

Small animal anaesthesia and the role of the nurse: part three

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Fiona Scarlett BSc(Hons), RVN, focuses on the VN's involvement in alternative venous access and arterial catheters to conclude her series

PREVIOUS articles in this series discussed advanced techniques in endotracheal intubation (*VN Times* 11.09) and local anaesthesia and continuous-rate infusions (*VN Times* 12.05). This article will focus on alternative venous access and arterial catheters.

Alternative vascular catheterisation

Venepuncture in practice tends to be predominantly carried out by VNs and SVN's; therefore, an understanding of the range of vascular access points and the associated management is required. We have all come across patients that have had multiple intravenous (IV) catheterisation attempts or in which several catheters have been placed for long-term IV therapy. Whether it is down to the temperament of the patient, poor placing technique or simply bad luck, gaining IV access in these patients can be challenging. The cephalic vein of the thoracic limbs or the lateral saphenous veins of the pelvic limbs are the most common peripheral veins catheterised; many of us will be familiar with cephalic IV catheter placement. There are, however, alternative options for IV access:

- accessory cephalic vein – distal to the carpus ([Figure 1](#));
- dorsal common digital vein – over metatarsal bones ([Figure 2](#));

- medial saphenous vein – useful in cats ([Figure 3](#)); and
- medial and lateral auricular vein – useful in Dachshunds, Basset hounds and beagles ([Figure 4](#)).

In hypovolaemic or hypotensive dogs and cats, peripheral vessels may not be easily detectable although the lateral and medial saphenous veins are often still visible due to the thin overlying skin ([Figure 5a](#)).

Considerations for choosing a site include accessibility, character of the patient, surgical site, detectable veins and vein integrity above the insertion site.

When patients require intensive IV treatment, such as prolonged fluid therapy in hypercalcaemic or diabetic ketoacidotic patients, or prolonged and multiple IV drug administration, nurses are perfectly situated to suggest placement of a longstay or even a jugular catheter. Selection will depend on experience and preference, cost, availability, and the patient's needs.

Long-stay catheters are made of a softer material (polyurethane) than conventional IV catheters (FEP polymer) and are more resistant to kinking and occluding. Catheters made from Teflon are less flexible, less durable and stimulate more tissue reaction than polyurethane or silicone¹.

Jugular catheters are also softer (polyurethane or silicone) and have the option of single, double, triple or quadruple lumens. Silicone catheters are more expensive and complicated to insert¹. Generally, for veterinary practice, the biostability and cost of polyurethane catheters make them preferable for both short and long-term use¹.

With placement of longstay catheters, strict asepsis is important. Appropriate clipping of the area and a full surgical scrub of the skin is necessary. Appropriate hand hygiene must be applied and sterile gloves worn. The use of a fenestrated drape over the area of venepuncture and a sterile tray or drape to place all necessary equipment on is advisable.

Long-stay catheter placement in a peripheral vein is otherwise very similar to the placement of a standard catheter. Considerations include:

- long-stay catheters are often longer so ensure catheter length is measured against the vessel to allow selection of the appropriate insertion point;
- a cut-down technique of the skin is advisable; and
- catheters will require suturing in place (Figure 5).

Placement can often be performed in conscious patients in the same way as for a standard IV catheter. An addition to the protocol is the topical application of a local anaesthetic agent to the site

of puncture, either using EMLA or local infiltration of the skin. Enough time has to be given for EMLA to attain the desired anaesthetic effect.

Jugular catheter placement requires slightly more skill. Multilumen central catheters are especially useful in intensive care cases where multiple infusions are needed. Central venous pressure monitoring may be required and frequent blood sampling is undertaken.

Various techniques exist, including:

- peel-away;
- Seldinger;
- through-the-needle; and
- over-the-needle.

Jugular catheters can be placed in patients under general anaesthesia, but, in critical patients, they may often be placed with a light sedation (or none at all) and a local anaesthetic agent injected into the skin where venepuncture is planned.

At the author's institution, the Seldinger technique for placement of jugular catheters is used; therefore, this technique will be described.

It is important to organise your equipment. The Seldinger technique adopts an over-the-wire catheter and is a commercially available kit ([Figure 6](#)), which includes:

- an introducer; over-the-needle catheter or a introducer needle;
- multi-lumen catheter;
- vessel dilator;
- J-tipped guide wire; and
- closed valves and caps.

When deciding on the length of the jugular catheter, measure the distance from the point of intended insertion to thoracic inlet ([Figure 7](#)). The width should be the largest gauge that can feasibly fit within the vein. See texts for other equipment required.

