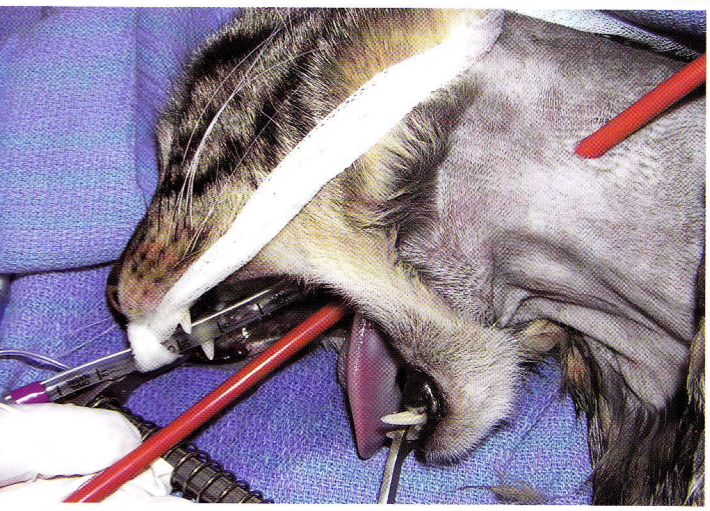
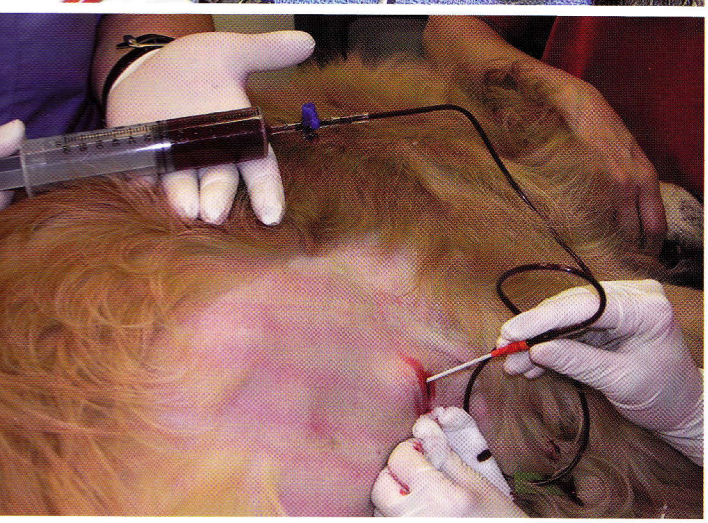
Timothy B. Hackett and Elisa M. Mazzaferro

Veterinary Emergency & Critical Care Procedures



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Timothy B. Hackett is associate professor and chief of emergency and critical care medicine at the James L. Voss Veterinary Teaching Hospital, Colorado State University.

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Dedication

I feel very fortunate spending the last 16 years doing something I love. Emergency and Critical Care Medicine has been a magnificent adventure. I'd like to thank Dr. Wayne E. Wingfield for recognizing a certain spark my first week on senior clinics and mentoring me through this emerging specialty. A heartfelt thanks to some other mentors who helped shape my career including Drs. Todd Tams, Mary Dulisch, and Debbie Van Pelt. I've been continually motivated by the Emergency/Critical Care residents with whom I've worked. Drs. Mike Lagutchik, Elisa Mazzaferro, Heather Connally, Mike Walters, Amy Butler, and Reagan Wells have taught me much more than I've taught them. Finally, a thanks to the fantastic nurses, veterinary students, and veterinarians around the country I've met over the years for whom this book is dedicated. - TBH

My life has been influenced by a series of teachers and mentors. First, for my father, Louis C. Mazzaferro, who instilled in me the importance of education and the idea to never become complacent with knowledge. Next, for Dr. Richard C. Rhodes III, my friend and mentor who demonstrated an enthusiasm for teaching that was contagious. For Dr. Wayne E. Wingfield, a founding Father of Veterinary Emergency and Critical Care, whose quiet insight and wisdom I value more than words can say. For Dr. Martin Fettman, who motivates me to reach for the stars. For Dr. Tim Hackett, who brought me to Colorado and taught me to never look back, but to constantly look ahead for whatever life has to offer. Finally, and most importantly, for my husband and soul mate, Dr. Adam Rosenberg, whose patience and understanding support me every day. - EMM

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Preface

Having prepared several emergency/critical care teaching laboratories for practicing veterinarians, it came to our attention that there weren't any texts clearly showing emergency medical procedures in a clear step-by-step approach. Thus, the concept for this text was born. The text is divided into sections. Each procedure includes a brief introduction, indications, contraindications, and necessary supplies. Each procedure is then displayed in a step-by-step format, with instructions as captions under each photograph. Helpful hints have been included to troubleshoot and make each procedure easier to perform. This material is meant to be a useful teaching tool and resource for veterinary students and veterinarians alike to improve clinical skills and save the lives of your small animal patients.

Acknowledgements

Many thanks to the veterinary nurses, interns, and residents for their assistance in performing and photographing the procedures in this textbook. Without their help and dedication, this would not have been possible.

Veterinary Emergency and Critical Care Procedures

CHAPTER 1

Vascular Access Techniques

INTRODUCTION

A variety of methods can be used for placement of peripheral, central venous, and arterial catheters. If a peripheral or central catheter cannot be placed due to small patient size, severe hypovolemia or dehydration, or hypotension, intraosseous catheters can be placed in the femur, humerus, or wing of the ileum. This chapter will discuss indications, contraindications, and methodologies listed above.

Through-the-needle catheters or over-the-wire central venous catheters can be placed in the jugular, medial saphenous, or lateral saphenous veins. The indications and contraindications for central venous catheter placement, irrespective of type, is similar.

CENTRAL VENOUS CATHETER PLACEMENT

Introduction

Central venous catheters can be placed into the jugular, lateral saphenous, and medial saphenous veins. Central venous catheters can be used for the infusion of colloid and crystalloid fluids, continuous or intermittent drug infusion, and infusion of hyperosmolar solutions including parenteral nutrition. Catheters placed into the jugular vein can be used for measurement of central venous pressure to guide fluid therapy and help avoid volume overload. An additional benefit of indwelling central venous catheters is ease of repeated blood sample collection without the need for repeated venipuncture. See figs. 1.1–1.31.

Supplies Needed

Antimicrobial scrub and solution
Central venous catheter(s)

Cotton roll gauze
Electric clipper
Electric clipper blades
Gauze 4 × 4-inch squares
Heparinized flush
Kling or gauze bandaging material
T-port
1-inch white tape

Indications

Large volume crystalloid or colloid infusion
Continuous drug infusion
Repeated blood sample collection
Infusion of parenteral nutrition or other hyperosmolar substances
Central venous pressure measurement

Contraindications

Coagulopathies
  Thrombocytopenia
  Thrombocytopathia
  Vitamin K antagonist rodenticide
Hypercoagulable States
  Hyperadrenocorticism
  Disseminated Intravascular Coagulation (DIC)
  Protein losing enteropathy
  Protein losing nephropathy
Catheters should not be placed in the jugular vein in cases of increased intraocular or intracranial pressure or thrombosis of one jugular vein.

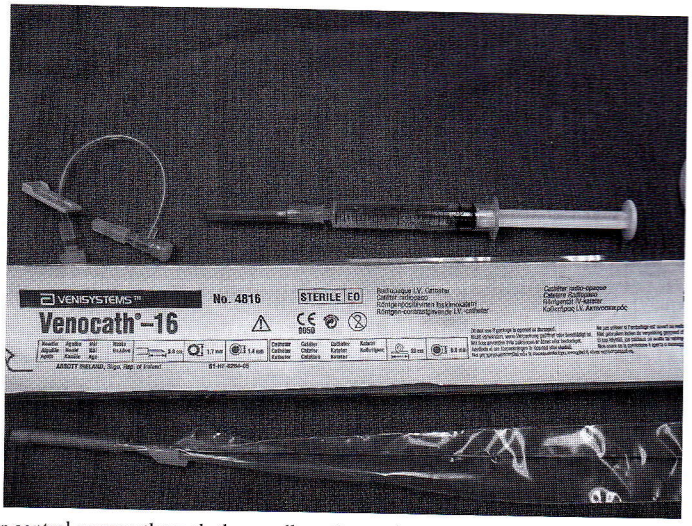

Fig. 1.1. Set up for central venous through-the-needle catheter placement. Helpful Hint: Have all components ready before restraining the patient and attempting to place the catheter.

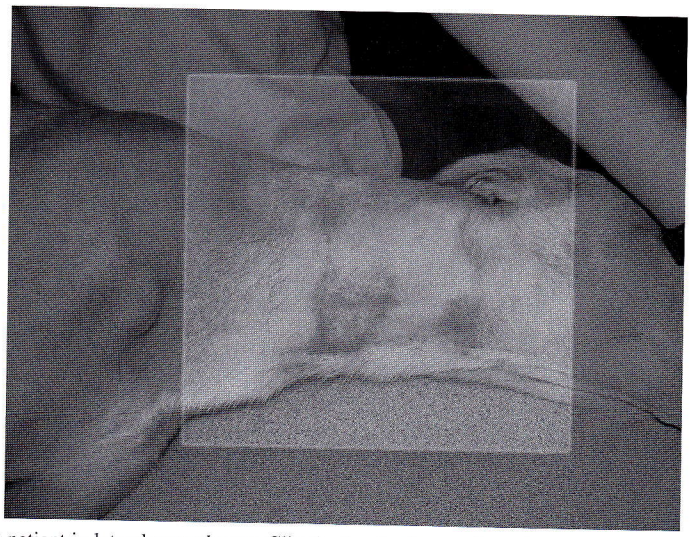

Fig. 1.2. Place the patient in lateral recumbency. Clip the jugular furrow from the ramus of the mandible caudally to the thoracic inlet and dorsally and ventrally to midline. Helpful Hint: In long-haired patients, make sure to clip the "feathers" that might lay over your field!

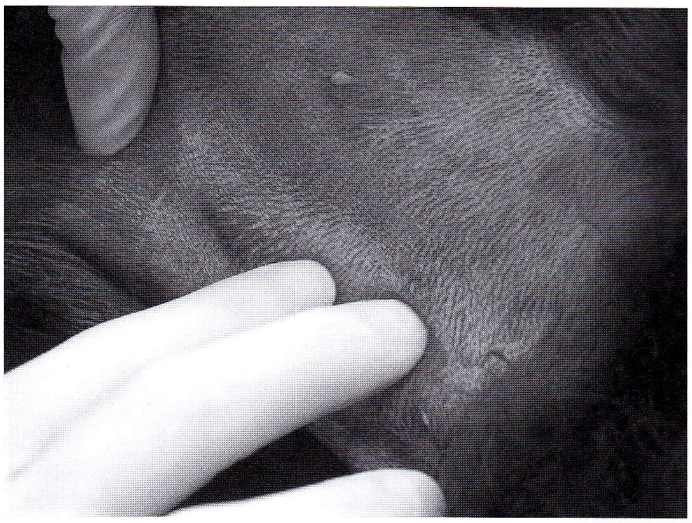

Fig. 1.3. Aseptically scrub the clipped area with antimicrobial scrub solution, then occlude the jugular vein distal to the point of insertion, and palpate the vein as it courses along the jugular furrow and choose your site of insertion. Release the pressure on the vein allowing the vessel to collapse. Helpful Hint: Be sure to remove all fur with a clean 4 × 4-inch gauze square before scrubbing.

Fig. 1.4. Insert the needle under the skin over the vein, then either you or an assistant can reocclude the jugular vein. Direct the needle over the vein at a 15° to 30° angle. Helpful Hint: It helps to "strum" the vein with the needle and watch the vein bounce in place.

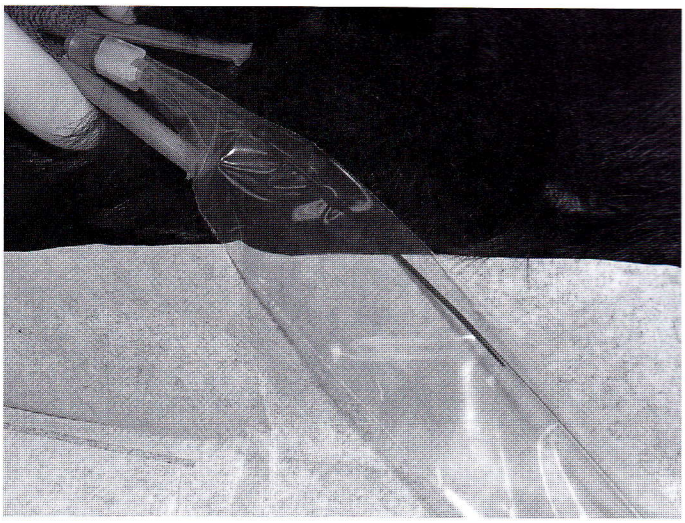

Fig. 1.5. Watch for a flash of blood coursing along the catheter. Once you see the blood, insert the catheter into the vein and remove the stylet. Helpful Hint: Sometimes it is necessary to feed the catheter into the vein off of the stylet if both won't feed together. Occasionally the catheter will begin down the vein easily but then it courses down the cephalic vein on the up leg and then stops. If this happens, withdraw the catheter 2–3 cm, hold the leg perpendicular to the table and readvance the catheter. It should now advance completely into the thoracic jugular vein.

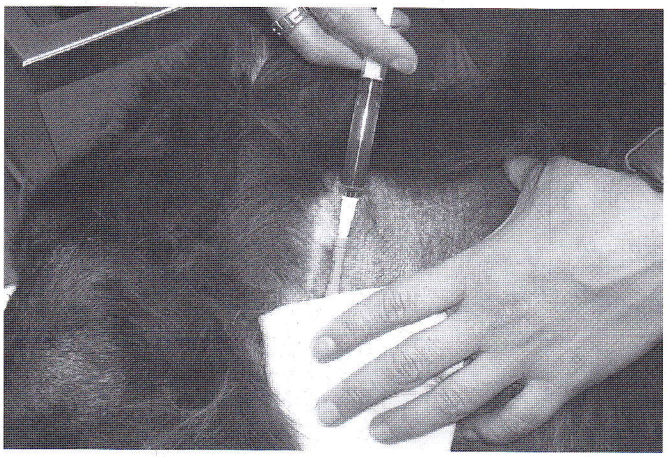

Fig. 1.6. Flush the catheter with heparinized saline solution, and tape in place.

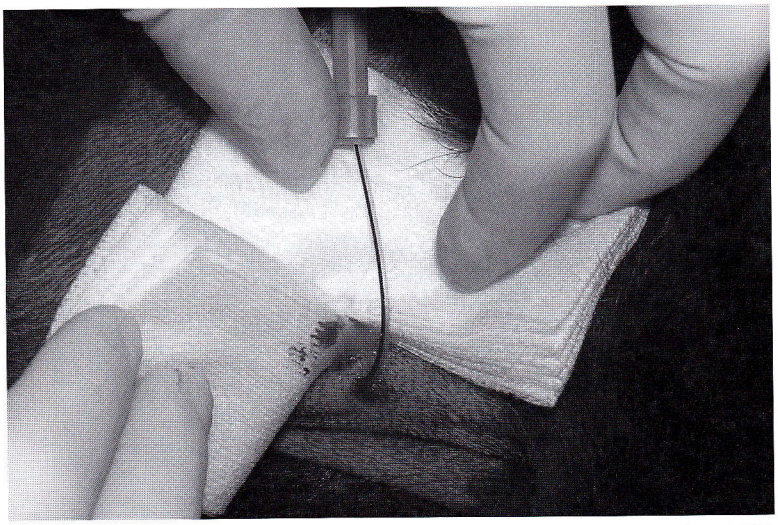

Fig. 1.7. In large dogs, remove approximately 2 inches of the catheter from the vein and make a half-loop approximately the size of a quarter. The length of catheter removed from the vessel may need to be longer in smaller patients, so that the tip of the catheter sits just outside the right atrium, for central venous pressure measurement. Helpful Hint: Make sure that you do not kink the catheter when making the loops, as it will be difficult to draw blood from the catheter.

