

Inserting peripheral intravenous cannulae – tips and tricks

Eoin Harty

Correspondence email: eoin.harty@rdefn.nhs.uk

INTRODUCTION - CATHETERS, CANNULAS AND 'VENFLONS'

The terminology used to describe peripheral intravenous (IV) access can be confusing to the newcomer. 'Cannula' and 'catheter' both mean exactly the same thing – a flexible tube inserted into the body to administer or withdraw fluids or to keep another tube patent. Venflon® is a trade name common in the United Kingdom. All of these terms are used interchangeably in anaesthetic rooms and operating theatres. In this article **cannula** will mean the whole instrument and **catheter** to refer to just the plastic tube that remains after withdrawal of the needle part of the cannula.

WHAT SIZE CANNULA SHOULD I CHOOSE?

The calibre of the needle within the cannula is expressed as a Stubbs iron wire gauge and illustrated in the Table 1, along with maximal flow rates through the catheter. The flow rate through the catheter is proportional to the fourth power of the radius (r^4 - a simplification of Poiseuille's equation).

Unfortunately different manufacturers use different colour schemes, so it is important to know the sizes and the flow rates in your hospital. Also bear in mind that flow rate varies inversely with the length of the cannula, meaning that '*short and thick does the trick*' if rapid infusion of fluid is required.

The size that you select depends on the indication for cannulation in a particular patient. Fluid and drug infusions can be run through any size cannula. Administration of fluid in shocked adult patients needs to be done rapidly, so an 18G or larger cannula is required. Non-urgent blood transfusion can be reliably achieved through 18G cannulae and larger, though some units use 20G cannulae.

PRACTICAL TECHNIQUE FOR CANNULA INSERTION

The technique of cannula insertion can be taught in many different ways. The following is a combined account of techniques the author has been taught that has been modified with experience.

1. Prepare your patient – explain what will happen and gain verbal consent. Consider using local anaesthesia (discussed in more detail later).
2. Select your site – site selection is discussed in more detail below: the default position is usually the dorsal hand, forearm or antecubital fossa. Apply a tourniquet proximally and encourage fist clenching to engorge the veins. Look for a straight, wide, 'spongy' vein, with no evidence of valves.
3. Prepare the site with locally approved antiseptic – the author's institution preference is for 2% chlorhexidine in 70% alcohol wipes, wiped for 30 seconds and left to dry before cannulation.

Summary

The insertion of intravenous catheters is one of the most frequently performed procedures by anaesthetists. It is one of the major concerns of patients and can also provoke a significant stress response.¹ This article describes different types of cannula, troubleshoot common problems with cannula insertion and consider how and when to use local anaesthetic drugs in adults.

Table 1. Characteristics of different gauge cannulae

Gauge	Colour	Maximal flow rate (ml.min ⁻¹)	Time to infuse 1000ml fluid
24G ('neoflon')	yellow	13	77min
22G	blue	31	32min
20G	pink	67	15min
18G	green	103	10min
17G	white	125	8min
16G	grey	236	4.2min
14G	brown/orange	270	3.7min

Eoin Harty

Core Trainee

Department of Anaesthesia

Royal Devon and Exeter NHS

Foundation Trust

Barrack Road

Exeter

EX2 5DW

UK

4. Warn the patient that you are starting the procedure. Be honest - 'a small scratch' is not accurate, 'a sharp sting' may be better.
5. Insert cannula with your dominant hand, using your other hand to tether and slightly stretch the skin over the target vein.
 - a. With the bevel facing up, slide the cannula through the skin and into the vein until first 'flashback' is seen (Figure 1a). This indicates that the needle tip has penetrated the vein. The cannula should then be angled about 5-10 degrees to the skin.
 - b. Advance the cannula a few millimetres further to ensure the catheter as well as needle tip enters the vein (Figure 1b).
 - c. Withdraw the needle until a second flashback is seen in the catheter itself (Figure 1c). This indicates that the catheter alone is in the vein.
 - d. Keeping the needle still, advance the catheter to the hilt.
 - e. Apply digital pressure over the catheter tip and remove the needle. Attach the giving set or bung.
 - f. Flush your cannula with 0.9% saline to confirm placement, watching for extravasation of fluid.
6. Place a locally approved dressing over the cannula.

The above is an 'ideal' cannula insertion which is achieved in the majority of cases. A discussion of potential pitfalls and problems follows.

