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A step-by-step approach to peripheral catheter placement: maintenance, care and complications

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ABSTRACT: Peripheral catheter placement is a fundamental task performed within the veterinary nursing profession and is a part of training towards gaining their qualification. According to a recent survey by the Institute of Employment Studies on behalf of the Royal College of Veterinary Surgeons in 2017, one of the most frequent tasks carried out by veterinary nurses (VN) is the placement of intravenous catheters (Robinson, D., Edwards, M., & Williams, M., The Future Role of the Veterinary Nurse: 2017 Schedule 3 Survey). The statistics show that out of 11,625 respondents, 71.4% of VNs conduct this task. Being able to demonstrate competence in this area formulates a crucial part of veterinary nurse training. Gaining sufficient experience will help to reduce and prevent complications from arising. Examples of complications in human studies have included infection at catheter sites, haematoma formation and thrombosis. A step-by-step approach in terms of technique, catheter choice and design along with care and maintenance would reduce complications associated with peripheral catheter placement.

Keywords: Peripheral catheter; catheter complications; catheter placement

Introduction

Intravenous catheters are commonly used in veterinary practice, primarily for providing intravenous fluids and medication. Catheters are designed with the purpose of minimising complications such as thrombosis (Tan, Dart, & Dowling, 2003).

It is thought that if the site has been adequately prepared using aseptic technique, catheters can usually be left beyond 72 hours of placement (Coolman et al., 1998). However, more recent publications suggest that if the catheter is left in the same site for more than 72–96 hours the risk of infection increases and therefore recommend replacing catheters after 72 hours (Haskey, 2016), (Macfarlane, Morris, Burnside, & Bell, 2016; Ward, 2018). From this, it can be accepted that the importance of aseptic skin preparation is more crucial when the duration of catheter placement is greater than 24 hours and up to 72 hours.

Aside from catheter placement techniques which this article focus on, hand hygiene, the use of alcohol hand gels, examination gloves and employing the correct techniques by using the WHO method are also important when preparing to place a catheter (Ashby, 2017). After placing a catheter it is important to ensure that the catheter is patent and monitor the catheter site for signs of infection.

A recent publication suggests the use of a Ward Phlebitis Scoring Chart which was designed and derived from a human nursing perspective. This offers a valuable visual guide to checking catheter sites which includes a four-stage scoring system with a primary focus on catheter site observations and occurrence of phlebitis (Ward, 2018).

There are several reasons as to why peripheral catheters are used. The most important is that of gaining emergency venous access when admitted as an inpatient (McCallum & Higgins, 2012; Weil, 2006) and facilitating:

- fluid therapy
- chemotherapy
- total parenteral nutrition
- drug administration such as propofol and other anaesthetic agents
- dyes and contrast media
- euthanasia
- administration of blood products, i.e. colloids
- blood sampling (if multiple tests or with very poor vein access)
- haemodynamic monitoring
- haemodialysis.

Sites for placement

The sites used most frequently for placement of peripheral catheters are as follows.

1. Cephalic vein – large veins which are easy to visualise and locate.
2. Medial branch of cephalic vein (accessory cephalic vein) can be used, although due to the more distal location the use of tape to secure the catheter increases the risk of oedema.
3. Lateral saphenous vein – contamination from urine and faecal matter can increase the risk of infection in this location.

Other locations which can be used for catheter placement include the metacarpal and metatarsal veins and the femoral vein.

Catheter choice/size

There are a number of different catheters available commercially. The length and gauge of the catheter chosen is dependent on patient size. The indications of the condition of the patient are also important to note. A typical example is a hypovolaemic patient that needs a large gauge catheter for quicker administration of fluid therapy.

GA or G refers to the 'Birmingham gauge wire system'. This offers the diameter or thickness of the needle or tube products. The gauge system is usually on a descending scale: the higher the gauge size, the smaller the tubing (Ahn, Bahk, & Lim, 2002).

Corresponding patient size with species are:

18GA – large dogs (Great Dane/ German Shepherd)
20GA – medium dogs (Cocker Spaniel/ Springer/Border Collie)
22GA – small dogs/cats
24GA – cats/kittens/puppies

A typical definition for peripheral catheters selection is shown in Table 1.

OD, outer diameter; ID, inner diameter.

Catheter length is often abbreviated as in (inches).

Gravity flow rate measured in millilitres per minute.

Tan et al. (2003) described the variety, use, advantages and disadvantages of catheters commercially available in the veterinary field.

Butterfly catheter

- Short-term use
- Range from 25GA to 19GA
- Easy placement
- Difficult to maintain due to risk of puncturing the vessel wall
- Careful taping required (avoid directly taping to the wall)
- Excellent for a single use such as injections
- Ideal if a patient is not mobile

Over-the-needle

- Most common and widely used catheter
- Inexpensive and easy placement
- Can be left in place for up to 72 hours before replacing

Through-the-needle

- Not commonly used
- Usually used primarily for central venous placement
- Usually longer in length and designed to prevent contamination
- Difficult to stabilise
- Likely to need sedation or general anaesthetic for use

Multi-lumen

These are usually available in both over and through the needle type catheters. The purpose is to have more than one lumen per catheter to allow a large infusion at the same time. They are not often used and can be expensive, but may prove useful in critical care and intensive care units.