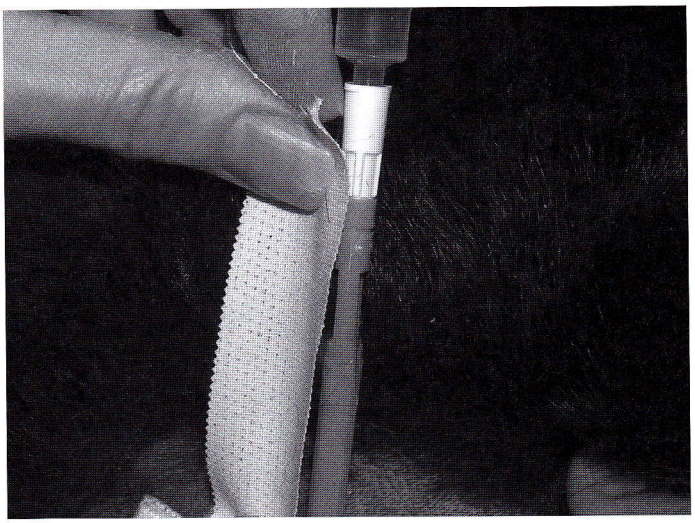

Fig. 1.8. Attach a syringe flushed with heparinized saline into the catheter hub. Helpful Hint: Secure the white piece to the blue piece with a length of 1-inch white tape, to prevent catheter disconnection.

Fig. 1.9. Place a 4 × 4-inch gauze square over the point of catheter insertion and tape it in place with lengths of 1-inch white tape, then layers of cotton bandage material and Kling. Helpful Hint: Use caution to not kink or occlude the catheter as each layer of white tape is placed.

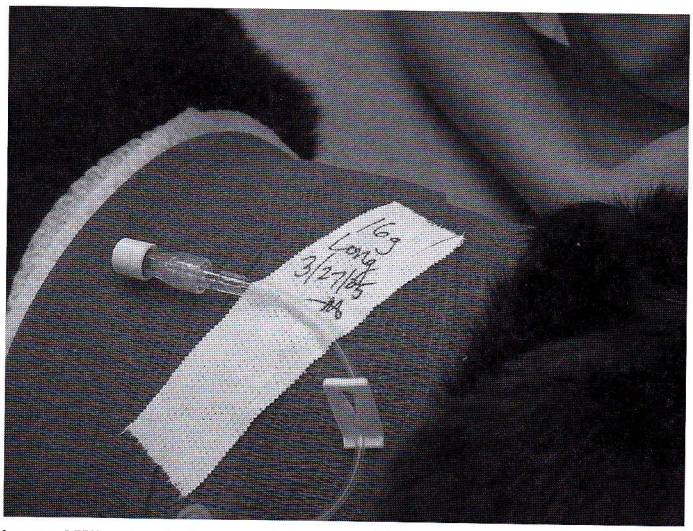

Fig. 1.10. After a layer of Kling bandaging material, cover with Elasticon or Vetrap and the catheter is ready to use. Helpful Hint: Be sure to flush the catheter and draw blood from it in between layers of tape and bandaging material, to make sure that you haven't occluded the catheter.

Fig. 1.11. Lateral saphenous vein.

Fig. 1.12. Place the patient in lateral recumbency and have an assistant restrain. Clip the distal limb circumferentially in between the stifle and the hock, over the lateral saphenous vein.

Fig. 1.13. Have an assistant occlude the vessel proximally, and visualize the vessel as it courses under the skin. Aseptically scrub with antimicrobial cleansing solution.

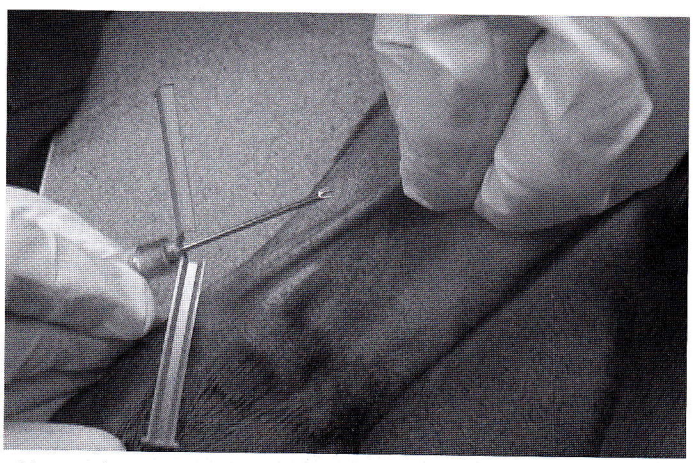

Fig. 1.14. Tent the skin over the vessel and insert the needle just under the skin, just over the lateral saphenous vein. Helpful Hint: Do not attempt to insert the needle directly into the vein until the needle is under the skin. To hold the vessel in place, pull the skin tightly around the back of the leg.

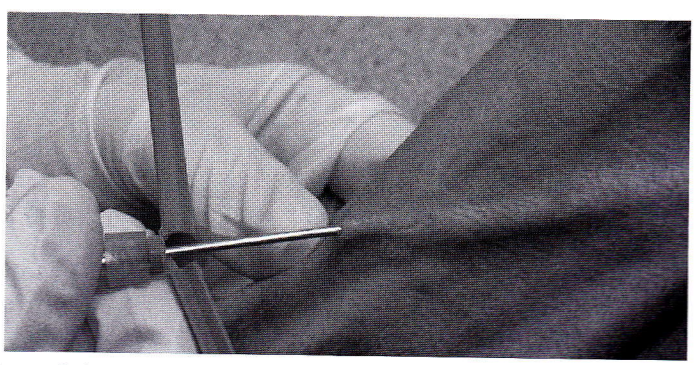

Fig. 1.15. Insert the needle into the vessel at a 15° angle, and watch for a flash of blood in the catheter.

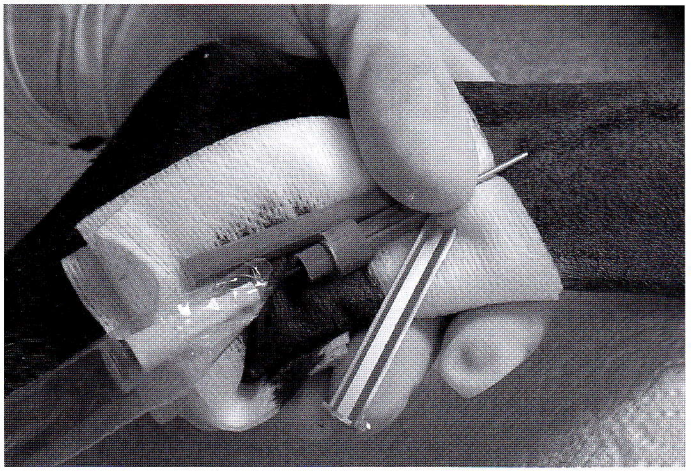

Fig. 1.16. Insert the catheter and stylet into the vessel. Helpful Hint: If the catheter doesn't feed easily, have an assistant move the limb into different positions, or feed the catheter into the vessel without the stylet in place. Don't be too forceful because the catheter can potentially kink or make a knot!

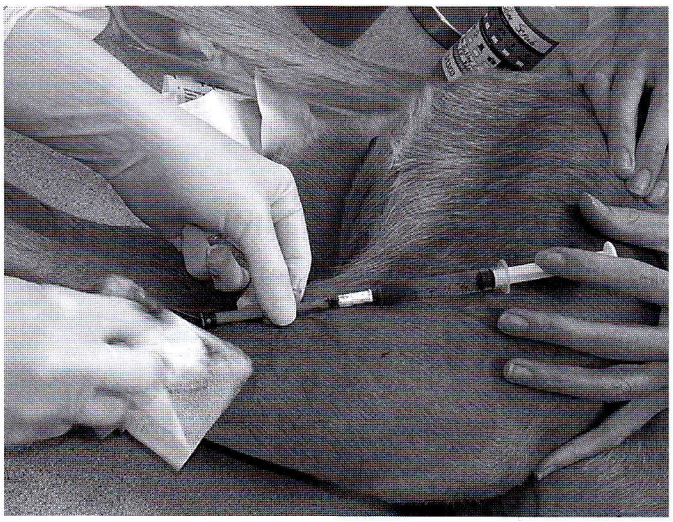

Fig. 1.17. Remove the stylet and flush the catheter with heparinized saline flush solution.

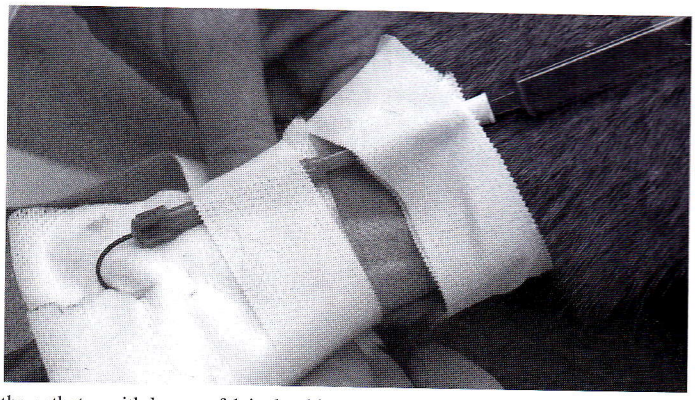

Fig. 1.18. Secure the catheter with layers of 1-inch white tape and bandaging material to secure in place and prevent catheter contamination. Helpful Hint: Make sure that the catheter draws blood and flushes easily in between layers of bandaging material.

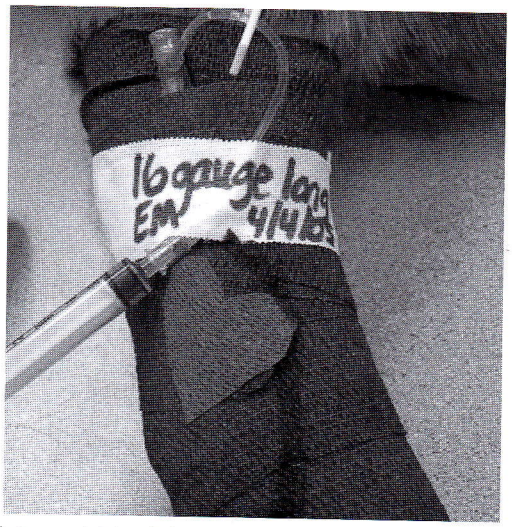

Fig. 1.19. Label catheter with type and date of placement.

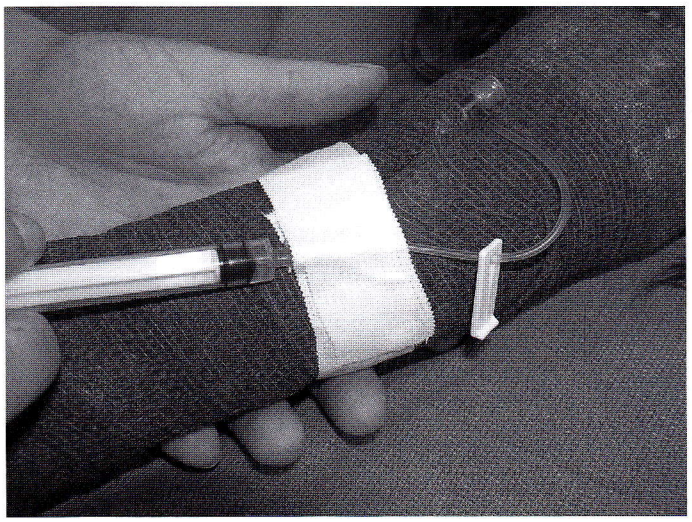

Fig. 1.20. The "three-syringe" technique should be used to remove any blood sample from any long catheter and T-port. First, flush the catheter with 1/2 ml of heparinized saline, then draw 3–6 ml of heparinized blood from the catheter. Save this sterilely, to give back to the patient.

Fig. 1.21. Place the heparinized blood sample in a secure place where it will not become contaminated while you obtain the clean blood sample.

Fig. 1.22. Draw out the amount of blood needed into a sterile syringe.

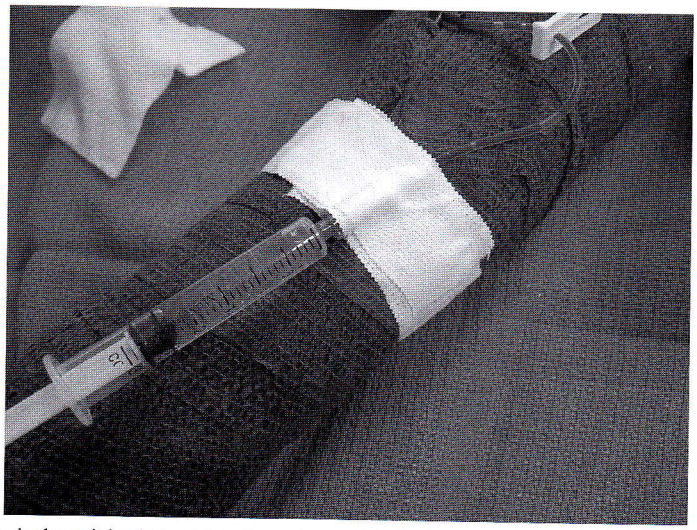

Fig. 1.23. Replace the heparinized blood into the catheter, then flush again with 3 ml of heparinized saline flush solution.

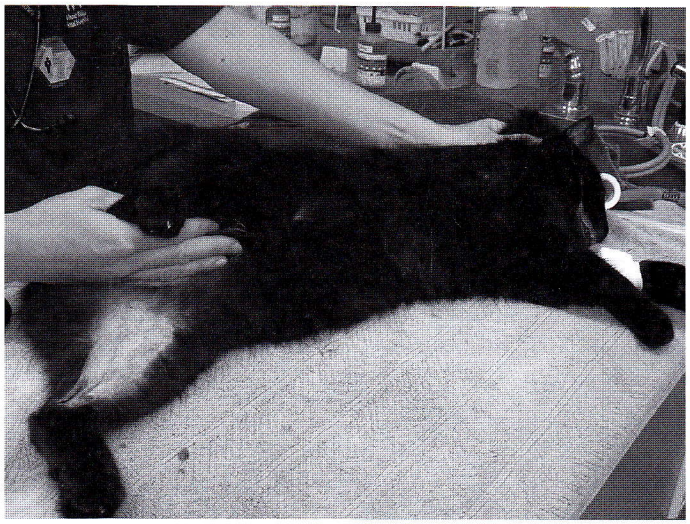

Fig. 1.24. Place the patient in lateral recumbency and have an assistant restrain. Clip the rear limb circumferentially in between the stifle and hock.

