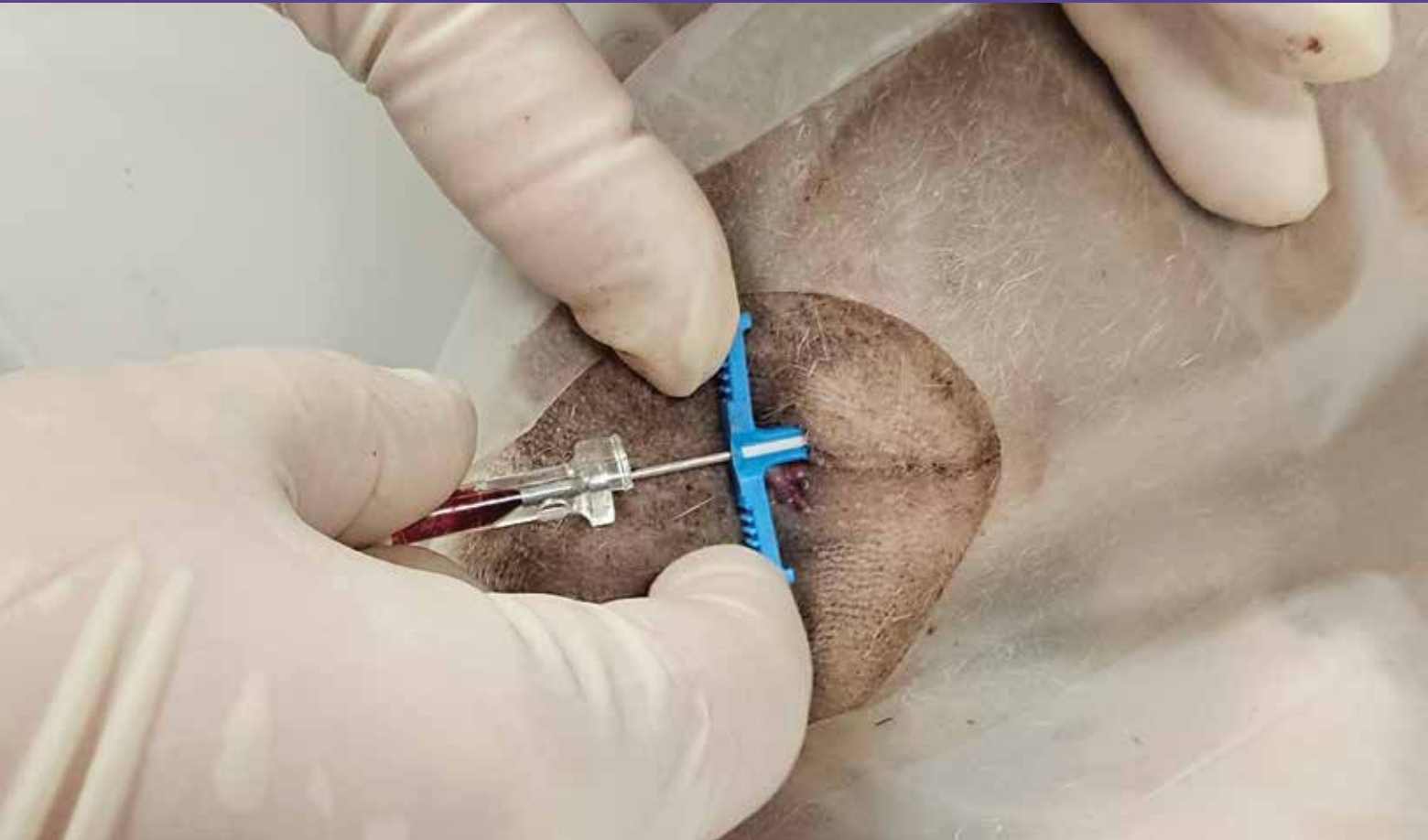




SKILLS CHECK

Placing Central and Peripherally Inserted Central Catheter (PICC) Lines

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Abstract

Central venous catheters (central lines and peripherally inserted central catheters) play a vital role in the management of critically ill veterinary patients. Either the modified Seldinger or the peel-away technique can be used for placing central venous catheters; with training and practice, veterinary nurses and technicians can use them to enhance patient care in emergency and intensive care settings.