It is good practice to monitor ECG in these patients as it is possible for the guide wire to come into

contact and 'irritate" the endocardium and cause arrhythmias. The most common arrhythmia is a ventricular premature complex. If an arrhythmia is seen, draw back on the guide wire slightly. An alternative would be to place a Doppler ultrasonic flow detector. This gives an audible indication of the pulsatile flow from the heart; if an arrhythmia occurs it would be heard. A lateral thoracic radiograph can be taken to ensure correct placement. The purpose of this is to confirm that the tip of the catheter has not entered the heart; it should sit in the intrathoracic vena cava. This position is also more accurate for central venous pressure measurement.

While learning this technique, it is helpful to have a colleague who is scrubbed and gloved to help minimise bleeding, pass equipment and hold the guide wire. It is important that communication is maintained, especially with the person holding the guide wire. The procedure is described below.

1. The patient can be positioned in lateral or dorsal recumbency.
2. A rolled-up towel, sandbag or foam cushion can be placed under the neck. This helps with visualisation and catheter insertion (Figure 8).
3. Liberally clip the area over the jugular vein (Figure 8).
4. Visualise the jugular vein.
5. Instil local anaesthetic agent to the planned insertion site if indicated.
6. Prepare the clipped area with sterile scrub.
7. Put on sterile gloves.
8. Prepare your jugular catheter kit:
 - lay it out on a sterile trolley;
 - preload the catheter and each lumen with heparinised saline ([Figure 9](#));
 - close the ports of the lumen, except for the one where the guide wire will come through (distal lumen); and
 - straighten the "J" tip of the guide wire.
9. Ask an assistant to raise the jugular vein so it can be seen easily.
10. Place a sterile drape over the area of insertion.

11. Ask the assistant to stop raising the vein and make a small stab incision using a blade over the proposed insertion site.

12. Tent the skin with your hand and insert the introducer needle or short, over-the needle catheter through the skin over the jugular vein ([Figures 10](#) and [11](#)). Push the catheter into the jugular vein and a flash of blood will appear in the catheter hub.

13. Remove the stylet from the catheter.

14. Introduce the guide wire. Once it is advanced into the vessel far enough, remove the catheter ([Figure 12](#)) – do not let go of the guide wire.

15. The dilator is then fed over the wire and into the jugular vein – do not let go of the guide wire ([Figure 13](#)). The aim is to create a larger opening in the vein so the multi-lumen catheter can be introduced easily.

16. Discard the dilator and introduce the catheter over the guide wire. Thread the catheter over the wire.

17. Advance the catheter into the jugular vein ([Figure 14](#)) – the guide wire will emerge through the external port of the catheter. Once the catheter is advanced into the jugular vein the wire can be withdrawn gently and discarded.

18. Attach a valve/close the port to the distal lumen port. A heparin flush is then attached to the valve(s) and each lumen can be checked to see if blood can be drawn back before flushing with heparinised saline, to ensure correct placement, [Figure 15](#).

19. The catheter is sutured into place and a sterile adhesive dressing is used to minimise contamination ([Figure 16](#)).

Arterial catheter placement

Indications for arterial catheter placement include:

- Beat-to-beat monitoring of blood pressure in patients with concurrent disease in which direct blood pressure monitoring is required. Also for procedures where haemodynamic changes are anticipated.
- Multiple arterial blood gas to assess respiratory function by analysing arterial oxygen and carbon dioxide tensions (PaO_2 and PaCO_2).
- In patients where non-invasive blood pressure measurement is not practical; for example, burns patients or degloving injuries affecting all extremities.

Arterial catheters can either be placed and used in patients during general anaesthesia or in awake but more critically ill patients. Examples are patients undergoing extensive surgery in which blood loss is anticipated or patients in which abnormal blood gases are anticipated (patients with respiratory disease or undergoing thoracotomies). A patient that is haemodynamically unstable or has arrhythmias would also benefit.

Arterial catheter placement requires skill and training. A good understanding of the regional anatomy and where the artery runs is essential. Various arteries can be used ([Table 1](#)); however, not all of these are practical and therefore may not often be used. Dorsal pedal, carpal, coccygeal and auricular arteries are the most practical choices ([Figures 17 to 20](#)).

For placement of an arterial catheter, the same materials are needed as for peripheral IV cannulation. The addition of a number 11 scalpel blade for a small cut down before catheter insertion is helpful. Dorsal pedal artery catheterisation is discussed as this is the most straightforward one to use, the easiest one to maintain, and most commonly used.

The dorsal pedal artery passes between metatarsal bones II and III in a medial to lateral direction. It is often used for assessment of peripheral pulses in either awake or anaesthetised patients. For placement, the patient is put into lateral recumbency with the limb to be catheterised on the dependent side. An assistant can help to steady the leg, but care must be taken to avoid pressure around the hock. Another option is to tape the leg to the table to secure it. The area is clipped and a full surgical scrub performed. With clean hands, the artery can be palpated along its entire course with one to three finger tips, depending on the size of leg. Ideally, the catheter is placed at the most distal side where it can be palpated.