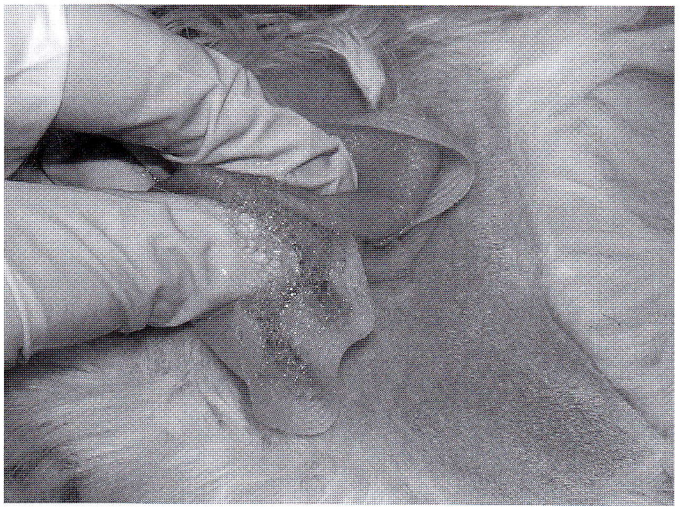

Fig. 1.25. Aseptically scrub the clipped area with antimicrobial solution.

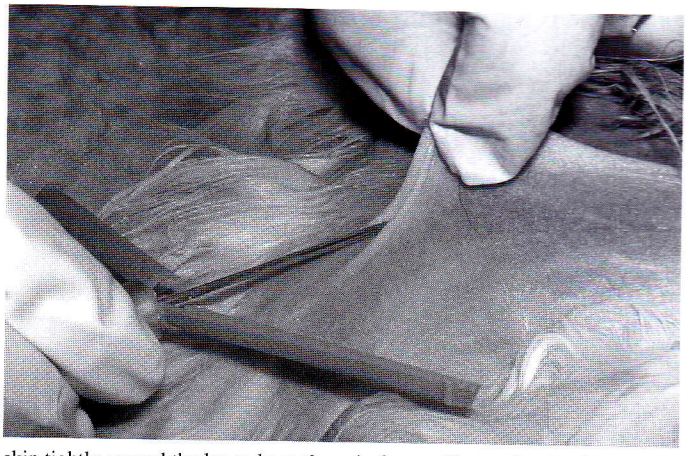

Fig. 1.26. Pull the skin tightly around the leg to keep the vein from rolling under the skin. Insert the needle through the skin just adjacent to the vessel. Avoid lacerating or puncturing the vessel.

Fig. 1.27. Place the needle directly over the vessel, and insert into the vessel at a 15° angle. Watch for a flash of blood in the catheter. Insert the catheter into the vessel.

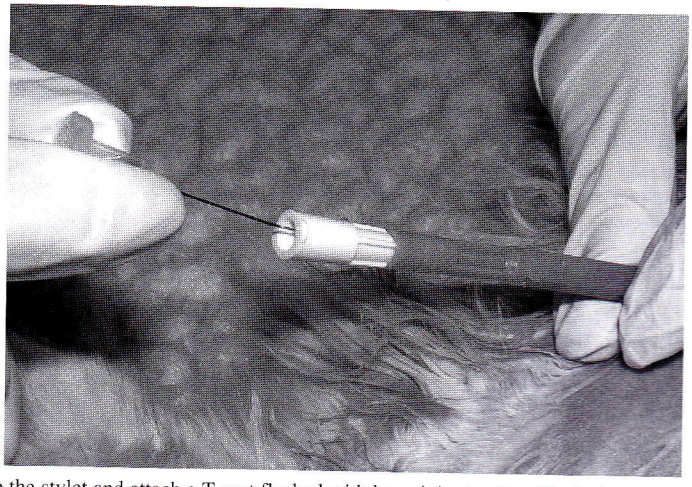

Fig. 1.28. Remove the stylet and attach a T-port flushed with heparinized saline. Flush the catheter with heparinized saline.

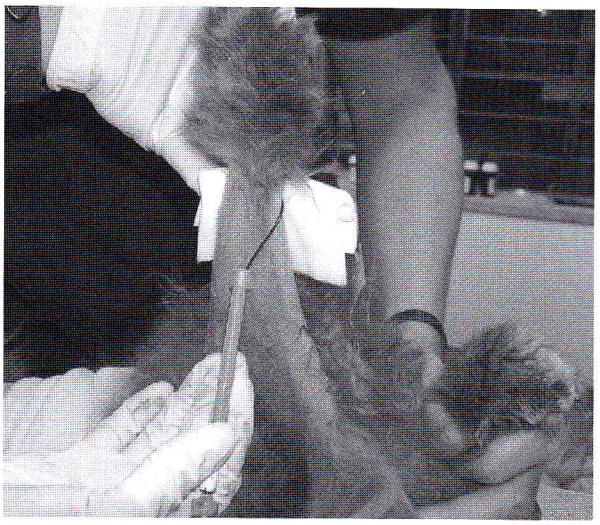

Fig. 1.29. Place the catheter and catheter hub around the lateral aspect of the limb for easy access, and secure the catheter in place with 1-inch white adhesive tape.

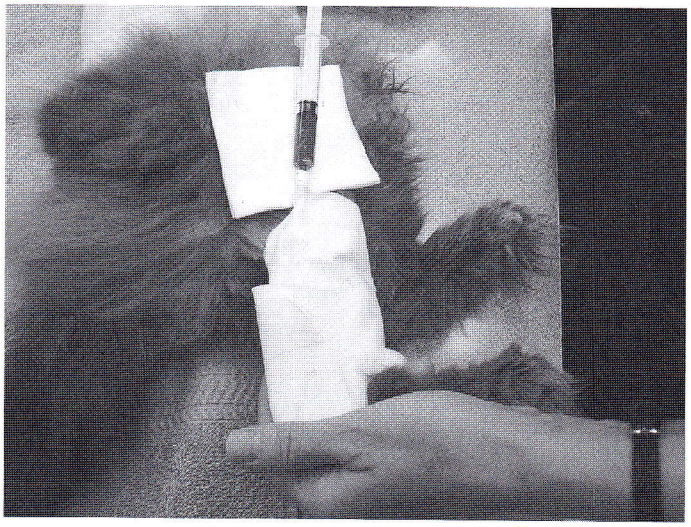

Fig. 1.30. Catheter hub on lateral aspect of the limb. Helpful Hint: Make sure that the catheter hub (blue and white piece) is secured to the limb proximal (dorsal) to the location where the catheter actually enters the skin and vein, or the catheter will not draw blood easily.

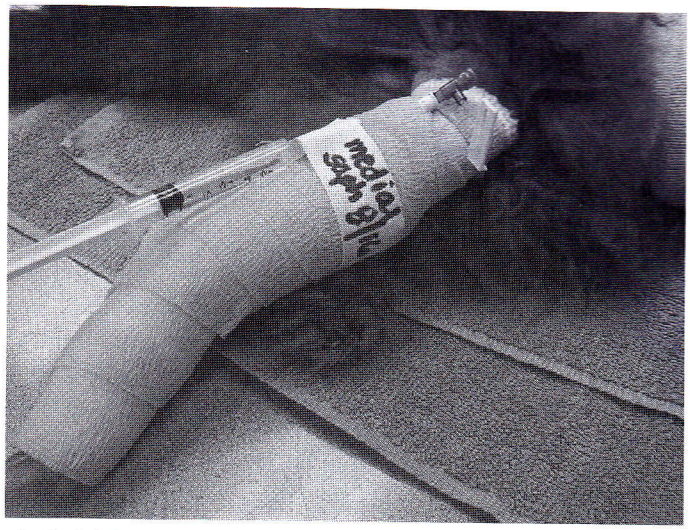

Fig. 1.31. Bandage the limb in layers of cotton roll gauze, Kling and Vetrap, or Elasticon. Helpful Hint: Make sure that the catheter draws blood and flushes easily in between each layer of material.

OVER-THE-WIRE CATHETERS (SELDINGER TECHNIQUE)

Introduction

Over-the-wire (Seldinger) central venous catheters can be placed into the jugular, lateral saphenous, and medial saphenous veins. Central venous catheters can be used for the infusion of colloid and crystalloid fluids, continuous or intermittent drug infusion, and infusion of hyperosmolar solutions including parenteral nutrition. Catheters placed into the jugular vein can be used for measurement of central venous pressure to guide fluid therapy and help avoid volume overload. An additional benefit of indwelling central venous catheters is ease of repeated blood sample collection without the need for repeated venipuncture. Many companies supply single- and multilumen over-the-wire products. Multilumen catheters are beneficial when multiple products are being infused into a patient simultaneously. The added ports allow vascular access without the need for placement of multiple single lumen central or peripheral venous catheters. See figs. 1.32–1.46.

Supplies Needed

Sterile gloves
Antimicrobial scrub solution
#11 scalpel blade
2% lidocaine
3-ml syringe with 24-gauge needle
Electric clipper and blades
1-inch white tape
3-0 nonabsorbable suture
Over-the-wire single or multilumen catheter kit
  Over-the-needle IV catheter
  Over-the-wire long catheter
  Vascular dilator
  Wire for catheter introduction into vessel
Needle holders
Suture scissors
Antimicrobial ointment
Gauze 4 × 4-inch squares
Cotton bandage material
Kling
Elasticon or Vetrap

Indications

Frequent blood sample collection
Infusion of multiple drugs, fluids, blood products, or parenteral nutrition
Measurement of central venous pressure

Contraindications

Venous thrombosis
Coagulopathies
Should not be placed in jugular vein in cases of increased intracranial pressure

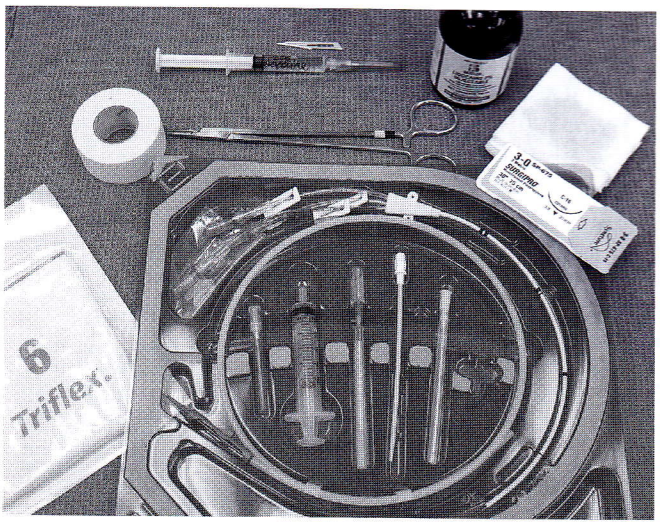

Fig. 1.32. Supplies needed for over-the-wire catheter.

Fig. 1.33. Place the patient in lateral recumbency.

Fig. 1.34. Clip and aseptically scrub over proposed site of catheter placement.

Fig. 1.35. Insert bleb of lidocaine over proposed site of catheter placement.

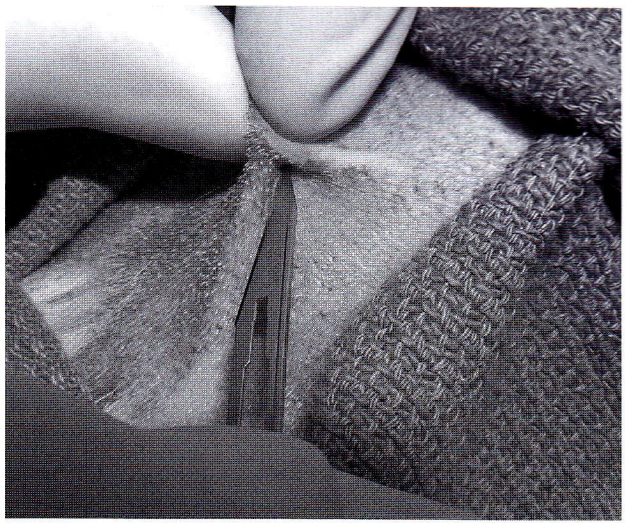

Fig. 1.36. Make a small incision with a #11 scalpel blade alongside the wire to create a larger skin opening for the catheter.

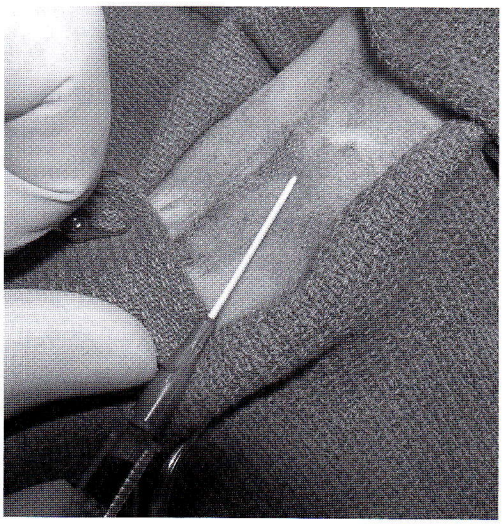

Fig. 1.37. Tent skin with fingers and insert over-the-needle catheter through skin, directing it into the vessel.

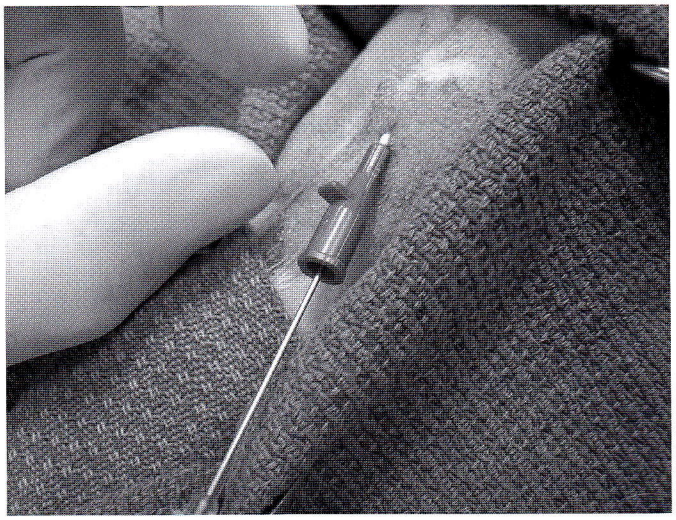

Fig. 1.38. Remove stylet from catheter. The catheter should bleed freely if it is seated in the vessel.

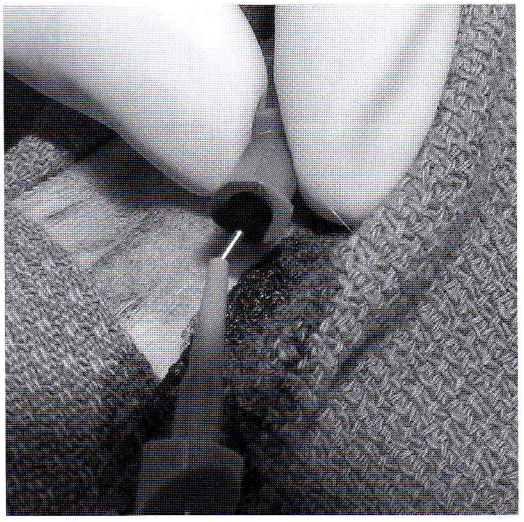

Fig. 1.39. Draw "J" back into introducer. Pick up the wire and gently seat the tip of the wire into the hub of the catheter. Push the wire into the vessel. Make sure to never let go of the wire.