TROUBLESHOOTING

'I can't find a vein'

This is probably the most common problem in IV cannulation, particularly in patients who have had multiple venous punctures, such as renal patients and intravenous drug abusers (IVDAs). There are two ways to solve this problem.

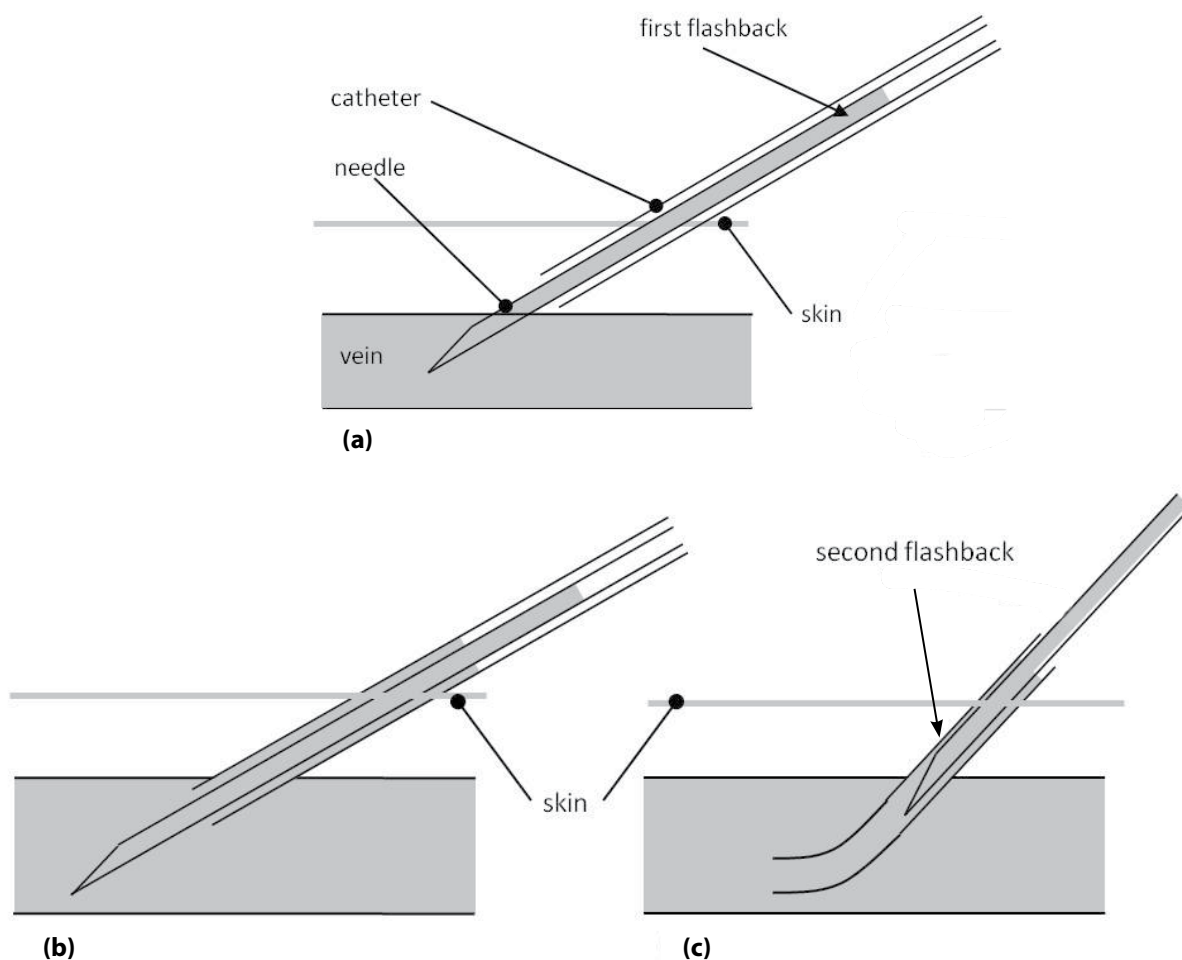


Figure 1. Practical tips for venous cannulation; (a) needle in vein, catheter outside vein – first flashback only; (b) needle in vein, catheter in vein – first and second flashback; (c) successfully withdrawing needle and advancing catheter inside vein – note second flashback in catheter

Look for alternative sites

Many longterm patients and IVDA's will be able to tell you where their best veins are. Otherwise think about insertion in:

- The ventral forearm or wrist – this area is often overlooked and usually has some wide flat veins. The inside of the wrist is a tender area with small branching veins that will only accommodate smaller cannulae.
- Feet – veins here tend to be small and friable, but sometimes suitable veins are found over the third, fourth and fifth metatarsals. In patients who have undergone bilateral axillary clearance for breast cancer, the arm veins must be avoided and this site is usually chosen.
- Long saphenous vein at the ankle. This vein is found just anterior to the medial malleolus. It may be difficult to palpate, but can be located using a 'tap test' – transmission of a finger tap can be felt 2 cm proximally if there is a column of blood present. This site is particularly useful in children and is almost always present if the site has not been used before (see Figure 2). Blind puncture at this site will often be successful, even if the vein cannot be palpated. This site is useful for adults undergoing superior (or cervical) mediastinoscopy, when it is useful to have reliable large bore IV access into an inferior vena cava (IVC) tributary in case a major neck vein (draining into the SVC) is damaged.



Figure 2. Cannulation of both long saphenous veins in a 3-year-old undergoing a procedure with potentially high blood loss

- Neck – often the external jugular vein is prominent (Figure 3). This requires a **very shallow approach** (<5 degrees) and often a slight anterior-posterior bend in the needle is helpful. Tilt the patient head-down and ask an assistant to place a finger along the superior border of the clavicle to compress the lower end of the vein and engorge the more cephalad section. There is often a valve in this vein so it is frequently not possible to insert the catheter fully - it can be fixed in the position that allows best flow. This site is particularly useful in cardiac arrest or emergency situations and provides convenient access for the anaesthetist.



Figure 3. The external jugular vein

- Note that in patients with peripheral oedema, the oedema can be compressed for a minute, driving the interstitial fluid elsewhere, and veins will come into view.
- Finally, the interosseous route should be considered if immediate access is required. Emergency paediatricians will attempt venous cannulation for 2 minutes before placing an interosseous needle. This is commonly done in the anterolateral tibial surface two centimetres below the tibial tuberosity, but they can also be placed in the medial femoral condyle or the head of humerus.

Optimise the veins you can see

Sometimes patients will not possess any veins that are suitable for cannulation. Here you will need to further engorge the veins you can see using a combination of the following techniques.

- Fist clenching and unclenching with tourniquet applied. This increases venous return from the muscles supplying the intrinsic hand muscles and thenar eminence.
- Tapping veins – often the local irritation of two or three of your fingers tapping along the length of the vein will cause the vein to dilate.
- Warm the hand. This will encourage venodilation and can be accomplished by immersing the hand **in hot water** or **wearing latex gloves** on the way to theatre.

Consider alternative induction techniques

On occasion it will be sensible to proceed to a gas induction using halothane or sevoflurane. This is frequently the case in children,

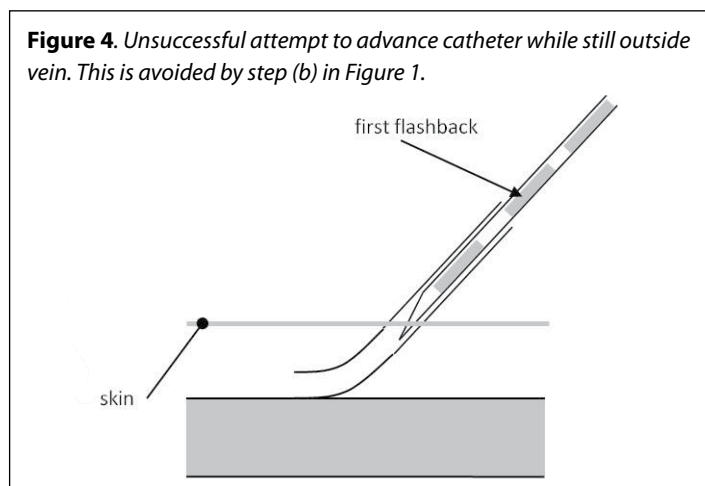
particularly in the age group between 6 months and 3 years. Venous cannulation is generally easier with the venodilatation of these agents, but make sure the patient is adequately anaesthetised prior to skin puncture.

Laryngospasm without the back-up of IV access is a dangerous situation. Many would advocate the presence of two anaesthetists for this technique but local staffing may make you reliant on a trusted and skilled assistant to maintain the airway while you perform cannulation or vice versa.

