A comparative study of disinfecting catheter caps and their effectiveness in the reduction of equine IV catheter-related thrombophlebitis

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ABSTRACT: The aim of this study was to identify whether the use of disinfecting catheter caps reduced the incidence of catheter-related thrombophlebitis in equine patients. Also of interest was if they minimised the long-term incidence of thrombophlebitis in equine patients with indwelling intravenous over-the-wire catheters. This was a retrospective pilot study, which involved 40 equine patients from 2012 and 40 equine patients from 2013. The results of the study showed a reduction in the number of patients that suffered from thrombophlebitis in the year 2013. The *p*-value (calculated probability) test for difference was 0.071; due to the number being larger than 0.05, this indicated there was a borderline significance and that the study could have been slightly underpowered. This led to the conclusion that disinfecting catheter caps reduced the rate of thrombophlebitis in the intravenously catheterised horse, thus supporting the researcher's hypothesis.

Introduction

There have been many developments in human medicine with advanced intravenous catheter care. Comparing human-centred and veterinary research, this study was based on implementing disinfecting catheter caps to see if they reduced the rates of thrombophlebitis within the veterinary hospital.

Disinfecting catheter caps contain alcohol and twist onto intravenous (IV) access ports for disinfection and protection. The caps disinfect within a minute of contact and are effective for 7 days if used correctly, effectively reducing the rate of central line-associated bloodstream infections (Ivera Medical Corporation, 2014)

Sitges-Serra et al. (1997) collated human research and demonstrated that disinfecting catheter caps used in human hospitals reduced thrombophlebitis statistics by a staggering 90%. Ramirez, Antonina, and Welch (2012) showed that disinfecting catheter caps reduced infection rates from 1.9 in 2010 to 0.5 during a 1-year trial period the following year. Ramirez et al. (2012) state that their results indicate that the consistent use of the disinfecting catheter caps, in conjunction with strict compliance, does influence central line-associated bloodstream infections in human patients. Ramirez et al. (2012) reviewed hundreds of patients that had catheter caps, and due to the scale of this study they were able to show a 75% reduction in infection rates. With these results and research collated it was decided to see if they could benefit the equine patient.

Preserving the jugular vein integrity is extremely important in the equine patient, as this vein is used most commonly for IV access and catheterisation. Losing patency of the jugular vein can be a challenge for the veterinary team, potentially causing detrimental and permanent health problems for the patient. As a result, a less-accessible vein might have to be utilised.

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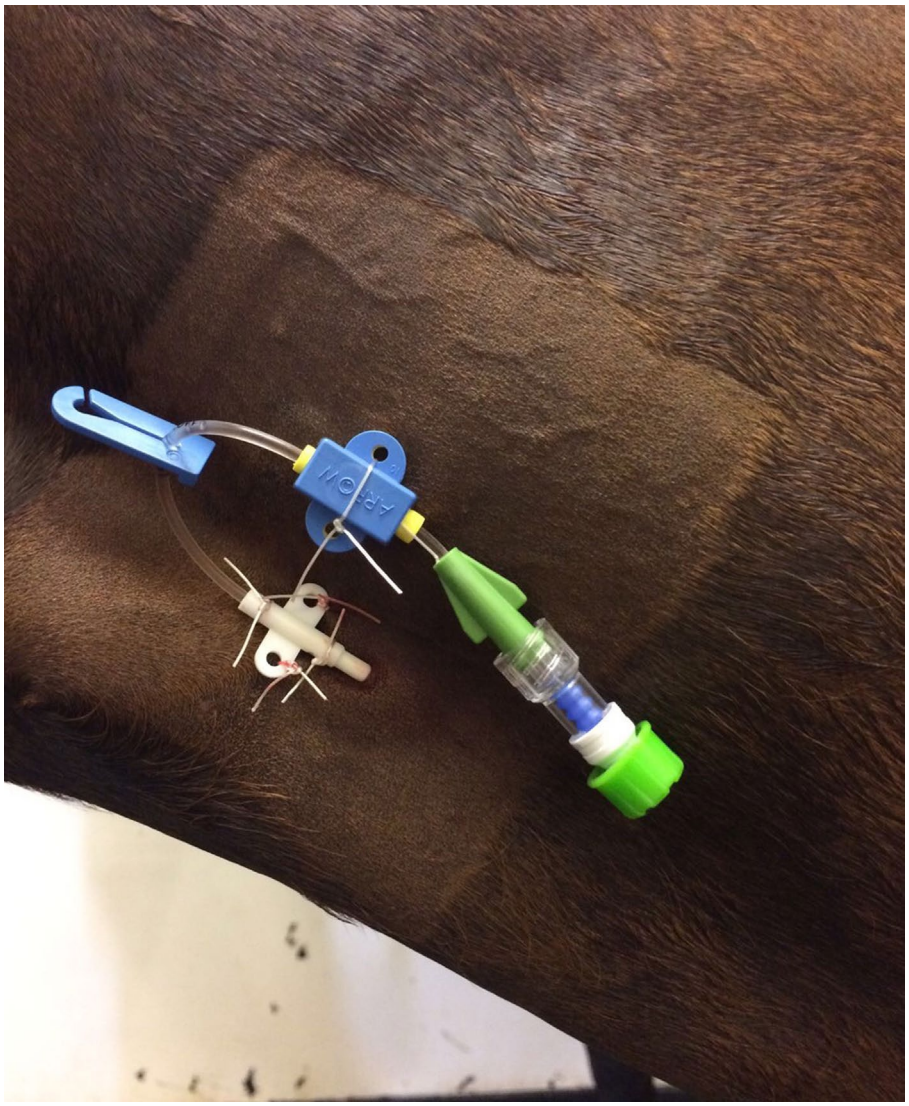