Take-Home Points

- Central and peripherally inserted central catheter (PICC) lines can enhance the care of patients who need frequent venous blood sampling, hyperosmolar or multiple incompatible medications, central venous pressure measurements, or parenteral nutrition.
- Aseptic technique when placing and handling central and PICC lines is crucial because they are typically left in place much longer than peripheral intravenous catheters.
- A solid understanding of anatomy and placement techniques can reduce anxiety around central and PICC line use.

A central line is a long-line catheter placed in a central vein, such as the jugular vein, and fed into the central circulation via the cranial vena cava. A peripherally inserted central catheter (PICC) line is placed in a peripheral vein, such as the saphenous vein, and fed into the central circulation via the caudal vena cava (**FIGURE 1**).

INDICATIONS

Central and PICC lines are indicated for administration of medications with osmolarity of >600 mOsm/L, such as dextrose $>10\%$ (maximum through a peripheral vein is 10%), or medications with a high risk of causing phlebitis/thrombophlebitis should they be extravasated,¹ such as vasopressors. Many lines have multiple lumens for delivery of several or incompatible medications. They are ideal for patients that require frequent blood sampling (e.g., patients with diabetic ketoacidosis, parvovirus infection, or hypoglycemia). Central lines inserted into the jugular vein also enable measurement of central venous pressure and administration of parenteral nutrition.²

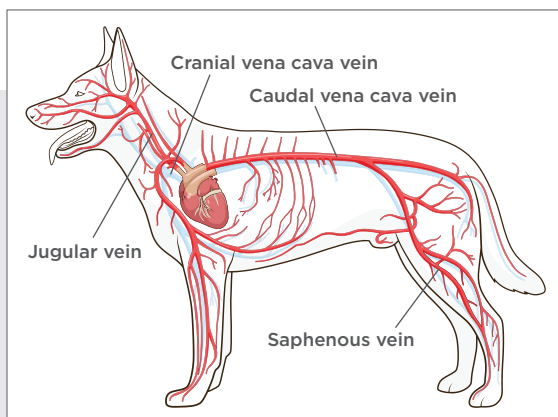


FIGURE 1. Venous circulation in a dog.

CONTRAINDICATIONS AND COMPLICATIONS

Contraindications and complications of central and PICC lines are similar in many respects but differ in others.

Contraindications

Central line contraindications include skin infection over the desired insertion site, increased intracranial pressure, or suspected or confirmed bleeding disorder. PICC line contraindications include skin infection over the desired insertion site, edema, mobility at the site, frequent urination, or diarrhea.³

Complications

Central line complications include arrhythmias secondary to placement, phlebitis, embolism, bleeding, and/or infection. PICC line complications include phlebitis, embolism, bleeding, and/or infection.⁴

TECHNIQUES

Many techniques can be used for inserting central and PICC lines. This article discusses the modified Seldinger and peel-away techniques. The modified Seldinger technique uses catheterization, guidewire placement, vessel dilation, and line insertion. The peel-away technique involves placing an introducer catheter, inserting the line, then “peeling away” the introducer.

Although both techniques can be used for central and PICC lines, for clarity the author describes the modified Seldinger technique for central lines and the peel-away technique for PICC lines. Both techniques begin with the same first 7 steps.



Shared Foundational Steps

STEP 1: Initiate sedation and monitoring as appropriate for the patient (i.e., have staff/multiparameter monitor available).

STEP 2: Position the patient in lateral recumbency.

STEP 3: Shave over the desired vein to be used.

- Central lines
 - **Dogs and cats:** From mandible to thoracic inlet
- PICC lines
 - **Dogs:** Lateral saphenous vein
 - **Cats:** Medial saphenous vein



VIDEO 1

Central line placement using the modified Seldinger technique. The video starts immediately after the intravenous catheter has been placed.



VIDEO 2

Bleeding each line after central line placement.



FIGURE 2. Measuring the guidewire for the modified Seldinger technique.

STEP 4: To determine the correct location, don examination gloves, hold off the vein, and palpate/visualize the site of insertion (which if too high or low may cause problems with insertion), securing the site and patient comfort.

STEP 5: Still wearing the examination gloves, use aseptic technique to prepare the insertion site.

STEP 6: Open the kit and verify that all needed parts are present.