A small incision is made in the skin after which the catheter is inserted at an angle of approximately 10 to 20 degrees. With the fingers of the other hand, the artery is palpated just above the insertion point to guide the direction in which the catheter is placed. As arterial walls are thicker than venous walls, firmer movement is needed to stab the artery. It is essential not to be too quick and to allow time to assess whether puncture of the artery has been successful.

Once an artery has been “hit”, haematoma formation and arterial constriction will often limit the number of attempts to just one.

Once blood is seen in the catheter hub, ensure the tip of the catheter is fully in the artery (not just the tip of the stylet), by advancing it slightly in the correct direction, after which the catheter can be threaded off the stylet. A T-port preloaded with (heparinised) saline is connected rapidly and the catheter secured in the same manner as an IV catheter. Pulsatile blood flow is often seen in the catheter hub or T-port connector, which confirms correct placement – unless the patient is extremely hypotensive.

Arteries are prone to spasm, which may occur during cleaning of the skin or attempts to

catheterise. It is therefore important to be gentle when preparing the skin for catheter placement. The use of topical anaesthetic cream or injection of a small amount of local anaesthetic along the artery may help reduce the chance of arterial spasm. Once spasm has occurred, it will be difficult to place the catheter and alternative sites have to be considered.

Potential complications of arterial catheterisation should be considered. In veterinary patients, dislodgement and, therefore, the potential for haemorrhage is real. Also, if the arterial catheter becomes disconnected, or T-ports are not being adequately attached, haemorrhage is a risk. However, the majority of patients that require an arterial catheter will be either under general anaesthesia or critically ill. Distal ischaemia, thrombosis and infection are also risk factors. To avoid accidental intra-arterial injection of drugs, arterial catheters must be labelled clearly and distinguishable from venous catheters ([Figure 21](#)).

A pressure bandage should be applied when arterial lines are removed to avoid risk of haematoma formation or haemorrhage; approximately five to 10 minutes is advisable. It is not recommended to leave it on for longer or the blood supply to the distal tissues will be compromised.

Catheter monitoring

The importance of the nurse's role in the prevention of infection associated with IV therapy is via the management of IV equipment and regular catheter monitoring. Monitoring will enable early identification of complications, including phlebitis, or inflammation of the vessel; thrombosis or formation of a thrombus on the catheter or vessel wall; embolism; breakage of a portion of the catheter into the circulation; and subcutaneous fluid infiltration. Tight taping or bandaging, leading to swelling distal to the catheter, may contribute to resistance to fluids and/or drugs being given via the IV catheter; and infection, often diagnosed by phlebitis, swelling, red skin and cellulitis.

Although peripheral IV catheters are removed after 72 hours in humans, there is no evidence in veterinary medicine that this is necessary if there are no complications².

To decrease risk of catheter-related complications, sterile placement, daily inspection and rewinding of the site, and avoiding injecting irritating or hypertonic solutions into a peripheral vein are recommended. At the author's institution, arterial and venous catheters are flushed every two and six hours, respectively. Both are inspected every six hours and rewound every 12 hours, unless wet or soiled, when bandages would be changed. Ideally, catheter maintenance should coincide with other routine daily monitoring, such as medicating and physiological parameter assessments.

While monitoring an indwelling venous or arterial catheter, record the date, catheter site and type, and comments daily. Catheters used for continuous fluid therapy do not need to be flushed routinely. Unused IV catheters should either be removed or flushed every four to six hours. Arterial catheters should be flushed every two hours to maintain patency. This should be done using 0.9

per cent sodium chloride with or without heparin. There seems to be little evidence to support the use of heparinised saline over normal saline to maintain patency of intravenous or arterial catheters^{3,4}.

In conclusion, VNs and SVN's play a key role in small animal anaesthesia. Within the techniques discussed in this series of articles, there are plenty that may be carried out by VNs under Schedule 3. With training, VNs are ideally placed to plan ahead and anticipate equipment requirements and techniques indicated in certain patients. A good understanding of anatomy is crucial for the more invasive skills, such as local anaesthetic blocks (see part two) and alternative venous and arterial catheter placement. Practising some of these techniques, such as endotracheal intubation (part one), on less challenging cases will stop skills degrading. Effective training, increased awareness and patient assessment will minimise complications. Some of these skills will be very easy to implement as they require minimal extra costs to the clinic.

• I would like to thank Colette Jolliffe from the Animal Health Trust for supplying Figure 3.

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