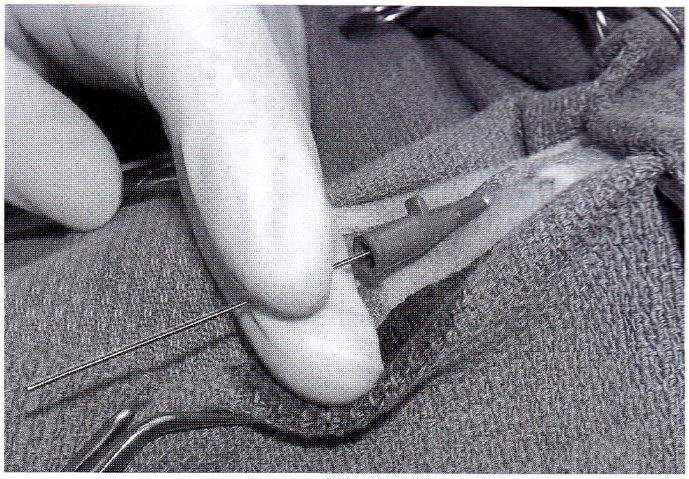

Fig. 1.40. Once the wire is inserted into the vessel, remove the catheter from over the wire. Again, never let go of the wire.

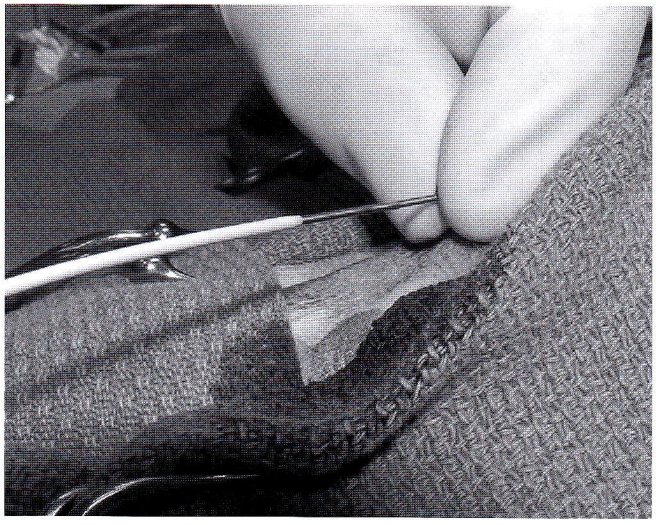

Fig. 1.41. Push the vascular dilator over the wire, through the skin, and into the vessel a short distance to enlarge the opening in the subcutaneous tissues and vessel.

Fig. 1.42. Flush all of the ports of the catheter and coil the catheter in your hand. Remove the vascular dilator, and insert the catheter over the wire into the vessel.

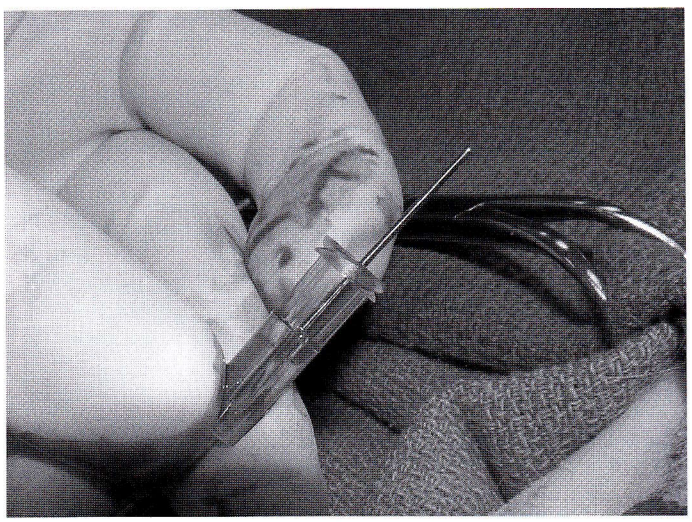

Fig. 1.43. Continue to insert the catheter over the wire. The wire will eventually appear out one of the catheter ports. Grasp the wire, and feed the catheter into the vessel up to the hub of the catheter.

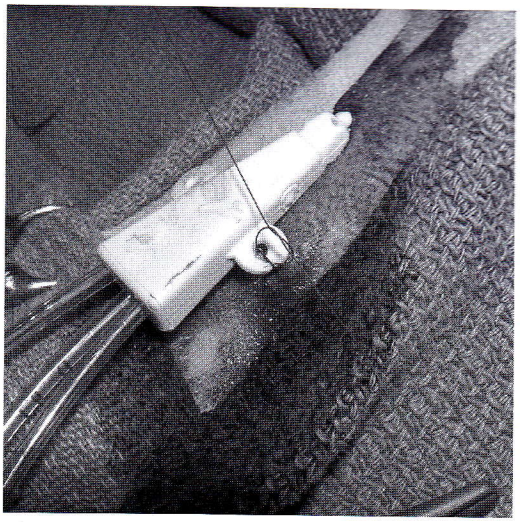

Fig. 1.44. Suture the catheter in place to the skin.

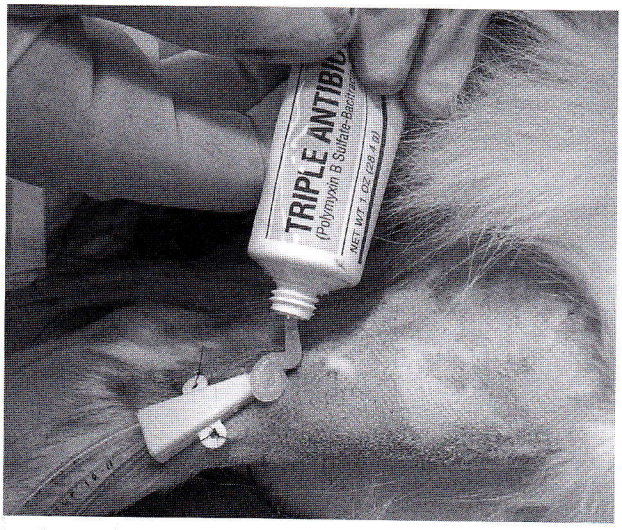

Fig. 1.45. Clean the area of any residual blood, and place antimicrobial ointment and a bandage over the catheter site.

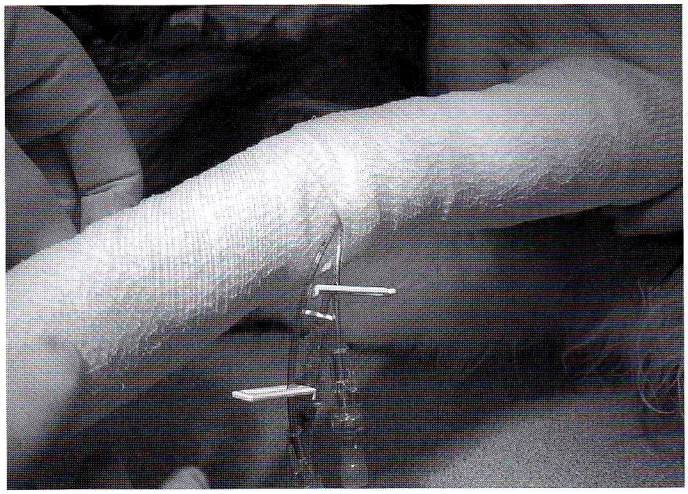

Fig. 1.46. Label the catheter site, as with any other intravenous catheter. Helpful Hint: You have placed a large hole in the vessel. Remember to place a pressure bandage over this site when it comes time to remove the catheter, to prevent hemorrhage!

PERIPHERAL CATHERIZATION

Introduction

Peripheral venous catheters are the most common type of intravenous catheter placed in small animal patients. Peripheral catheters are easy to place and simple to maintain, and have minimal risks to the patient. Peripheral catheters can be used for the infusion of crystalloid and colloid fluids, including blood products, and for the infusion of intravenous drugs and anesthetic agents. In large breeds, larger-bore (16–18-gauge) catheters can sometimes be used for blood sample collection. See figs. 1.47–1.54.

Supplies Needed

1/2- and 1-inch white adhesive tape to secure and wrap catheter
Kling or brown gauze
Permanent marker to label catheter bandage
Triple antibiotic ointment
Cotton balls
4 × 4-inch gauze squares
T-port or male adapter
Heparinized flush solution in 3-ml syringe
1000 units of nonfractionated heparin per 250–500-ml 0.9% saline; bags of unused heparinized saline should be discarded after 24 hours.
Antimicrobial scrub product
Electric clippers
Electric clipper blades
Intravenous catheter

Indications

Infusion of crystalloid and colloid fluids
Infusion of blood products
Infusion of intravenous drugs
Blood sample collection
Induce and maintain general anesthesia

Contraindications

Burn, abrasion, or pyoderma over catheter site
Thrombosis of catheter and vein selected for catheterization
Infusion of hyperoncotic solutions (parenteral nutrition)

Fig. 1.47. Supplies needed for peripheral catheterization.

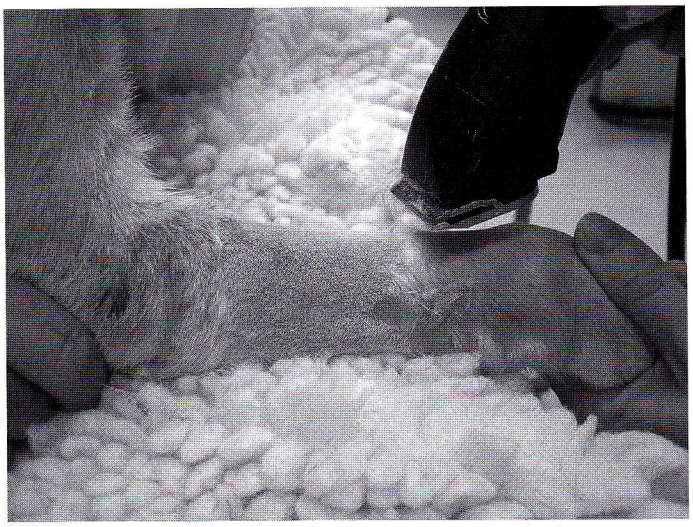

Fig. 1.48. Have an assistant restrain the patient and clip the antecrachium circumferentially in between the elbow and carpus, then aseptically scrub the clipped area. Helpful Hint: Remove any loose fur with a piece of dry 4 × 4-inch gauze prior to scrubbing the limb.

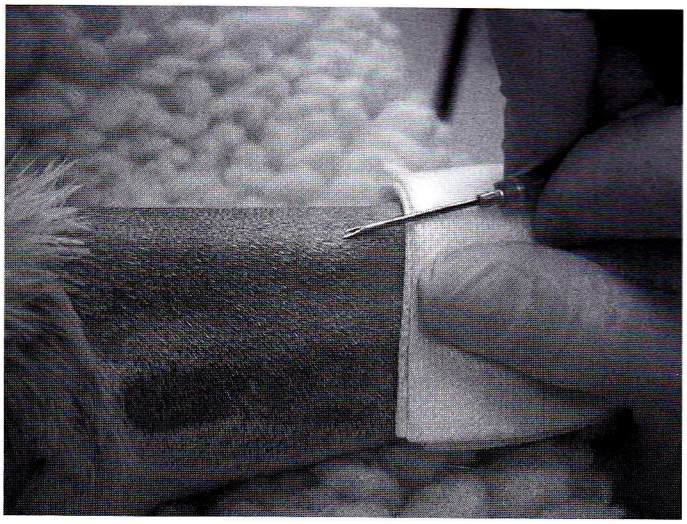

Fig. 1.49. If the skin is very tough, or the patient severely dehydrated, make a small nick incision through the skin with the bevel of an 18-gauge needle. This is called "percutaneous facilitation" and will make the task of catheter insertion easier. Helpful Hint: Use care to avoid lacerating the vessel during this procedure!

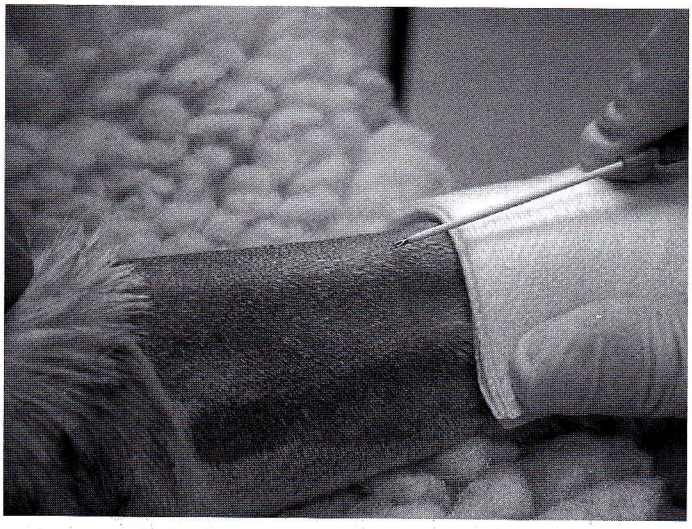

Fig. 1.50. Have an assistant occlude the vessel, then insert the needle through the skin at a 15° angle. Bluntly but gently penetrate the vein.

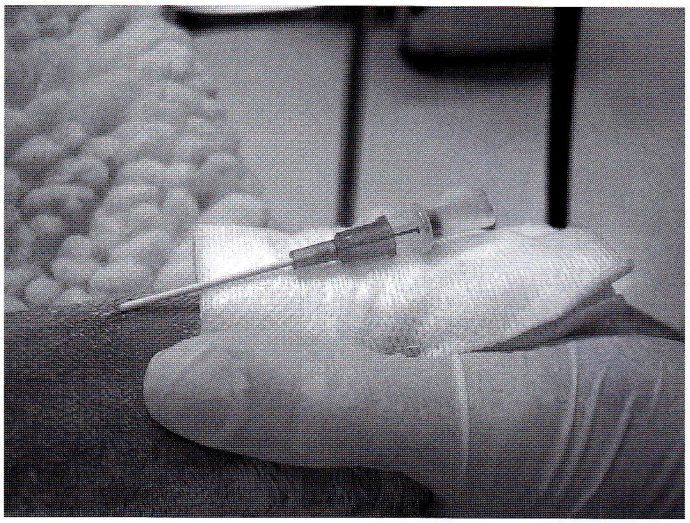

Fig. 1.51. Watch carefully for a flash of blood in the hub of the catheter and stylet.

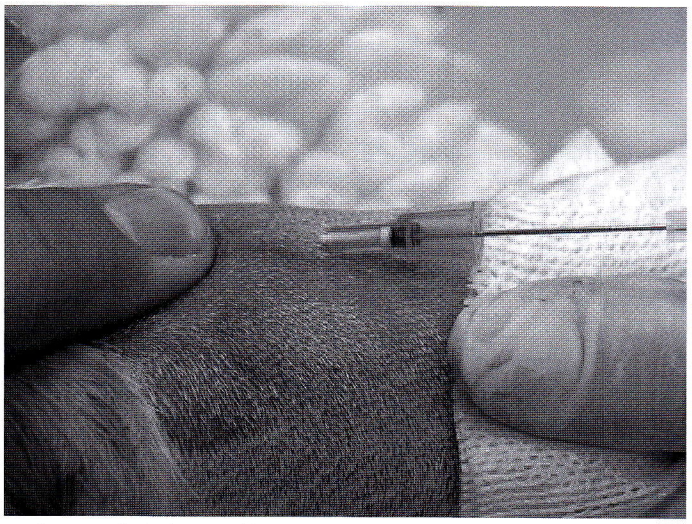

Fig. 1.52. Have an assistant occlude the vessel just over the point of catheter insertion, then remove the stylet. Helpful Hint: Having the assistant occlude the catheter during this step helps to prevent backflow of blood into your field.

