australian haemodialysis units and what are the physical, psychological and financial implications of these infiltrations? I think it is important that we define this and start to gain some evidence. Further research is needed including a comparison between metal and cannula needles. Some valuable comparisons between sharp metal needles and blunt cannulae would be; infiltrations and impact of same; time taken to cannulate; perception of pain; blood flow rates; need for single needle dialysis; missed cannulation; inability to cannulate an AVF/AVG (e.g. no safe areas).

Conclusion

The cannula needle is now available in Australia. I feel it will be a valuable addition to our haemodialysis units and change our thinking around cannulation. There are high infiltration risk patients in most haemodialysis unit who would benefit from cannulation with the blunt cannula needle. Further research is required to show a physical, psychological and financial benefit for using cannula needles for all haemodialysis patients. Can you think of examples where you would have liked to have a cannula needle in your haemodialysis unit? I think back to when I started and imagine if I was trained to cannulate with a cannula needle. If I was then shown a sharp metal needle and asked if I would use it for haemodialysis, what would my reaction be? I think it would be the same as my reaction on my first day "what if the patient moves their arm?"

References

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