Figure 1. A jugular over-the-wire IV catheter.
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Graph 4.2: Control group

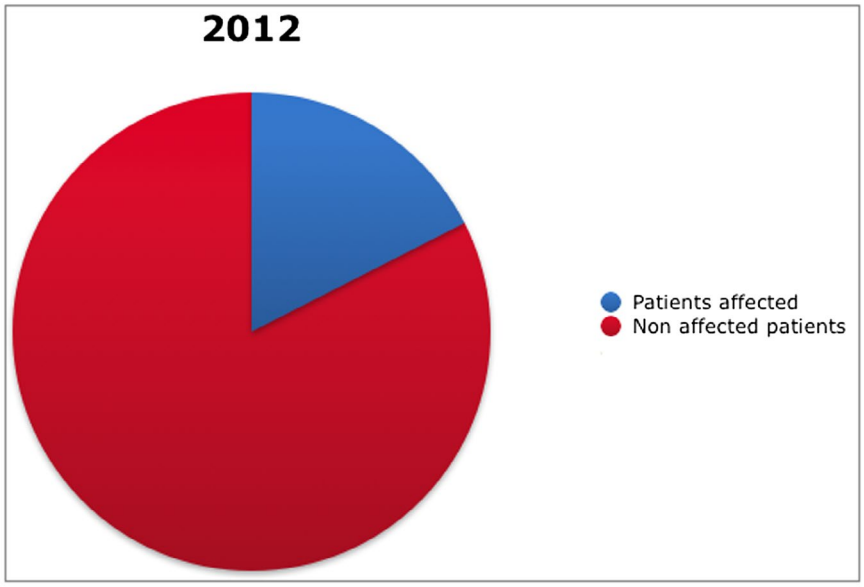

Figure 2. Control group.

In equine veterinary practice, intravenous catheter (IVC) placement is one of the most common procedures performed by the registered equine veterinary nurse (RVN) (Rippingale & Fisk, 2013). Often, the importance of this clinical procedure is underestimated, considering the frequency that it is performed. Thrombophlebitis is a relatively uncommon complication of intravenous catheter placement, but is more common and prevalent in intensive care patients (Mair & Smith, 2005). Phlebitis is defined as inflammation of the vein, while thrombophlebitis refers to thrombus formation within the vessel wall of the vein (Harold & Mckenzie, 2008).