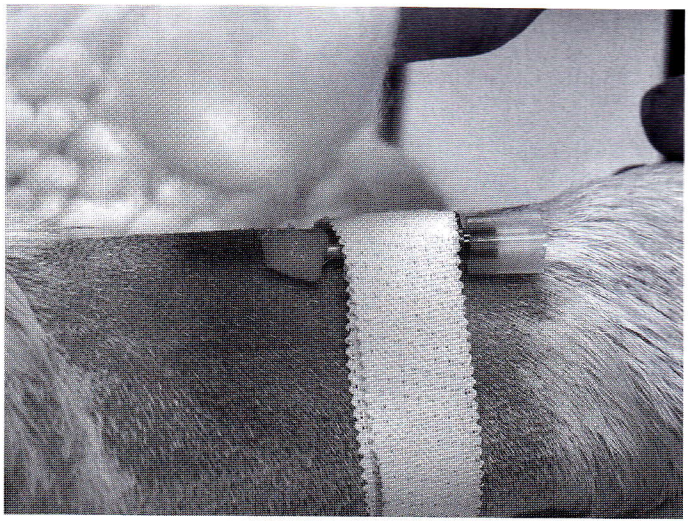

Fig. 1.53. Place antimicrobial ointment over the point of catheter insertion, and tape the catheter around the hub and limb with a 1/2-inch length of white adhesive tape. Helpful Hint: Make sure that the catheter hub and skin are completely dry so that the tape will securely attach itself to the catheter hub and the catheter will not "spin around," or else the catheter will not remain in place and will pull out of the vessel.

Fig. 1.54. Place a T-port flushed with heparinized saline and flush the catheter; then finish taping the catheter in place with layers of 1-inch white adhesive tape, Kling or brown gauze, Elasticon or Vetrap. Helpful Hint: Label the top layer of tape with the size of the catheter, date of catheter placement, and initials of the person who placed the catheter.

ARTERIAL CATHETERIZATION

Introduction

Arterial catheterization is a technique that is useful in nonambulatory, critically ill, small animal patients. Arterial catheters should be placed when repeated arterial blood samples are required, such as in patients with pulmonary or cardiac disease. Arterial catheters can also be used for continuous invasive blood pressure monitoring. Arterial catheters are commonly placed in the dorsal pedal, femoral, coccygeal, and auricular arteries. See figs. 1.55–1.59.

Supplies Needed

Electric clippers
Electric clipper blades
Antimicrobial scrub solution
Over-the-needle catheters (20- and 24-gauge)
1/2- and 1-inch white adhesive tape
T-port or luer-lock male adapters (flushed with heparinized saline)
Triple antibiotic ointment
Cotton balls
3-ml syringes with heparinized saline
Permanent marker to label catheter
Stickers "Not for IV infusion"

Indications

Measurement of direct arterial blood pressure
Obtain blood samples for blood gas analyses

Contraindications

Abrasions, burns, pyoderma over site of catheter placement
Thromboembolic disease or hypercoagulability
Coagulopathy
Ambulatory patients that will disconnect catheter
Is never to be used for blood sample, drug, or fluid infusion

Fig. 1.55. Supplies needed for arterial catheterization.

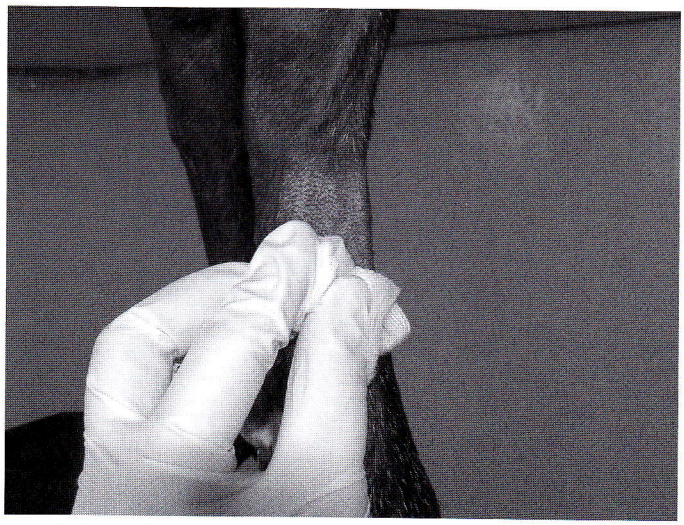

Fig. 1.56. Clip and aseptically scrub over the site of proposed arterial catheter placement. Common insertion sites include the dorsal pedal, femoral, or auricular arteries.

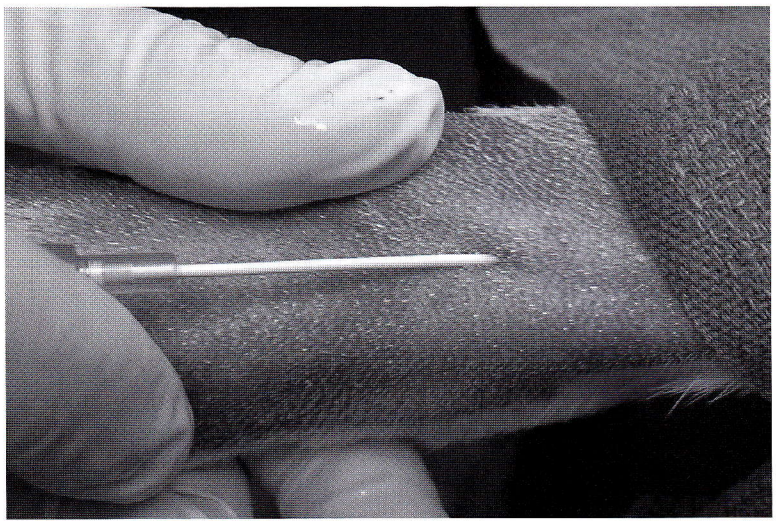

Fig. 1.57. Insert the needle through the skin at a 30°–45° angle. Once the needle is under the skin, palpate the arterial pulse and direct the needle into the artery using very small, blunt movements. Watch carefully for a flash of blood in the hub of the stylet. Unlike venous catheterization, there is no "pop" felt as the catheter passes through the thick vessel wall.

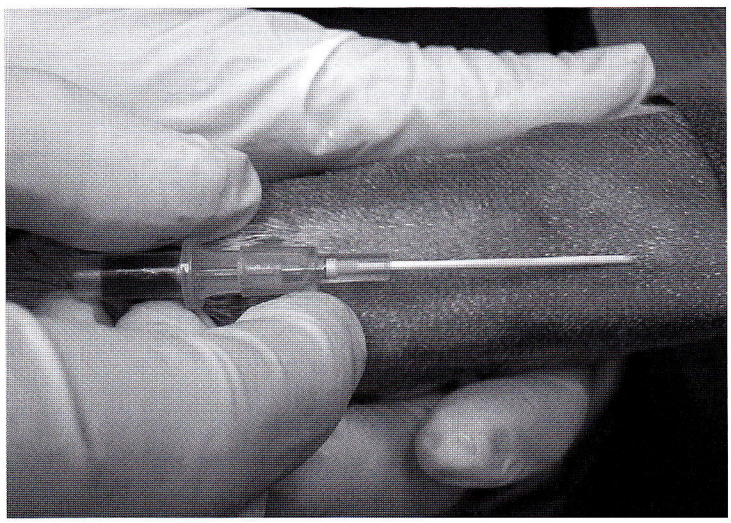

Fig. 1.58. Once the blood is in the catheter hub, gently push the catheter off of the stylet into the artery. Helpful Hint: If the catheter won't feed easily, direct it so that it is parallel with the artery. If you cannot feed the catheter, keep the catheter in place and start again proximally to the point of original catheter attempt. If you remove the original catheter, a hematoma will form preventing further attempts into the same artery.

Fig. 1.59. Once the catheter is in place, blood will flow freely. Flush the catheter immediately with heparinized saline and secure it in place as with any other catheter. Helpful Hint: Make sure that the site is completely clean and dry when securing the tape in place, or else the catheter will "spin" and fall out.

VASCULAR CUTDOWN

Introduction

In small animal patients with severe hypovolemia, dehydration, and hypotension, percutaneous vascular access may be difficult or impossible. Surgical cutdown allows direct visualization of the vein for ease of catheter placement. Vascular cutdown is usually performed in emergent situations. Although sterile technique should be maintained at all times, the risk of introducing bacteria into the patient's vessel is great. For this reason, cutdown should be performed in emergencies, and then the catheter should be changed to a percutaneous catheter as soon as the patient's volume and blood pressure have been normalized. See figs. 1.60–1.69.

Supplies Needed

Electric clippers and blades
Antimicrobial scrub solution
Sterile gauze 4 × 4-inch sponges
Sterile gloves
Sterile surgical pack
  Scalpel handle and #11 scalpel blade
  Field towels
  Towel clamps
  Tissue/thumb forceps
  Mosquito hemostats
  Mettzenbaum scissors
  Needle holders
3-0 absorbable suture
14–18-gauge venocath or over-the-needle peripheral catheter
Heparinized saline flush solution
T-port connector or male adapter
Antimicrobial ointment
2-inch Kling bandaging material
1-inch white tape
Elasticon bandaging material

Indications

Catheterize vessel in patients with extreme hypotension, peripheral vasoconstriction, or obesity.
Infusion of crystalloid or colloid fluids
Infusion of blood products
Infusion of drugs
Obtain blood samples

Contraindications

Abrasion, burn, or pyoderma over catheter site
Direct percutaneous catheterization is possible.

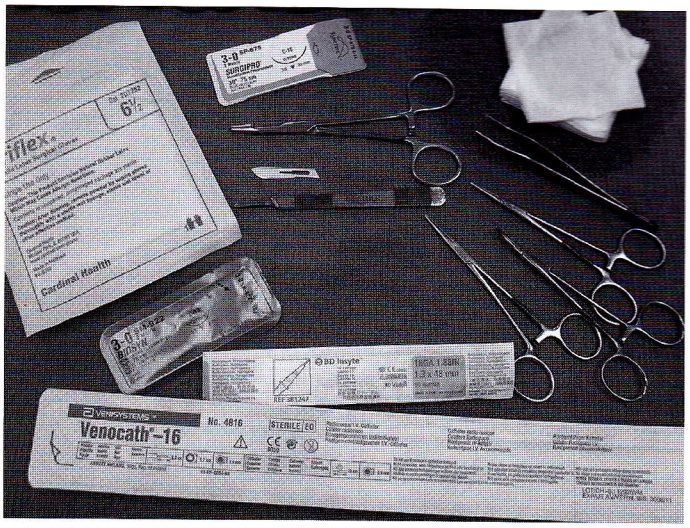

Fig. 1.60. Supplies needed for vascular cutdown.

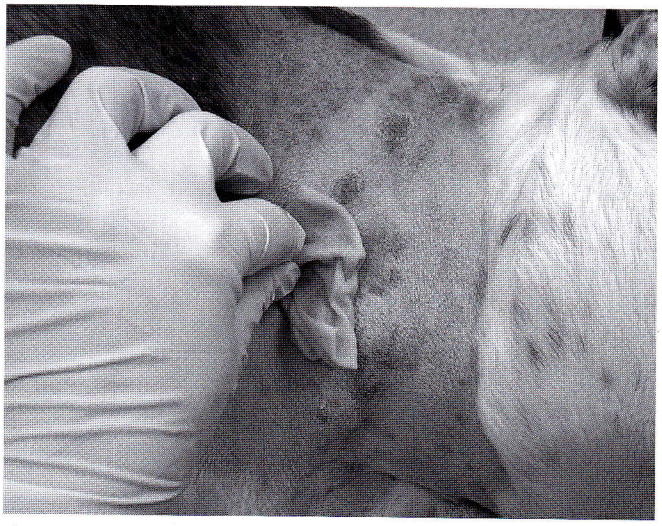

Fig. 1.61. After clipping the fur and then aseptically scrubbing the clipped area, drape the surgical site with sterile field towels.

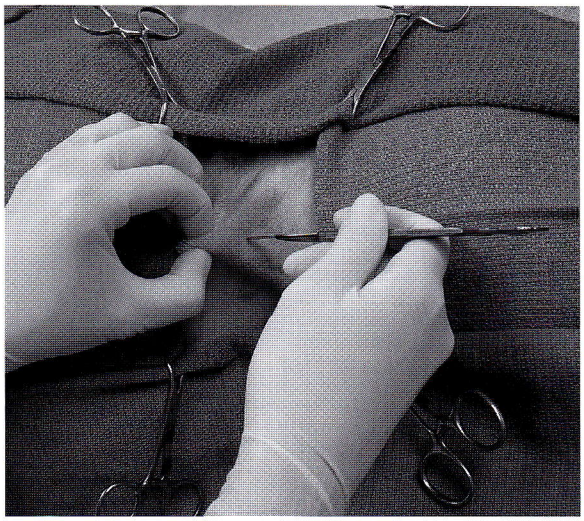

Fig. 1.62. Tent skin over site of proposed vascular catheterization. Incise skin using a #11 scalpel blade. Helpful Hint: Gently move the skin away from the vein to avoid cutting the vessel.

Fig. 1.63. Visualize the vessel under the skin incision.

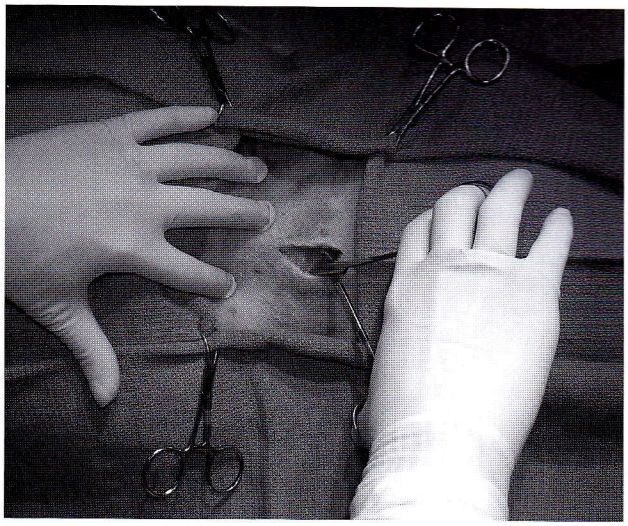

Fig. 1.64. Bluntly dissect fascia overlying the vessel using a curved mosquito forceps. Helpful Hint: Make sure that all of the fascia is dissected away from vessel, or else attempts at placing the catheter into the vessel will be difficult.