'The catheter won't advance'

This is usually because the catheter is not in the vein. If there's been a first flashback but no second flashback in the catheter itself, then the catheter is usually in one of two places:

- It has passed through the vein and out of the other side. This situation may be salvaged by pulling the needle a centimetre or so out of the catheter and then **very slowly** withdrawing the whole cannula, as you look for a second flashback of blood in the catheter. Once this is present, the catheter is in the vein and it may be possible to advance it.



- It is superficial to the vein – i.e. only the needle tip has entered the vein, not the catheter itself (See Figure 4). This happens if the cannula is not advanced 1-2mm after the first flashback as in step 4(b) in the technique described above. If you have already withdrawn the needle then this is unsalvageable as it is not good practice to reinsert the needle into the cannula.

'A haematoma or bruise is forming at the site of cannulation'

This means that the needle has gone through the vein and out of the other side, with extravasation of blood into the surrounding tissues. This can be salvageable by withdrawing the whole cannula and needle again, looking for a second flashback. Once this is present, the catheter can be advanced into the vein and past the haematoma. It's particularly important to flush the cannula to be sure it is truly in the vein.

'This vein is very mobile'

Subcutaneous connective tissue typically degrades in the elderly, allowing veins to be relatively mobile under the skin. Tethering the skin with your other hand can help to immobilise them, and a speedy approach will pierce the vein before it has time to move away.

'I've hit a valve'

If a catheter, that was advancing well within the lumen of a vein, comes to a stop before it is in place, you may have hit a valve within the vein. This can sometimes be remedied by flushing the catheter with 0.9% saline while advancing – the hydrostatic pressure opens the vein or dislodges any clot allowing the catheter to slide further. If this proves impossible, and the catheter is stuck but still flushing well, secure it well and use as normal. Bear in mind flow rates through a 'half-in' catheter will be less and they are very prone to being dislodged.

LOCAL ANAESTHESIA FOR VENOUS CANNULATION – WHAT TO USE AND WHEN?

Anaesthetising the skin before cannulation helps allay patient anxiety and reduce pain. It has been shown that cannulation results in an increase in mean arterial blood pressure by 10-15%, an effect which is abolished by intradermal injection of local anaesthesia (LA).¹ The vast majority of patients and healthcare workers would prefer to have local anaesthetic for cannulation even with a 22G needle.²

There are two methods – application of cream containing local anaesthetic or direct intradermal injection of local anaesthetic at the venopuncture site. The advantages and disadvantages are shown in Table 2.

Intradermal injection is used commonly in the UK as it works quickly and provides good, reliable analgesia. A comparison of intradermal injection and local anaesthetic cream found them to be equally effective in relieving venepuncture pain.³

Table 2. Advantages and disadvantages of different techniques for providing local anaesthesia for IV cannulation

	Advantages	Disadvantages
Intradermal injection	Works quickly Good analgesia	Requires a second skin puncture Increases chance of needlestick injury Pain on injection Can make cannulation more difficult by obscuring the target vessel
Cream	No needles required	Takes an hour to work reliably

The ideal intradermal anaesthetic would be cheap, fast acting, effective and cause minimal pain on injection. Morris et al compared etidocaine, bupivacaine, mepivacaine, chloroprocaine and lidocaine and found that the latter two were least painful to administer intradermally.⁴ Further work has found that alkalinised lidocaine is less painful than plain, but this approach may be unnecessarily complex for cannulation.⁵ Lidocaine is also the fastest acting and the cheapest of the available local anaesthetic agents.^{6,7}

It is often argued that intradermal LA distorts tissues surrounding the vein and makes cannulation more difficult, but there is certainly no evidence to support this. Röhm et al found that intradermal LA made no difference to cannulation success rate in 301 patients,⁸ while Holdgate et al found the same in 166 patients.⁹

Do smaller cannulas require LA in the same way? While McNaughton et al found that LA made a difference to pain scores in 22G needles, another study compared 14, 16, 17, 18 and 20G needles, finding that there was significant difference in pain scores with the two largest needles, 14 and 16G.⁸ The evidence on smaller needles is conflicting; it is probably best to use LA in patients who request it, or that you think may benefit from it.

Various other methods of analgesia have been tried, such as entonox¹⁰ or capsaicin cream.¹¹ There is no evidence that any are superior to intradermal lidocaine.

CONCLUSION

In this article we have looked at selecting your cannula, practical insertion technique, common problems and reviewed the evidence for local anaesthesia. This is only a guide and there is no substitute for inserting a large number of cannulae yourself. In this way you will develop your own method and salvage techniques and your success rate will improve.

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