Horses with colitis and other gastrointestinal disorders are at increased risk of developing thrombophlebitis. Interestingly, ruminants are much less prone to jugular thrombosis than horses (Hogan, 2011). Preventative management and improved catheter care would help reduce the risk considerably, especially in the high-risk intensive care patient (Rippingale & Fisk, 2013).

Technological advances in veterinary medicine have increased the expectations of staff and owners for improved nursing care within the equine veterinary hospital. Studies have yet to be investigated in the equine veterinary nursing field in relation to preventing contamination of IVCs, which initiated the idea for this study.

Young horses and patients with severe disease and compromised immunity are predisposed to developing complications associated with IVCs (Mair & Smith, 2005). Bacterial colonisation has shown to occur in 6.9–14.3% of all horses where IVCs are used. The incidence of bacterial colonisation is much higher in systemically ill horses, for example:

- Patients with pneumonia are 41% higher
- Acute abdominal crisis 48% higher
- Foals 83% higher
- Diarrhoea patients of horses 85% higher, being the most likely to have some sort of bacterial colonisation

(Tan, Dart, & Dowling, 2003).

The main cause of contamination is through the catheter cap itself, so preventative measures such as hand washing, wearing disposable gloves, changing lines according to practice standards, covering the insertion site of the IVC and implementing disinfecting catheter caps can significantly reduce the rates of infection (Sitges-Serra et al., 1997).

Table 1. Control group

Year	Patients affected	Non-affected patients
2012	7 (17.5%)	33 (83%)

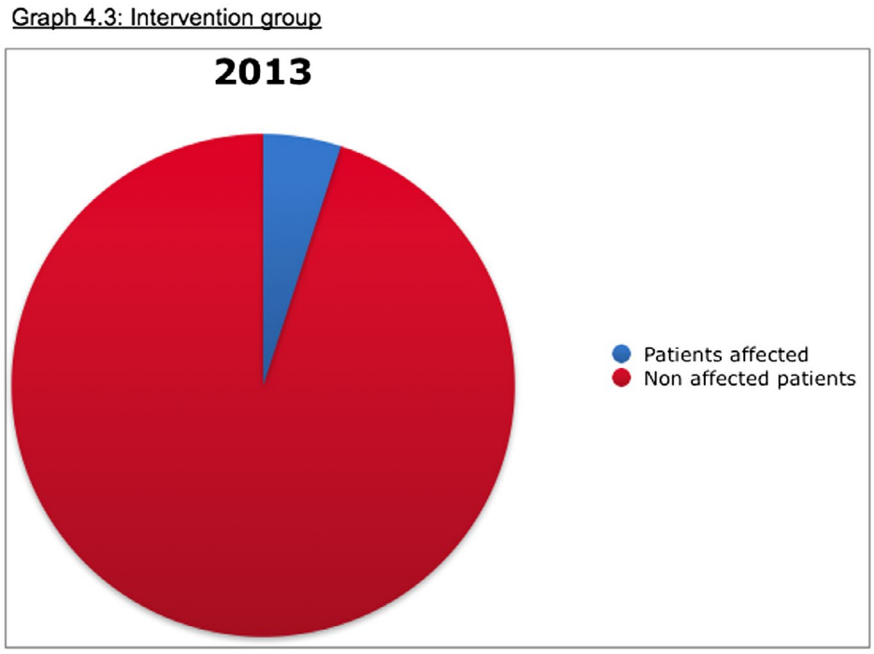

Figure 3. Intervention group.

Table 2. Intervention group

Year	Patients affected	Non-affected patients
2013	2 (5.0%)	38 (95%)