STEP 7: The person placing the catheter should don sterile gloves, and the assistant, wearing examination gloves, holds off the vein far above the venipuncture site.

Secondary Steps Specific to the Modified Seldinger Technique

The modified Seldinger technique is used for placement of a central line in the jugular vein. Follow the first 7 steps under **TECHNIQUES** and then the steps below. See also **VIDEOS 1 AND 2**.

STEP 8: Measure the guidewire (keeping it sterile) from the planned entry site to the 3rd to 4th intercostal space, and visually note the location on the guidewire. Lines are marked on the guidewire to help track the length inserted (**FIGURE 2**).⁵

STEP 9: Keeping it sterile, measure the central line from the planned entry site to the 3rd to 4th intercostal space (to the right atrium), and visually note the centimeter mark on the central line, or use a tape measure if available in the kit.



FIGURE 3. Cutdown in the modified Seldinger technique.



STEP 10: Remove the drape window, if needed, and place the drape on the patient, putting the desired entry point in the center of the fenestration.

Note: Visualization can be difficult after draping—be diligent in selecting a spot.

STEP 11: To facilitate initial catheter placement, perform a cutdown over the desired entry point (**FIGURE 3**). **Note:** A larger cutdown can be performed if needed for visualization.

STEP 12: Have the assistant hold off the vein at the jugular furrow with a sterile-gloved hand under the drape (**FIGURE 4**).



FIGURE 4. Holding off at the jugular furrow to visualize the jugular vein during the modified Seldinger technique.



FIGURE 5. Inserting the intravenous catheter during the modified Seldinger technique.

STEP 13: Insert the catheter at the desired location; when blood appears, advance the catheter and remove the stylet. The restraining assistant can then stop holding off the vein at the jugular furrow (**FIGURE 5**).

STEP 14: Straighten out the J hook (**FIGURE 6**) and plug the guidewire housing set into the catheter (**FIGURE 7**). Advance the wire to the predetermined estimated mark (guidewires have single or double line marks to help notate desired insertion site). To avoid inadvertently losing the wire inside the patient, do not advance more than two-thirds of the wire into the patient. Do not at any point let go of the guidewire (a case of a guidewire accidentally lost in a patient led to it being surgically retrieved⁶).

STEP 15: Remove the guidewire housing, leaving the guidewire in place (**FIGURE 8**). **Note:** Be cautious to keep the wire sterile and not let go of it.⁷

STEP 16: Remove the catheter, leaving only the guidewire in place (**FIGURE 9**).

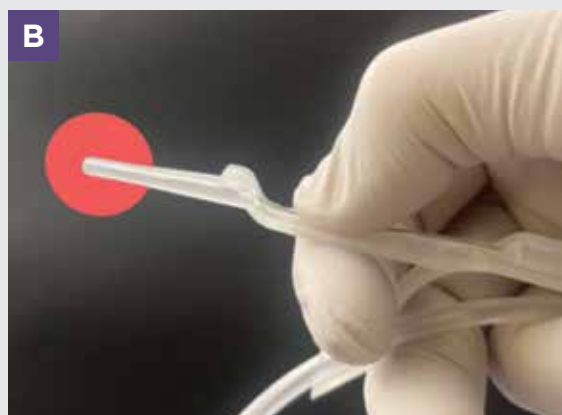


FIGURE 6. J hook (**A**) outside of the housing and (**B**) pulled back into the housing for the modified Seldinger technique.



FIGURE 7. Connecting the guidewire housing to the intravenous catheter during the modified Seldinger technique.

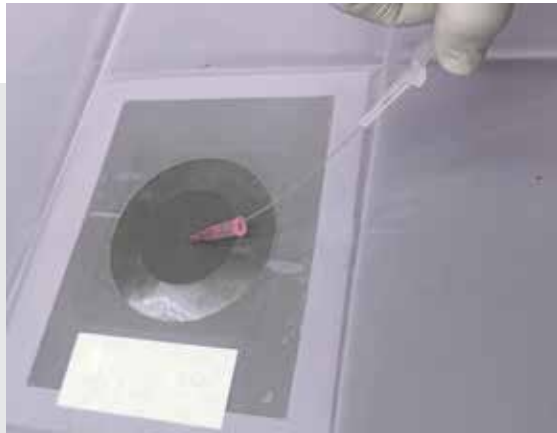


FIGURE 8. Removing the guidewire housing, leaving the guidewire in place, during the modified Seldinger technique.