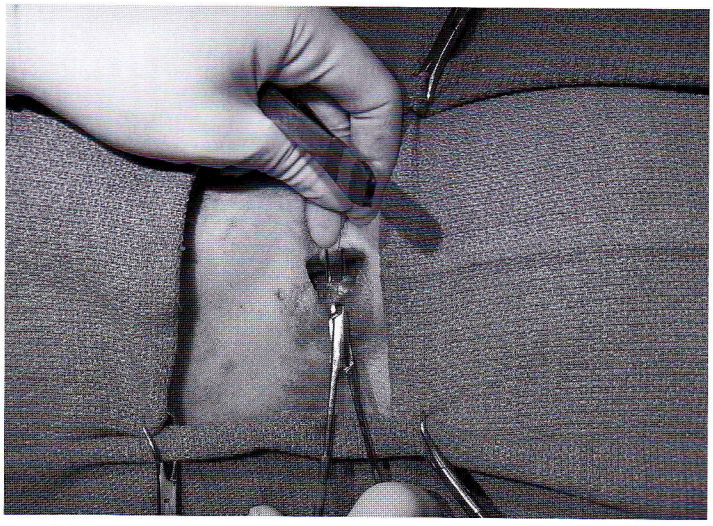

Fig. 1.65. Insert curved hemostats under the vessel and raise the vessel to the skin surface.

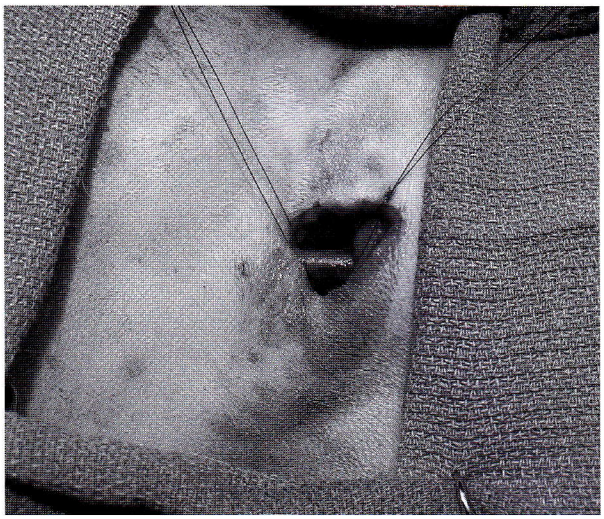

Fig. 1.66. Place two separate absorbable stay sutures secured with mosquito hemostats, to raise the vessel to the level and parallel with the skin surface.

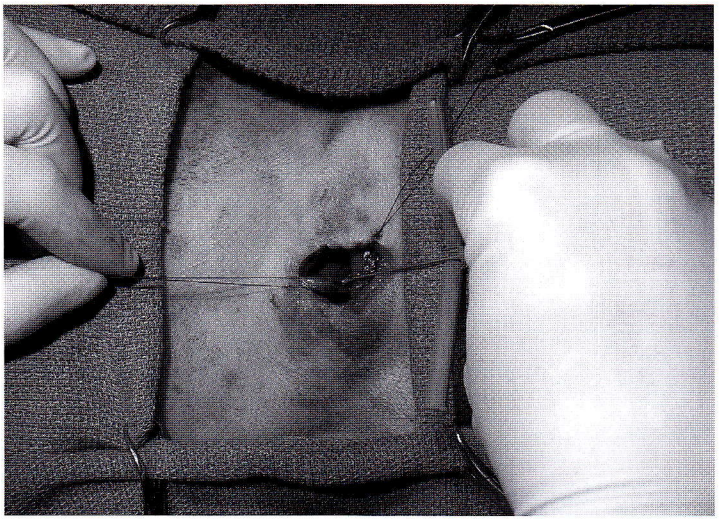

Fig. 1.67. With the vessel raised and parallel to the skin surface, gently puncture the vessel with the needle, and insert the catheter.

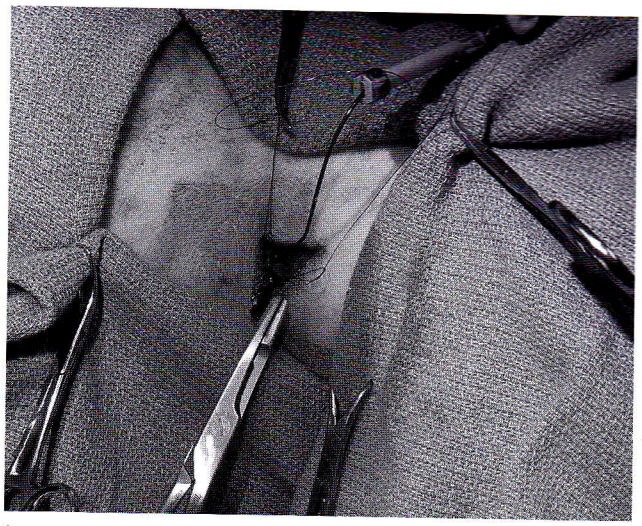

Fig. 1.68. Gently tie the stay sutures occluding the vessel.

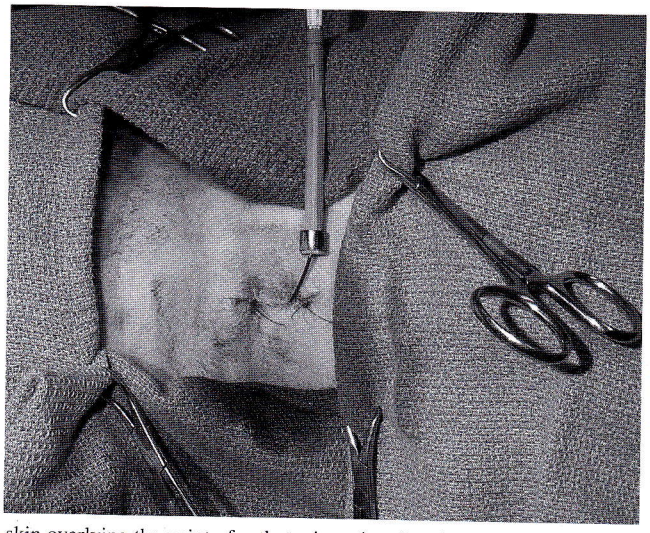

Fig. 1.69. Suture the skin overlying the point of catheter insertion. Bandage in place as with a percutaneously placed catheter. The vessel will remain ligated. Collateral circulation will suffice. If the vessel is not occluded, there will be too much hemorrhage. Helpful Hint: When a percutaneous catheter can be placed, this catheter can be removed.

INTRAOSSEOUS CATHETERIZATION

Introduction

Intraosseous catheterization is often necessary in pediatric small animal patients and exotic species when vascular access is impossible. Any fluid, including blood products and parenteral nutrition, which can be infused into a peripheral or central catheter can be infused through an intraosseous catheter. Intraosseous catheters are well tolerated but can be somewhat uncomfortable. Because the catheter or needle traverses the periosteum, intraosseous catheters are somewhat uncomfortable and should be changed to a venous catheter whenever possible. See figs. 1.70–1.75.

Supplies Needed

Electric clippers and blades
Antimicrobial scrub solution
2% lidocaine
1–3-ml syringe and 22-gauge needle
3-ml syringe with heparinized flush solution
#11 scalpel blade
16–18-gauge bone marrow needles or spinal needles with stylet
20–22-gauge hypodermic needles
1/2–1-inch white tape
T-port or male adapter flushed with heparinized saline
3-0 nylon suture

Indications

Infusion of crystalloid and synthetic colloid fluids and blood products
Infusion of drugs
Infusion of parenteral nutrition
Vascular access is impossible.

Contraindications

Intravenous catheterization is possible.
Pyoderma or abrasion over site of intraosseous catheter placement
Ambulatory patients, as catheter can become dislodged.

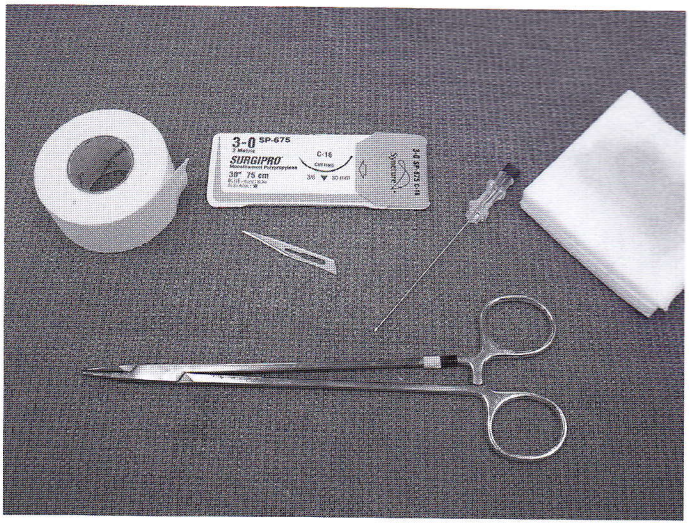

Fig. 1.70. Supplies needed for intraosseous catheterization.

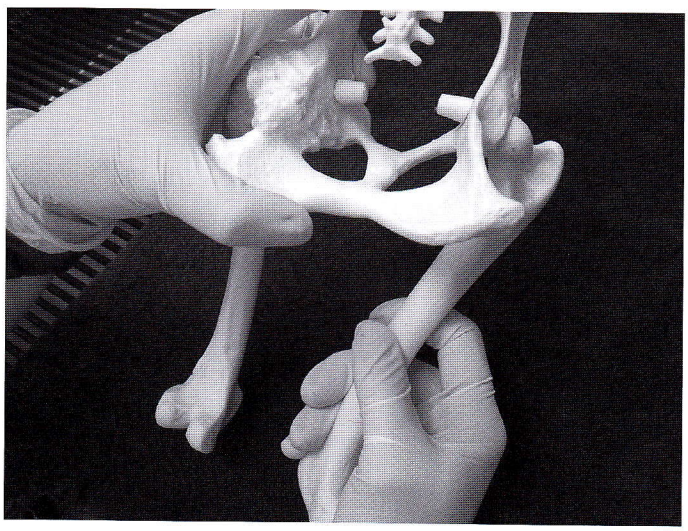

Fig. 1.71. Abduct the femur so that the stifle is away from the body. This allows the sciatic nerve to move out of the way of catheter placement.

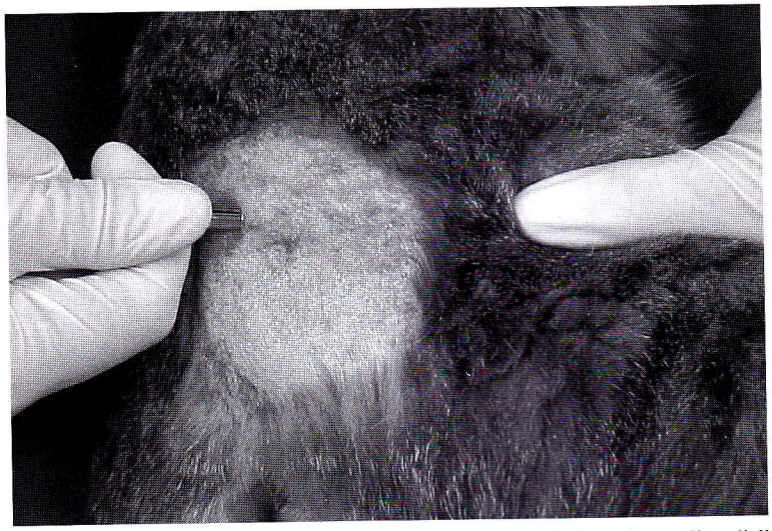

Fig. 1.72. Palpate the greater (major) trochanter of the femur. The trochanteric fossa drops off medially from the greater trochanter. Insert the needle through the skin after placing a bleb of 2% lidocaine into the level of the periosteum. Walk the tip of the needle medially off the greater trochanter into trochanteric fossa. Once the needle is against bone at the bottom of the trochanteric fossa, push the needle in parallel with the femur. Then use a simultaneous twisting and pushing motion to seat the catheter into the medullary cavity. In larger animals, you can make a stab incision with a #11 scalpel blade before needle placement, to prevent tissue drag.

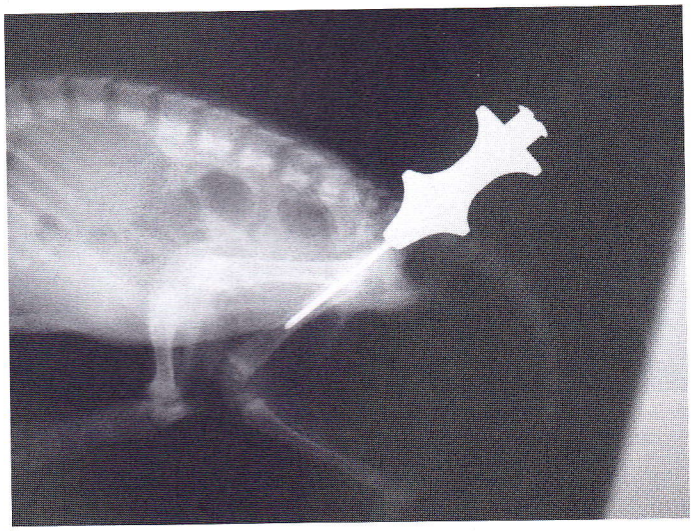

Fig. 1.73. Once the needle is in the correct position, infuse a small amount of saline. The saline should flow freely. Check catheter placement with a lateral and AP radiograph. Helpful Hint: If you place a catheter using a hypodermic needle, the needle can sometimes become clogged with bone debris. If this occurs, remove the needle and replace an identical needle in the same hole.

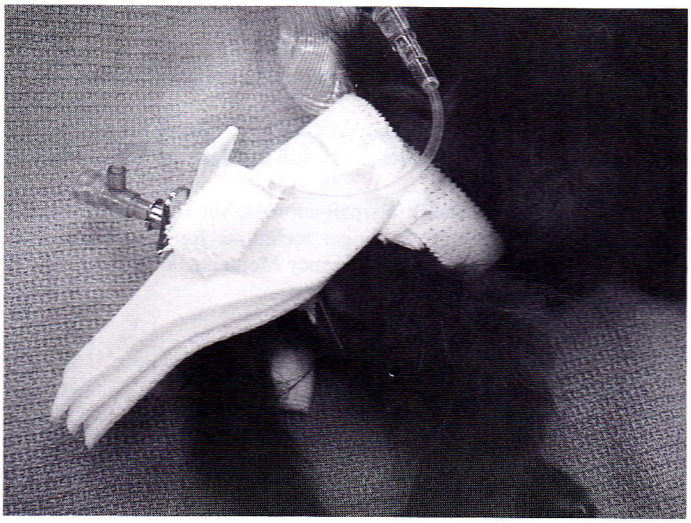

Fig. 1.74. Secure a piece of 1/2- or 1-inch tape around the hub of the needle and male adapter, and tape around the body. Alternatively, you can make wings of tape and suture to the skin at the base of the catheter hub.