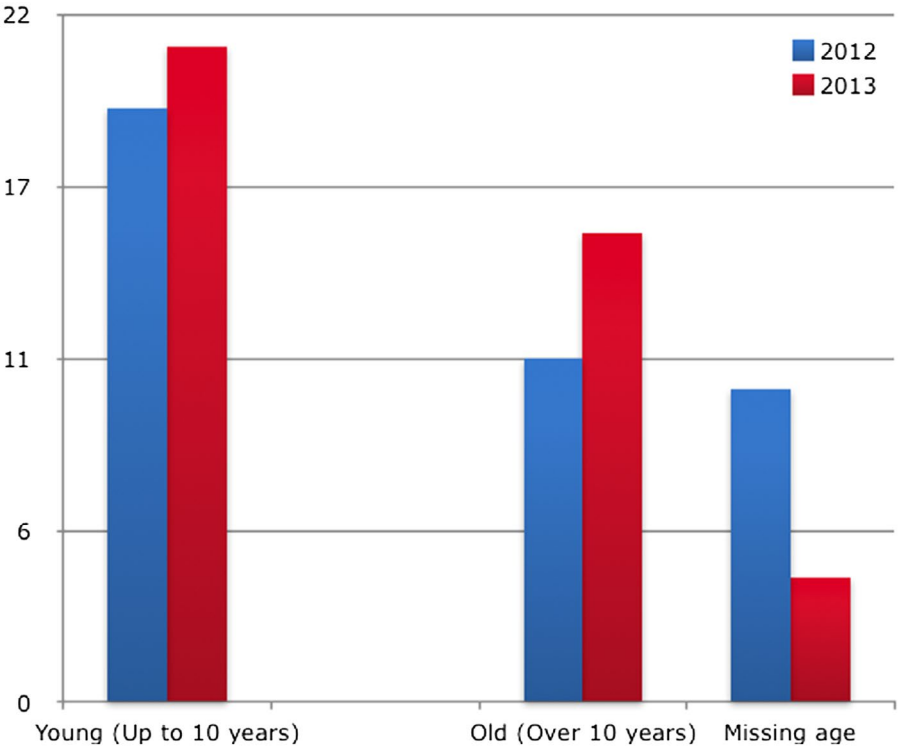

Figure 4. Characteristics of horses in the two groups.

There is an extensive range of IVCs available for equine use, all with differing properties and indications. This must be taken into account when selecting an appropriate IVC for individual patients. Teflon IVCs are more likely to kink due to their rigidity and are more thrombogenic to the vein, which is why they are indicated for short-term use only (Hay, 1992). Over-the-wire catheters are considered the gold standard of IVCs. They are less thrombogenic and are made from polyurethane or silicone (Rippingale & Fisk, 2013). The flexibility of these IVCs is by far the best and the least traumatic to the lumen of the vein. This catheter type is the optimal choice for long-term catheterisation in the equine patient, but requires greater skill to insert than other IVCs. All these factors must be taken into consideration when weighing up the risks of introducing infection. Antimicrobial IVCs are also favourable for use in systemically ill patients due to the increased risk of endotoxaemia and septicaemia being much greater. The lumens of these IVCs are impregnated with silver sulfadiazine.

Materials and methods

The investigation was carried out by electronic random selection of data from 40 equine patients' records. These patients had IVCs placed as part of their treatment from two subsequent years: 2012 and 2013. All the data collected from 2012 were from patients catheterised intravenously with a 14 gauge over-the-wire, polyurethane, single lumen catheter. These patients did not have a disinfecting catheter cap to protect the injection port of the catheter.

The other 40 patients' data had been collected from 2013 and were also randomly selected. Only those patients that had a 14-gauge, over-the-wire, single lumen IVC placed with a disinfecting cap protecting the port were chosen. To avoid bias, patients were only selected if they had inserted the same type of IVC. Some other types of catheters can cause increased irritation to the lumen of the vein, thus increasing the chance of thrombophlebitis (Hay, 1992).

The entire control group from 2012 had 14-gauge polyurethane over-the-wire catheters placed without disinfecting catheters caps. These IVCs were left indwelling in both groups for no longer than 21 days, even though the manufacturer recommends a maximum of 28 days. The patients from 2013 had all been given a disinfecting catheter cap to protect the IVC port, compared to the control group of 2012 that had not been given the caps. The IVCs were all made from polyurethane, a less thrombogenic material