Step-by-step approach to catheter placement

1. An important consideration is deciding whether the patient requires manual restraint, muzzling if conscious or chemical restraint, e.g. sedation. Additional considerations such as local anaesthetic could be useful such as EMLA cream at the proposed catheter site (van Oostrom & Knowles, 2018). Note: EMLA is 'off licence' for use in animals. Ethyl chloride (EthyCalm, Invicta Animal Health) could be useful due to the reported desensitisation by cooling the skin.
2. Obtaining or acquiring suitable equipment preparation such as clippers, suitable retaining tape, chosen catheters, skin scrub for aseptic technique, IV bung/T-connectors where appropriate and sodium chloride 0.9% saline for flushing.
3. Personal protective equipment (PPE) preparation – open gloving technique ideally using the World Health Organisation (WHO) hand hygiene method to prevent any possible contamination.
4. Place patient in sternal recumbency where possible. An assistant restrains the patient by placing one hand underneath the muzzle region and placed towards the assistant away from the operator. The assistant extends the foreleg using their other hand.
5. Once restrained, the site is chosen, ideally as distal as possible to prevent any kinking at the elbow, for example. The area is clipped to remove as much hair as possible.
6. Scrub the insertion site using an appropriate antimicrobial agent. The most common agent used is chlorhexidine gluconate as this is proven to be effective in reducing bacterial counts on canine skin (Dorey-Phillips, & Murison 2008). The use of isopropyl alcohol preparations are also often used, such examples are 2% chlorhexidine in 70% isopropyl alcohol for site

Table 1. Common peripheral catheter selection.

Colour of catheter	Gauge	Catheter length (in)	Catheter ID (mm)	Catheter OD (mm)	Gravity flow rate (ml/min)
Yellow	24	0.75	0.445–0.521	0.699–0.724	17
Blue	22	1.00	0.546–0.648	0.826–0.851	28
Pink	20	1.16	0.699–0.800	1.080–1.105	49
Green	18	1.16	0.876–0.978	1.306–1.336	86

Source: BD Medical Ltd (www.bd.com/ivcaths).

preparations (Young et al., 2014). Scarlett, 2012, stated that the use of 2% chlorhexidine followed by isopropyl alcohol is effective. The use of povidone iodine are also known to have been used although chlorhexidine gluconate is proven to be more effective with lower infection rates and also causes less inflammatory skin reactions (Scarlett, 2012; Tan, Dart, & Dowling, 2003).

7. The assistant to occlude the cephalic vein using the thumb just below the elbow. (Figure 1). This is placed over the vein to restrict blood flow returning to the limb, the vein at this point should be engorged with blood allowing good visibility. (Squeezing the digit pads will also improve venous return to assist this.)
8. The operator should extend the leg towards them and align their thumb adjacent to the vein to prevent any movement of the vein (Figure 2).
9. Using the chosen catheter, ensure the bevel is facing upwards and introduce into the vein slowly at a 30° angle.
10. Once blood is observed in the catheter, slowly advance the catheter further without the stylet (Figure 3). A common mistake is to introduce the stylet too far, causing haematoma at the site.
11. Remove the stylet once the whole catheter is threaded into the vein completely. There should be no resistance or swelling at this point.
12. The assistant should place their finger just proximal to the insertion site to prevent any excess blood flow until the catheter cap is placed on.
13. Attach the appropriate device required, this can be a giving set for Intravenous fluid therapy, injection cap, T-connector or simply a catheter stop cap.
14. Place medical tape to secure the catheter in place. Strips of tape should be prepared prior to this and be of a suitable length to go around the circumference of the leg. Be careful not to secure the injection cap to allow ease of removal later.
15. Flush catheter with sodium chloride 0.9% saline to ensure patency at the site before placing a cap on.
16. Place a strip of tape underneath the device and around the leg then loop the T-connector or giving set to go around again with the remaining tape.
17. Patient interference can be prevented either by using self-adherent bandage or a Buster collar.

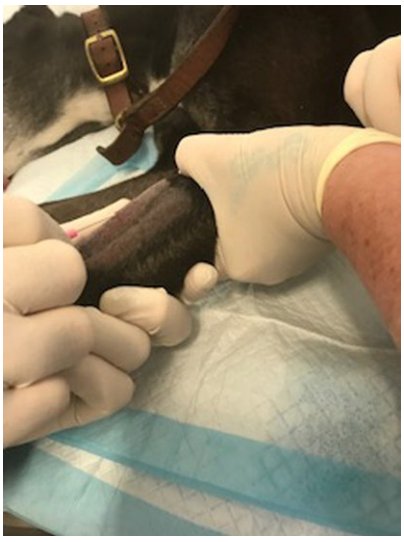

Figure 1. An example of a patient restrained and vein occluded at the cephalic vein using the thumb just below the elbow. Note the angle of catheter placement at 30°.

Figure 2. The operator placing their thumb adjacent to the vein to prevent any movement of the vein.