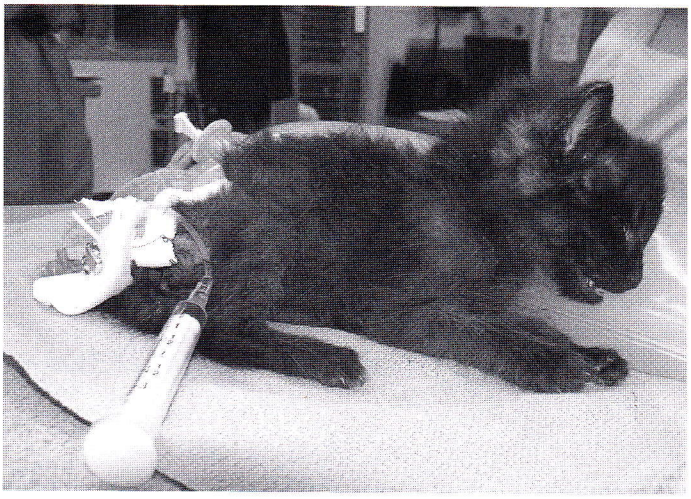

Fig. 1.75. Patients will tolerate the intraosseous catheter quite well. Helpful Hint: As soon as the patient is ambulatory or vascular access can be obtained, place an intravenous catheter and remove the intraosseous catheter.

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CHAPTER 2

Nutritional Support

INTRODUCTION

Nutritional support of the critically ill patient is important to providing necessary proteins, carbohydrates, and lipids for energy and to repair processes in a variety of illnesses. In any patient that has a functioning gastrointestinal tract and is not vomiting, the placement of an enteral feeding tube for nutritional supplementation should be considered. This chapter describes the placement and maintenance of a variety of enteral feeding devices, including nasoesophageal, nasogastric, and esophagostomy tubes.

NASOESOPHAGEAL AND NASOGASTRIC TUBES

Introduction

Nasoesophageal and nasogastric feeding tubes should be considered in any patient for short-term enteral nutritional support when the patient either cannot or will not voluntarily eat, and has no known esophageal disorder or vomiting. Specialized veterinary liquid enteral diets are commercially available for use with nasoesophageal and nasogastric tubes. In addition to providing enteral nutrition, nasoesophageal and nasogastric tubes can also be used to suction air and fluid from the esophagus and stomach in patients with severe ileus. See figs. 2.1–2.8.

Supplies Needed

Needle holders
Proparacaine
Nonabsorbable suture (3-0)
5–10 French Argyle infant feeding tube

Permanent marker
Elizabethan collar

Indications

Short-term enteral nutrition in patients that are inappetant
Suctioning of gastric fluid or air in cases of severe ileus

Contraindications

Nasopharyngeal trauma
Vomiting
Esophageal reflux
Regurgitation
Esophageal strictures
Megaesophagus
Thrombocytopenia or thrombocytopathia
Recumbent or unconscious patients

Fig. 2.1. Supplies needed for a nasoesophageal or nasogastric tube include an infant feeding tube, 3-0 nonabsorbable suture, topical proparacaine, permanent marker, sterile lubricating jelly, and needle holders.

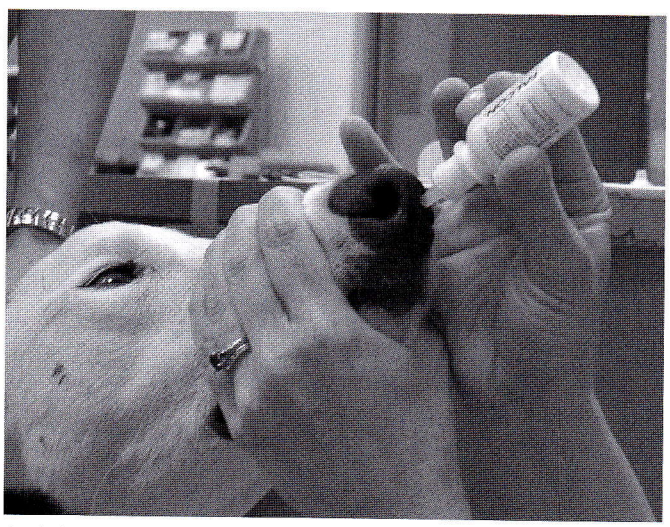

Fig. 2.2. Tilt the patient's head upward toward the ceiling and place several drops of topical proparacaine into the nostril.

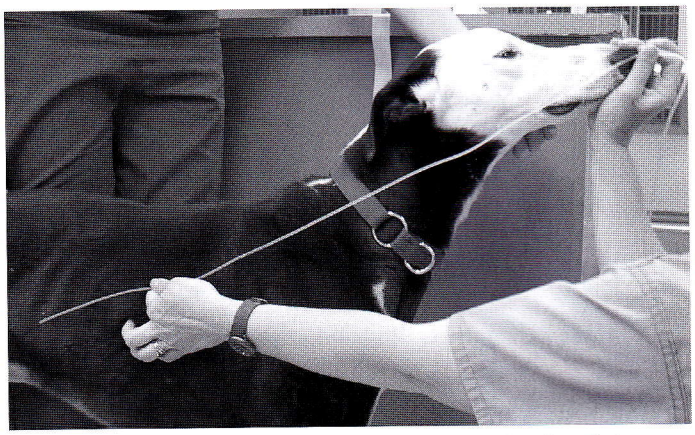

Fig. 2.3. Measure the feeding tube to the level of the carina (nasoesophageal) or last rib (nasogastric) and mark the tube with a permanent marker.

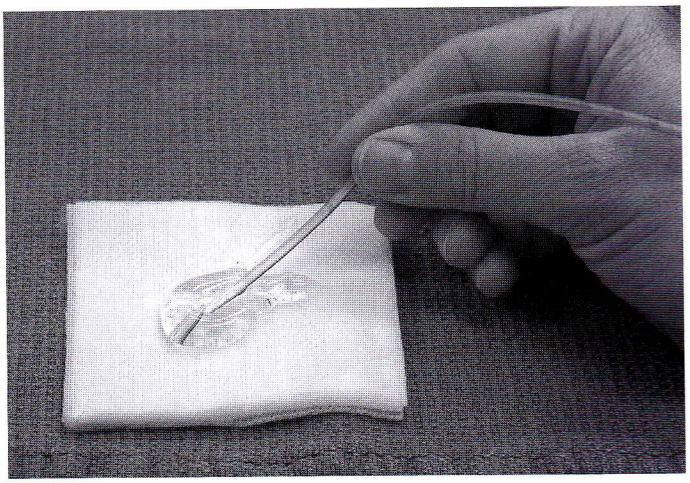

Fig. 2.4. Lubricate the tip of the tube with sterile lubricant jelly.

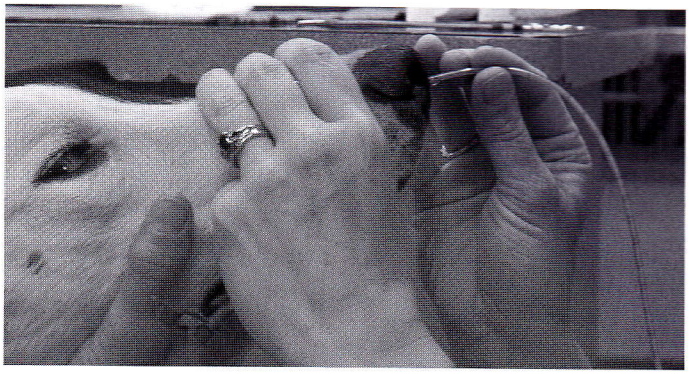

Fig. 2.5. Grasp the dog's muzzle and gently and briskly insert the tube ventrally and medially. Helpful Hint: Hold onto the tube as close to the patient's muzzle as possible to prevent the patient from sneezing the tube back out at you. Push the patient's nose toward the ceiling when passing the tube, to extend the neck. The patient should swallow the tube.

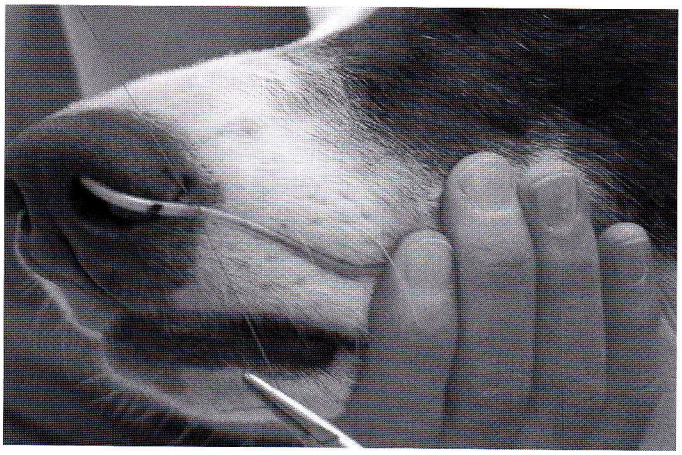

Fig. 2.6. Once the tube is passed to the level of the permanent marker, secure the tube lateral to the nostril with a suture or surgical staple.

Fig. 2.7. Secure the tube lateral to the eye, or medial to the eye, and to the top of the head with sutures or surgical staples. Take care to avoid the patient's whiskers.

Fig. 2.8. Place an Elizabethan collar on the patient to prevent tube displacement. Helpful Hint: If the tube is bothersome to the patient and the patient is sneezing, apply more topical anesthetic as needed to minimize patient discomfort. Check the placement of the tube with a lateral thoracic radiograph. If the tube does not have a radiopaque marker, add a small amount of iodinated contrast material. Once placement has been confirmed, the tube can be used immediately. It is advisable to start all feedings with 5 to 10 cc of water. If the patient has accidentally aspirated the tube into the trachea, fluid will elicit a cough. The tube position should be rechecked. Upon tube removal, make sure that the tube is kinked well and then pulled briskly, to prevent fluid from entering the trachea and lungs.

ESOPHAGOSTOMY TUBES

Introduction

An esophagostomy tube should be considered whenever patients are inappetent because they either voluntarily will not or cannot eat (i.e., severe maxillofacial trauma, neoplasia or mass effects, inappetence). Esophagostomy tubes are simple to place, require minimal equipment, and can be used immediately. An esophagostomy tube is contraindicated in patients that cannot protect their airway, are vomiting or regurgitating, or have functional or mechanical esophageal abnormalities such as megaesophagus or strictures. See figs. 2.9–2.22.

Supplies Needed

Surgical instruments
- #10 scalpel blade
- Scalpel handle
- Needle holders
- Mayo scissors
- Rochester carmalt
- Nonabsorbable suture (variety of sizes, depending on size of tube and patient)

Permanent marker
Electric clippers and blades
Antimicrobial scrub
Christmas-tree adapter
Bandage material
- Gauze 4 × 4-inch squares
- Cotton roll gauze
- Kling
- Elasticon or Vetrap

Indications

Inappetance
Maxillofacial trauma
Severe dental disease
Orofacial, pharyngeal masses

Contraindications

Vomiting
Regurgitation
Esophageal strictures
Megaesophagus
Conditions in which patients cannot protect their airway
Severe cough
Pneumonia

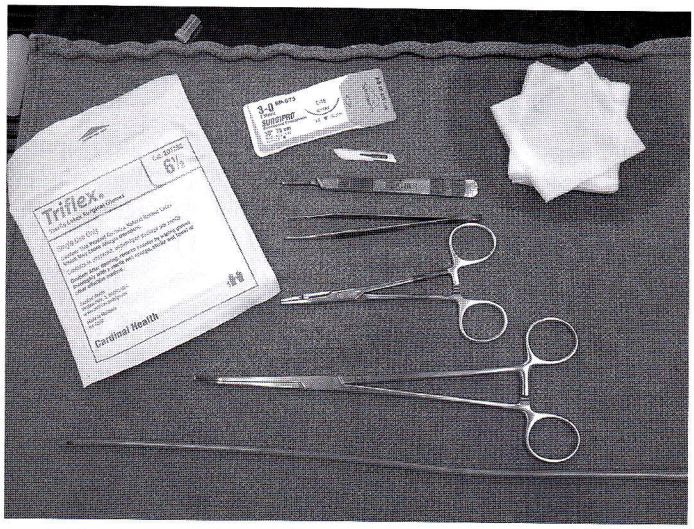

Fig. 2.9. Materials needed for placement of an esophagostomy tube include a red rubber tube (10–20 French depending on size of patient), #10 scalpel blade and handle, Rochester carmalt, Mayo scissors, needle holder, permanent marker, nonabsorbable suture, electric clippers and blade, antimicrobial scrub, and a Christmas tree adapter.

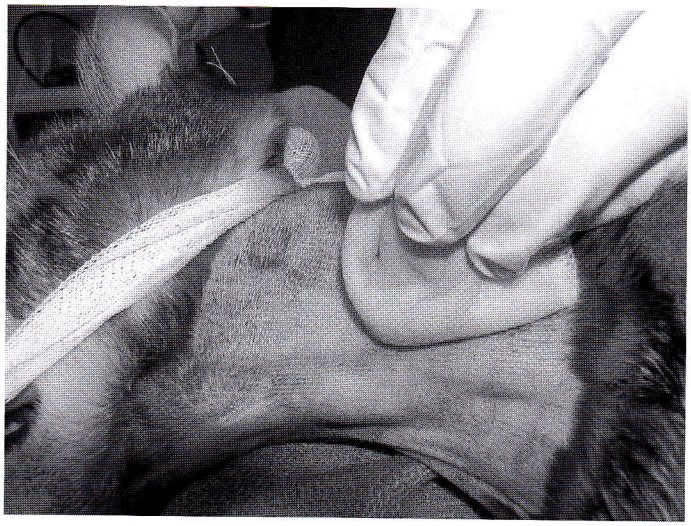

Fig. 2.10. Anesthetize and intubate the patient. Place the patient in right lateral recumbency, and clip the neck from the ramus of the mandible caudally to the thoracic inlet and dorsally and ventrally to midline. Aseptically scrub the clipped area. Helpful Hint: If the patient is intubated, there is only one tube into which you can possibly insert your esophagostomy tube!

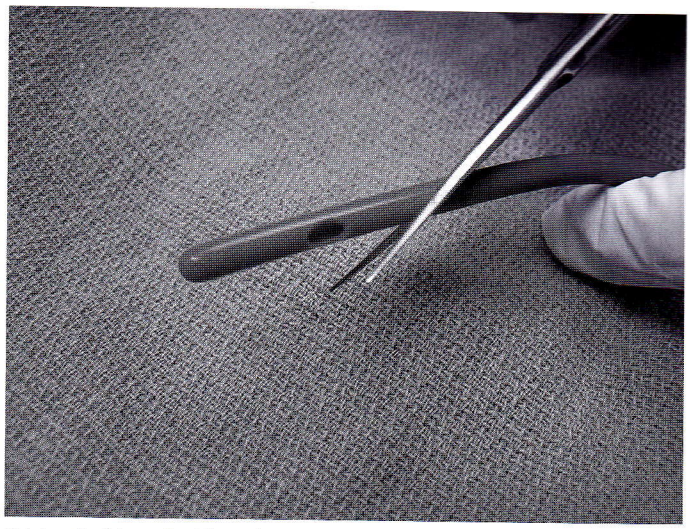

Fig. 2.11. Cut the distal end of the red rubber tube on a diagonal proximal to the holes in the tube. This will increase the diameter through which food is passed, decreasing the risk of tube occlusion. Helpful Hint: Make sure that the cut edges of the distal end of the tube are not sharp, to prevent esophageal irritation.