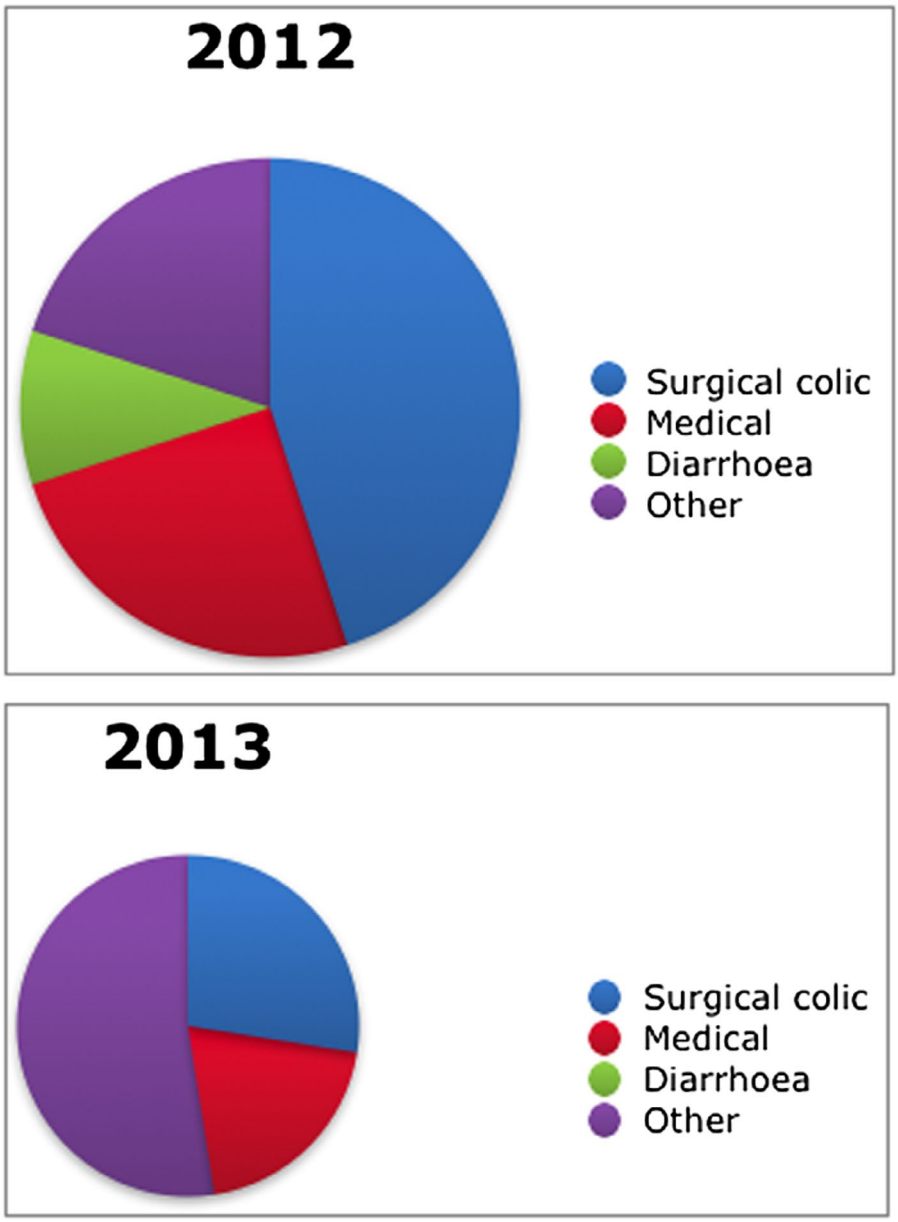

Figure 5. Conditions of horses in the two groups from both years.

Table 3. Conditions of horses in the two groups

Conditions	2012	2013	p-value
Surgical colic	18 (45.0%)	11 (27.5%)	0.113
Medical	10 (25.0%)	8 (20.0%)	
Diarrhoea	4 (10.0%)	0 (0%)	
Other	8 (20.0%)	21 (52.5%)	

compared to the Teflon™ short-stay catheters (Hay, 1992). Inclusion criteria involved any patient that had an over-the-wire catheter placed in the jugular vein in 2012 and 2013. Exclusion criteria included patients that did not have an over-the-wire catheter placed or patients that contracted a thrombophlebitis prior to intravenous catheterisation.