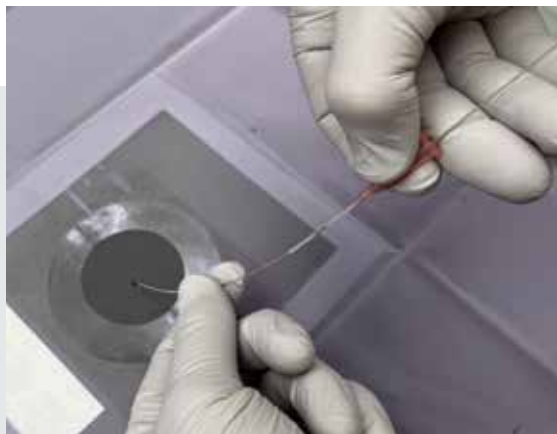


FIGURE 9. Removing the intravenous catheter, leaving the guidewire in place, during the modified Seldinger technique.

STEP 17: Fully feed the dilator into the vessel with a slight twisting motion, until the hub has reached the skin, and then remove the dilator (**FIGURE 10**). It will take more force than you might expect. For ease of insertion, hold the dilator close to the skin.

STEP 18: After removing the dilator, hold gauze over the site to stop bleeding.



FIGURE 10. Feeding the dilator (**A**) over the guidewire and (**B**) into the vessel, and (**C**) removing the dilator from the vessel during the modified Seldinger technique.



STEP 19: Feed the central line over the wire to the desired location. The wire will come out of the brown distal port. The assistant should watch for the wire to unclamp it and reclamp it as soon as it has passed (**FIGURE 11**).

STEP 20: To avoid air embolism, bleed each line, then flush with saline from the patient's dedicated bag (**FIGURE 12, VIDEO 2**). **Note:** Consider blood loss and the size of the patient.

STEP 21: Place 2 caps on each line, each of which should have a Luer lock port and a cap on top of it.



FIGURE 11. Feeding the central line over the wire during the modified Seldinger technique.



FIGURE 12. Bleeding each line during the modified Seldinger technique.

STEP 22: Place a temporary securing bandage over the line and transport the patient to radiology.

Note: Placing central lines while in the radiology suite (instead of before) decreases the risk for inadvertent line removal.

STEP 23: Take lateral (**FIGURE 13**) and ventral/dorsal views from the neck to the xiphoid process.

Radiographs are recommended to confirm placement in front of the right atrium. If the line is too far in, back it out slowly, taking additional radiographs. Pull the line out in increments. Do not insert the line after it has been pulled out as it would no longer be sterile.

STEP 24: It is best to unwrap the bandage manually before suturing in place. If cutting the bandage, be careful not to cut any lines.

STEP 25: After catheter positioning is correct, suture each butterfly wing in place with a single interrupted pattern and tightly around both indentations of the hub to secure the line in place (**FIGURE 14**).



FIGURE 13. Central line (**A**) incorrect position and (**B**) correct position during the modified Seldinger technique.



Note: Depending on the length, you may need to use butterfly extenders and secure 1 or both ports.

STEP 26: Place a Tegaderm dressing or Telfa pad over the insertion site and bandage with rolled cotton and elastic wrap. Leave the ports out and tape them to the elastic wrap to create a secondary source of tension (**FIGURE 15**).

STEP 27: Label ports with tape (e.g., IVF [intravenous fluids], FLK [fentanyl, lidocaine, ketamine constant-rate infusion], insulin, sampling, alfaxalone).

Secondary Steps Specific to the Peel-Away Technique

The peel-away technique is used for PICC line placement in a peripheral vein. Follow the first 7 steps under **TECHNIQUES** and then the steps below.

STEP 8: Measure the PICC line (keeping it sterile) from the planned entry point to just past the femoral head (to the caudal vena cava). Visually note the cm

mark on the PICC line or use the provided tape measure.

STEP 9: Clamp each line to avoid air embolism.

STEP 10: Remove the drape window, if needed, and place the drape on the patient, putting the desired entry point in the center of the fenestration (**FIGURE 16**).