Figure 3. Introducing the catheter with the bevel facing upwards until blood is seen in the catheter and slowly removing the stylet once the whole catheter is in.

Maintenance and complications

The intravenous catheter site should be dressed and monitored for any indications of inflammation or infection daily. If a catheter bung is placed, the catheter should ideally be flushed with saline every 4–8 hours to maintain patency (Haskey, 2016). There is no evidence to suggest that heparinised saline is more effective than saline (Mathews, Brooks, & Valliant, 1996; Ueda, Odunayo, & Mann, 2013).

It is recommended that catheters should be replaced every 72 hours as previous studies have shown that greater dwell time beyond the 72 hours increases the risk of IV catheter infection in dogs (Mathews et al., 1996; Haskey, 2016).

A common complication associated with catheters is inflammation caused by infection and/or mechanical irritation of the catheter. Complications were seen in 27–70% of human catheter placement patients (Maki, Ringer, & Alvarado, 1991).

Other complications seen are air embolism as a result of air in catheters or giving sets prior to or during placements causing pulmonary oedema and respiratory distress. Excessive bleeding internally at the site could lead to the formation of a haematoma. Sepsis (localised bacterial infection) and thrombophlebitis (clot formation) are factors associated with complications requiring vigilance and care with monitoring (Tan et al., 2003; Weil, 2006), all of which can be prevented through the step-by-step approach to technique, sterility of placement and maintenance of the catheter site.

Inspection of the site should ideally be every 6 hours to coincide with parameter monitoring during ward rounds. This differs depending on whether the catheter is in use; checks should be more frequent when it is not in use compared to those used for constant fluid therapy. This would ensure patency, sterility of site, removal of wet or soiled bandages and prevention of swelling potentially caused by tight taping (Ashby, 2017).

It would be of benefit to include the use of the Ward Phlebitis Scoring Chart (WPSC) as part of a nursing evaluation of each catheter placement to ensure appropriate action is taken if any swelling or infection occurs as a result (Ward, 2018).

It has been noted that skin and hair are factors which harbour bacteria so appropriate aseptic skin preparation, systematically using the appropriate antimicrobial agent after hair removal will reduce the incidence

of local thrombophlebitis (Smallman, Burdon, & Alexander-Williams, 1980; Tan et al., 2003).

A peripheral venous catheter care bundle checklist is an ideal tool to aid as a monitoring process and will aid any nurse aiming to have a good outcome from indwelling catheter placements which covers all elements of catheter care in relation to indwelling time over a set period such as 24 hours and 48 hours of placement. This was developed by Sarah Hancill RVN and this is available through the RCVS Charitable Trust (Hancill, 2013).

Further studies would be beneficial from areas relating to the use of medetomidine as a common agent used in anaesthetic or sedation protocol as this could have an adverse effect on the placement of catheters due to venous vasoconstriction, and the significance of this combined with technique and equipment used are all factors in patient compliance and ease of application (Chebroux, Leece, & Brearley, 2015).

Summary

The key element for peripheral catheter placement is dependent on:

1. Sufficient equipment preparation and consumables including appropriate choice of catheter
2. Suitable catheter site
3. Competence and confidence in yourself to introduce a catheter
4. Appropriate handling and restraint
5. Hand hygiene using the WHO method and sufficient PPE equipment
6. Adequate aseptic site preparation
7. Peripheral venous catheter care bundle checklist is an invaluable tool to aid monitoring processes
8. Post placement monitoring protocol (example: the Ward Phlebitis Scoring Chart)
9. Patient benefits for the purpose of the catheter placement

Disclosure statement

No potential conflict of interest was reported by the author.

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Multiple Choice Questions

1. Provided no signs of phlebitis are observed, IV catheters should be replaced:

- **(a)** After 72 hours
- **(b)** After 72-96 hours
- **(c)** Between 24 and 72 hours

2. Haematomas at the site of insertion can be minimised by:

- **(a)** Careful site selection and preparation
- **(b)** Use of sedation for catheter placement, if necessary
- **(c)** Care when advancing the stylet
- **(d)** Use of the Ward Phlebitis Scoring chart

3. Factors to consider when selecting a site for catheter placement are:

- **(a)** Ease of visualisation of vessel
- **(b)** Possibility of contamination
- **(c)** Ability to adequately secure the catheter
- **(d)** Need for aseptic preparation

4. Which step is not part of the aseptic approach?

- **(a)** Aseptic preparation of site using antimicrobial agent
- **(b)** Monitoring after 72 hours
- **(c)** Handwashing and open gloving technique
- **(d)** Complete fur removal

5. You are asked to administer a 10mL/kg fluid bolus to a 28kg dog on a gravity drip. Suitable catheter sizes include:

- **(a)** 22G, 20G, 18G
- **(b)** 20G, 18G
- **(c)** 24G, 22G, 20G
- **(d)** 18G

6. Monitoring of an IV catheter site should include:

- **(a)** Rebandaging
- **(b)** Assess patency
- **(c)** Assess for swelling and/or infection
- **(d)** Consider use of a scoring chart or bundle
- **(e)** All of the above

For the answers to the MCQs, please go to: **http://www.bvna.org.uk/publications/veterinary-nursing-journal**