Jugular vein thrombophlebitis was visually identified by an RVN or a veterinary surgeon. They noted thickening, inflammation and partial or complete cording of the vein. In some cases it was identified by ultrasound to assess patency of the vein with treatment commencing promptly.

Findings

Within the control group from 2012 (without the disinfecting cap), 17.5% of patients contracted thrombophlebitis.

Within the intervention group from 2013 (with the disinfectant cap) only 5.0% of patients contracted thrombophlebitis.

The results of the study demonstrate a 12.5% reduction in infection rates between the control and intervention group. This equates to a *p*-value of 0.071, with a statistically significant *p*-value being any value below 0.05. This shows that while there is a clear reduction in the occurrence of thrombophlebitis when using disinfecting catheter caps, this is not considered to be a statistically significant reduction, with an underpowered sample size one possible cause for this. However, it does demonstrate that further research into this area with a larger sample size and more specific inclusion criteria for both control and intervention groups is needed to fully demonstrate the effectiveness of disinfecting catheter caps in reducing rates of thrombophlebitis in equine patients.

The age differences demonstrated between the two groups, in both years, showed the number of young horses seen was slightly higher than that of the older horses. In 2012, 66.3% and in 2013, 58.3% of young horses were treated, showing a similar value in subsequent years.

This was most likely due to the hospital's caseload being predominantly young thoroughbred racehorses in training. The same pattern was seen in the older horse category in 2012 (33.7%) and 2013 (41.7%). This roughly demonstrated the same amount of young and aged horses were seen in both years, but showed a slight increase in aged horses in 2013. The *p*-value is greater than 0.05, which indicated that there was no significant difference seen given a *p*-value of 0.678.

Surgical colic was the most represented condition in 2012 with 45% requiring an over-the-wire IVC. In 2013 the 'other' categorised patients were the most represented with 52% of the group getting over-the-wire IVCs.

The *p*-value identified the study had borderline significance. The results did show a reduction of the amount of patients affected by thrombophlebitis and the difference in infection rates from 2012 to 2013 was 12.5%

This demonstrated a significant decrease of infection rates when disinfecting catheter caps were implemented in the intervention group.

Environmental standardisation

The duration of catheterisation was not standardised in this study, this can be a significant factor predisposing the patient to thrombophlebitis (Hay, 1992). Although

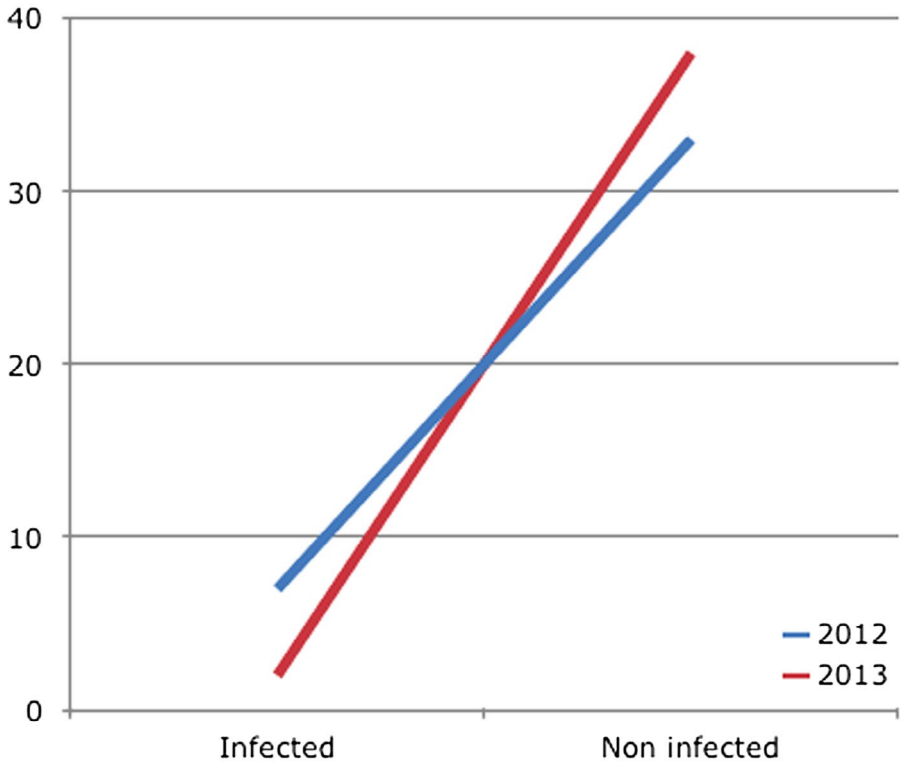

Figure 6 Numbers of infections in the two groups.