STEP 11: Perform a stab incision over the desired entry point with the blade facing toward the ceiling (optional).

STEP 12: Have the assistant, wearing examination gloves, hold off the vein above the stifle.

STEP 13: Insert the catheter at the desired location; when blood appears, advance the catheter and remove the stylet (**FIGURE 17**). The assistant then stops holding off above the stifle.

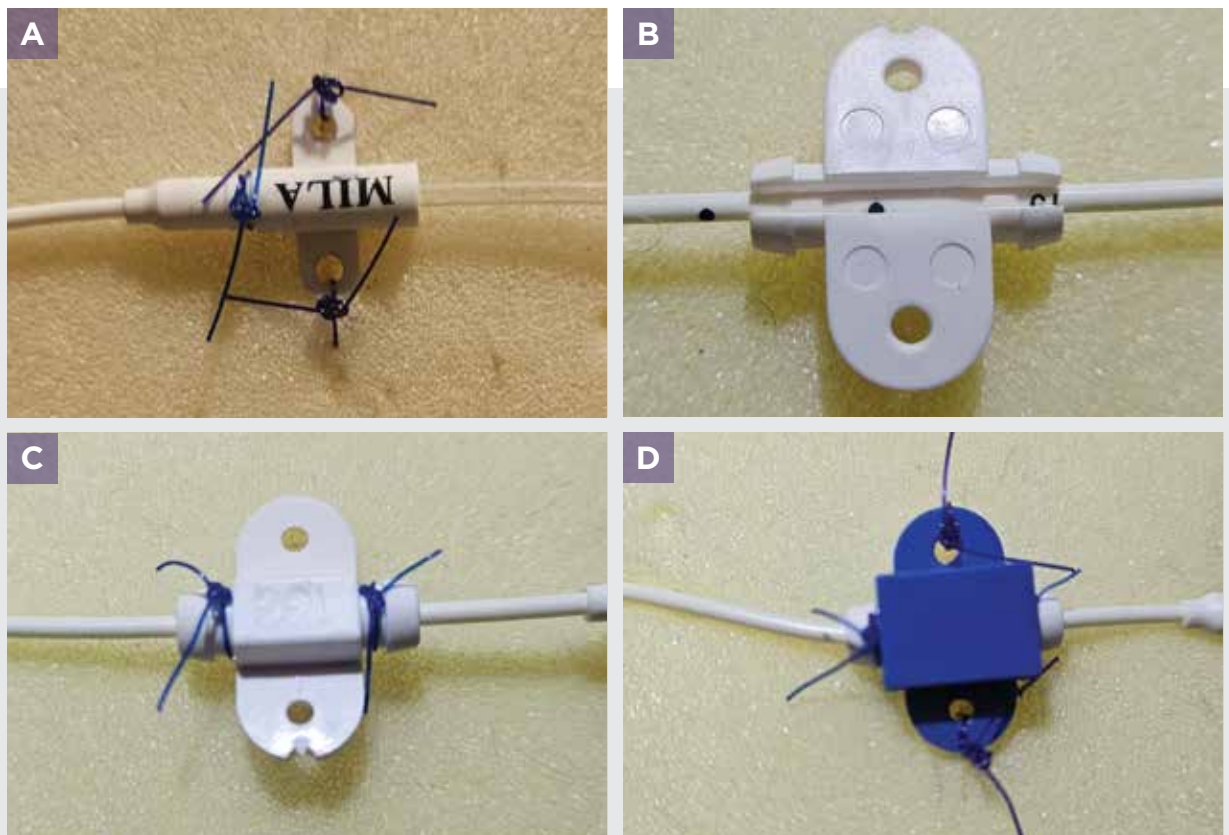


FIGURE 14. Suturing the central line after placement using the modified Seldinger technique.



STEP 14: Feed the PICC line into the catheter to the measured location (**FIGURE 18**).

STEP 15: Place 2 caps on each line. Each line should have a Luer lock port and a cap on top of it.

STEP 16: “Peel away” the catheter and remove it (**FIGURE 19**).

STEP 17: After the line is secured (with a single interrupted pattern, tightened around both indentations of the hub), place a Tegaderm dressing or Telfa pad over the insertion site and bandage with rolled cotton and elastic wrap. Leave the ports out and tape them to the elastic wrap to create a secondary source of tension (**FIGURE 20**).