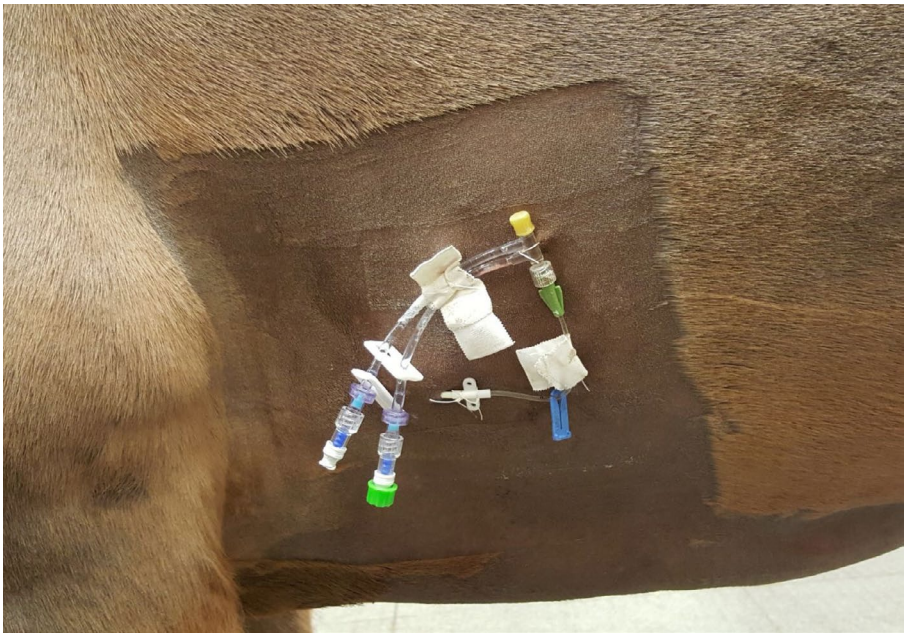

Figure 7 Lateral thoracic intravenous catheter. © Bonny Millar

duration of an IVC is important, long-stay IVCs have a time limit on how long they should be left *in situ*. If a long-stay IVC has been in place longer than 21 days, practice policy is to remove it and, if needed, replace it in an alternative vein.

The temperament of the patient was not considered in the study. The disposition can be a significant predisposing factor to thrombophlebitis for several reasons: including excessive movement, rubbing catheter sites against a contaminated environment and self-mutilation (Hay, 1992). These are all factors that increase the risk of thrombophlebitis by trauma to the vein.

Conclusion

IVCs can act as a focal point that provides access for bacteria to enter the patient's body, putting patients at risk from localised and systemic infections. Sepsis through catheter cap neglect is something that can be minimised through effective nursing care and impeccable aseptic technique (Leonidou & Gogos, 2010). There is a great deal of research regarding thrombophlebitis and the diseases that predispose a patient to the condition. However, there is limited research outlining the environmental factors that can attribute to equine thrombophlebitis.

Intravenous catheter sepsis is a disconcerting complication in veterinary medicine. Much can be learned from human nursing and adapted to veterinary medicine to improve the way we manage our intravenous catheter care.

Along with other major human research it does indicate that disinfecting catheter caps are a worthwhile preventative measure against the risk of thrombophlebitis. If used appropriately, it is worthwhile implementing their use in veterinary hospitals to improve intravenous catheter care, thus protecting patients from central line-associated bloodstream infections.

Carrying out research projects has become increasingly popular with RVNs (Heayns, 2012), indicating enthusiasm for further knowledge and improved standard of care. The onus is on the RVN to review literature, so they can use knowledge gained to provide up-to-date gold standard nursing care in IVC management.

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