FIGURE 15. Bandage over the central line site, leaving the ports out, after placement using the modified Seldinger technique.



FIGURE 16. Drape placed over the lateral saphenous vein in a dog, preparing for the peel-away technique.



FIGURE 17. The introducer catheter is (A) placed and then (B) the stylet is removed during the peel-away technique.



FIGURE 18. Feeding the PICC (peripherally inserted central catheter) line into the introducer catheter during the peel-away technique.



Flushing should be performed every 4 hours, with at least the priming volume of the central line (approximately 0.5 to 2 mL, depending on catheter size/manufacturer).¹⁰



STEP 18: Label ports with tape (e.g., IVF, FLK, insulin, alfaxalone, sampling).



FIGURE 19. Peeling away the introducer catheter during the peel-away technique.

SAMPLING FROM CENTRAL AND PICC LINES

Multilumen central lines ideally have a dedicated port for blood sampling. The distal (brown) port is ideal because it is the farthest from the insertion site and closest to the vena cava, but any port can be used.

Sample Collection

STEP 1: Stop any fluids running through any ports.

STEP 2: Don gloves.

STEP 3: Remove the cap, keeping it sterile.

STEP 4: Clean the port with alcohol for at least 5 seconds and let it air dry.

STEP 5: Use the push/pull method.

- Attach a 10-mL syringe with 1 mL of saline and flush the line.
- Pull 3 mL of blood and push it back into the line 3 times, then draw the sample.
- Flush the line with saline, being mindful of the volume used, using a positive-pressure pulsating technique. Flushing with heparinized saline has not



FIGURE 20. Bandage, leaving the ports out, following the peel-away technique.



been demonstrated to be superior to saline, and excessive flushing with heparinized saline could lead to coagulation disorders, although this has not been proven.^{8,9}

- **Troubleshooting:** Flushing with saline may help if you cannot get a sample. Adjusting the patient's head or leg position may help. If you still cannot get a sample, unwrap the bandage to verify that the line is still in place.

MAINTAINING CENTRAL AND PICC LINES

To maintain catheter patency, the line should be routinely flushed, especially when a port is not in use. Flushing should be performed every 4 hours, with at least the priming volume of the central line (approximately 0.5 to 2 mL, depending on catheter size/manufacturer).¹⁰ Consider the size of the patient and concerns for fluid overload. When flushing, use a saline bag dedicated for that patient, wear gloves, maintain pulsating positive pressure as you flush, and clamp the line before disconnecting the syringe.

Bandages should be unwrapped by hand once daily and the insertion site inspected for erythema, swelling, or discharge. The insertion site should be gently cleaned with chlorhexidine scrub and dried, and all ports and the line should be wiped down for at least 5 seconds with alcohol and allowed to air dry. The bandage can then be replaced.

Note that when parenteral nutrition is to be administered, unnecessary disconnection of the central line port from parenteral nutrition administration lines should be avoided to prevent contamination. If disconnection is necessary, strict aseptic technique should be followed.

SUMMARY

Although central catheter placement requires advanced technical skills and comes with potential risks, being able to correctly place catheters is invaluable for management of critical-care patients. With training and practice, the skill can enhance patient care in emergency and intensive care settings. **TVN**

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Laura is an RVT from southern California with an AS degree in veterinary technology and is working on her BASc degree at St. Petersburg College. She has 21 years of veterinary experience, the last 11 of which were in emergency medicine. Laura is a RECOVER-certified basic and advanced life support instructor and RECOVER-certified pet rescue instructor. She is the training manager at Animal Emergency Clinic in Victorville, California, and an adjunct veterinary technology instructor at Platt College in Los Angeles, California. She also co-owns Southwest Veterinary Training, which focuses on RECOVER cardiopulmonary resuscitation training for veterinary professionals and pet owners. Her passions are emergency medicine and teaching. Her goals are to achieve VTS certification in emergency and critical care, write textbook chapters, and continue presenting at veterinary conferences. During rare nonworking moments, Laura enjoys playing PS4 with her little brother; reading; listening to true crime podcasts; swimming; and hanging out with her family, husband, and their small zoo of dogs and cats.