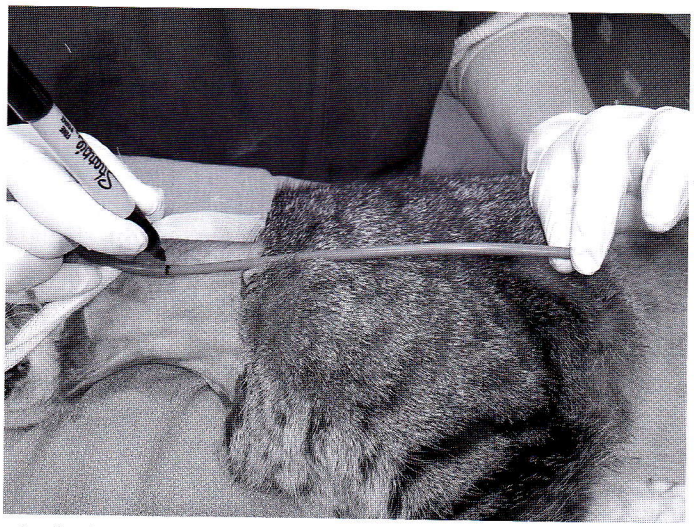

Fig. 2.12. Measure the distal end of the tube from the level of the midthorax to the point of tube insertion in the lateral cervical region. Mark the tube at the point of insertion with the permanent marker.

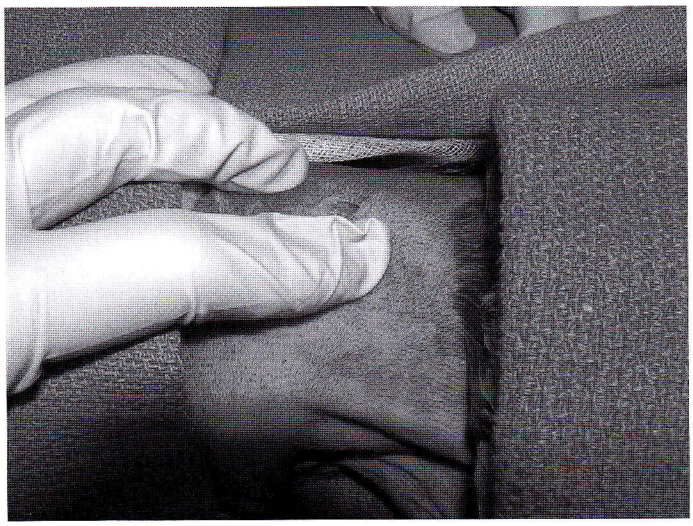

Fig. 2.13. With the patient anesthetized, drape the clipped area with sterile field towels secured with towel clamps. Gently pull the tongue rostrally, and insert a Rochester carmalt into the mouth and down the throat, bringing the tips of the carmalt laterally to the skin at the level of midcervical region. You should be able to palpate the tips of the carmalt under the skin with your fingertips.

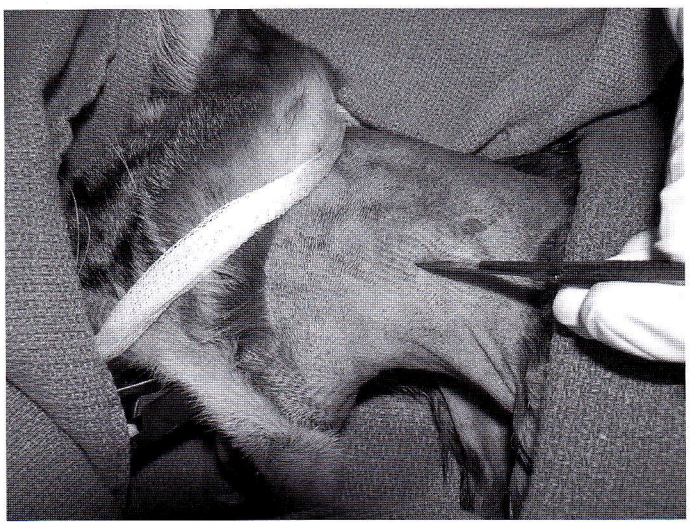

Fig. 2.14. Open the tips of the carmalt, and make a stab incision with the scalpel blade through the skin and underlying fascia, into the esophagus. You should be able to push the tips of the carmalt laterally through the edges of the skin incision. Helpful Hint: In some cases, it may be necessary to gently incise the esophagus over the tips of the carmalt. Make sure to keep the tips of the carmalt in sight, so as to create only one hole!

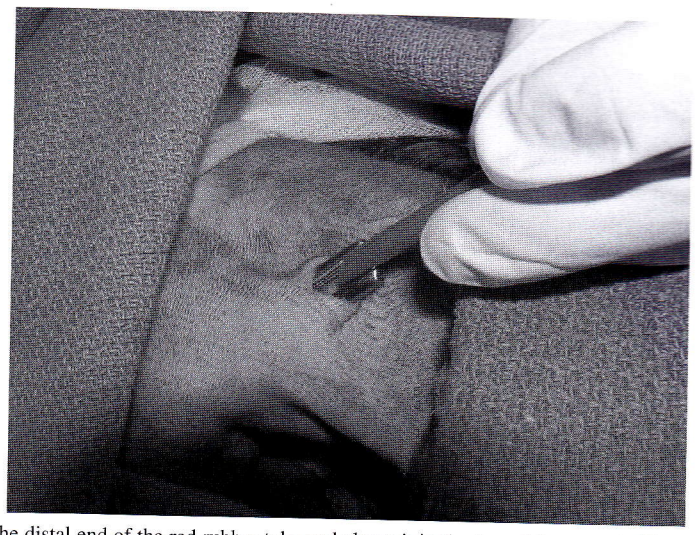

Fig. 2.15. Grasp the distal end of the red rubber tube and clamp it in the tips of the carmalt. Helpful Hint: At this point, it is easy to also grasp tissue in the mouth or esophagus in the hinges of the carmalt. This will prevent you from easily bringing the tube forward.

Fig. 2.16. Pull the distal end of the red rubber tube rostrally out the front of the mouth. The proximal end of the tube will be facing caudally at this point. Helpful Hint: If you are not able to pull the tube forward easily, make sure that you do not have tissue caught in the hinges of the carmalt, and make sure that the red rubber tube or carmalt is not wrapped around the tie-gauze of the endotracheal tube.

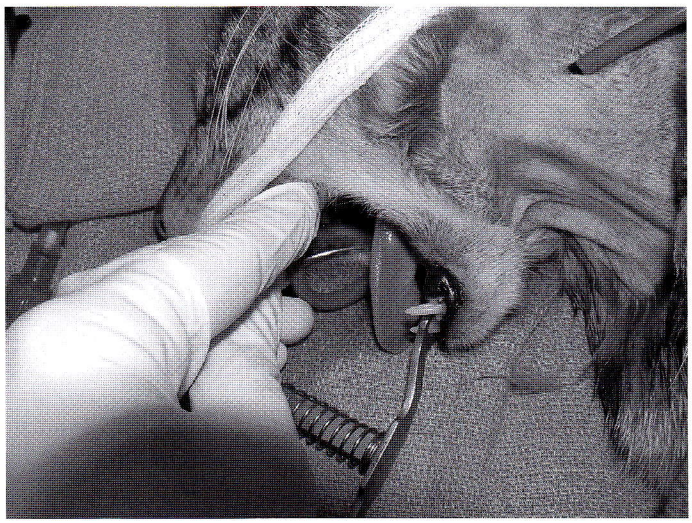

Fig. 2.17. Unclamp the distal end of the red rubber tube from the carmalt, and gently push the distal end caudally. Use your fingers or the carmalt to push the distal end of the tube down the esophagus. Helpful Hint: Make sure that patients are well anesthetized before attempting this step, as they can clamp onto your fingers with stimulation in their mouth.

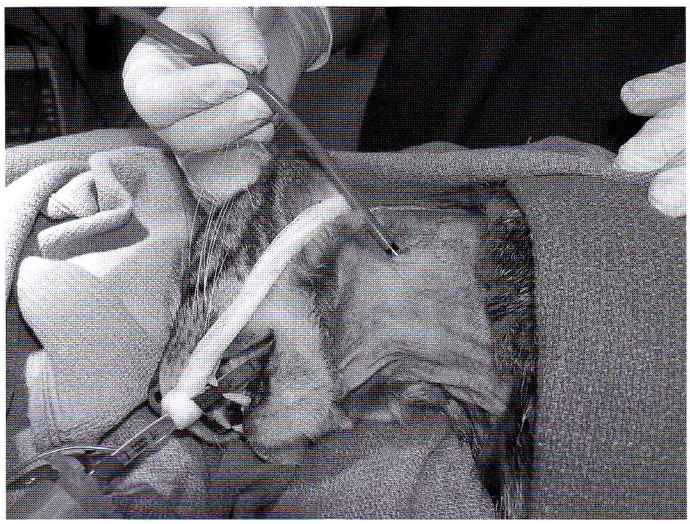

Fig. 2.18. Once the tube is in place, the proximal end of the tube will "flip" rostrally toward the front of the patient. At this point, gently twist the tube to make sure it is in the correct place.

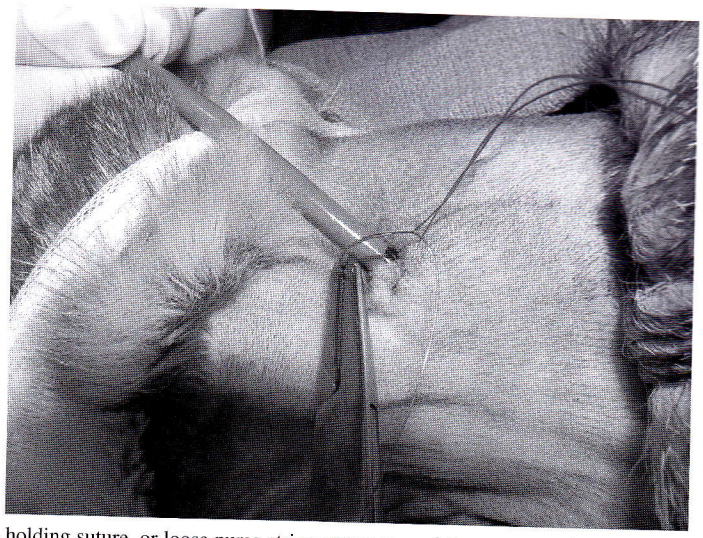

Fig. 2.19. Place a holding suture, or loose purse-string suture around the entrance of the tube site, leaving the ends long. Place a finger-trap suture around the base of the tube where the tube enters the skin.

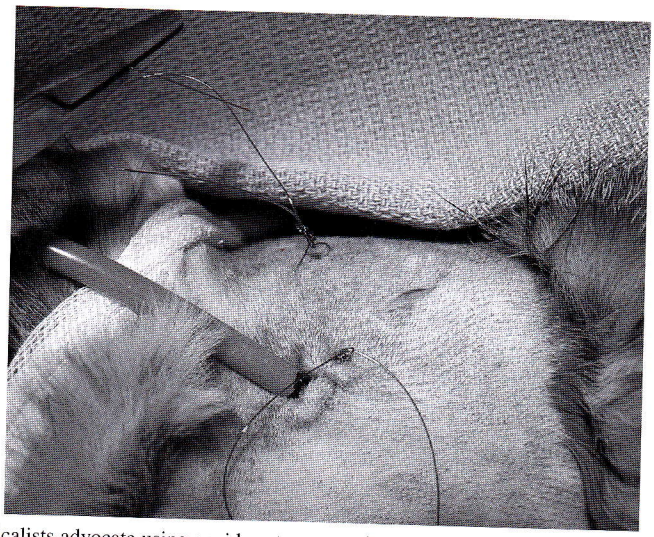

Fig. 2.20. Some criticalists advocate using a wide suture, scraping the periosteum of the atlas to secure the mid-portion of the tube in place to the wing of the atlas.

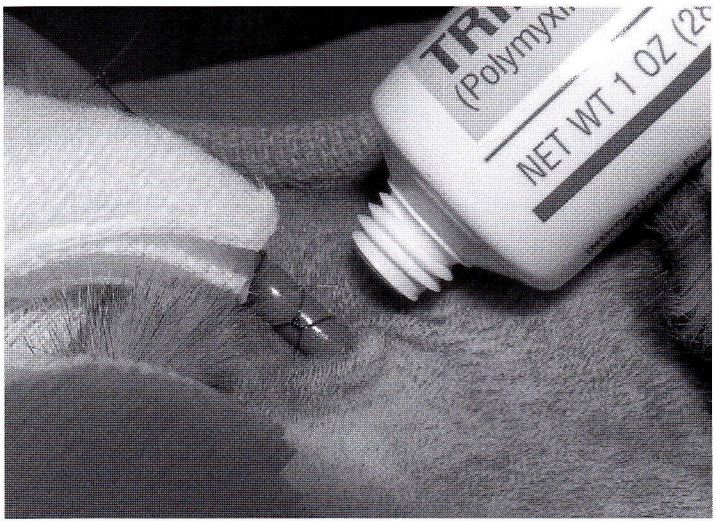

Fig. 2.21. Place antimicrobial ointment over the entry site, and then loosely bandage the tube in place. Check the tube for erythema and drainage on a daily basis.

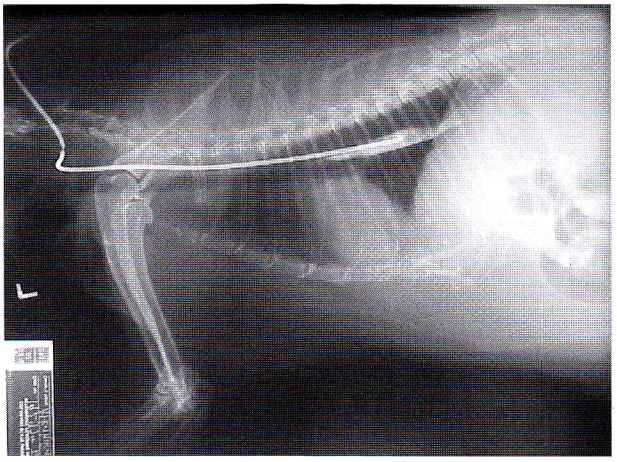

Fig. 2.22. Radiograph the tube using a small amount of iodinated contrast material, to make sure tube is in place, before using. When correct placement has been confirmed, the tube can be used immediately.

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CHAPTER 3

Thoracocentesis and Thoracostomy Tube Placement

THORACOCENTESIS

Introduction

Thoracocentesis can be both diagnostic and therapeutic in patients with pneumothorax or pleural effusion with respiratory distress. Thoracocentesis should be considered in any patient with respiratory distress and a short, choppy restrictive respiratory pattern caused by pleural effusion or pneumothorax. Thoracic auscultation usually reveals dull muffled heart and lung sounds when intrathoracic, extrapulmonary fluid is present. Other causes of a restrictive respiratory pattern such as pain from fractured ribs, flail chest, pulmonary contusions, pulmonary edema, and lower airway disease should be considered prior to thoracocentesis or if thoracocentesis is unrewarding. See figs. 3.1–3.9.

Supplies Needed

20–22-gauge 1-inch needles
Three-way stopcock
IV extension tubing
60-ml syringe
Clippers and blades
Nonsterile gloves
Aseptic scrub
Collection basin for fluid
EDTA and red-topped tubes
Sterile culturettes
Port-a-cul for bacterial culture

Indications

Diagnosis and treatment of:

Pleural effusion
- Hemothorax
- Chylothorax
- Pyothorax
- Neoplastic effusion
- Right-sided cardiac failure

Pneumothorax

Cautions and Contraindications

Caution must be exercised when draining chronic pleural effusions, as fibrinous adhesions of the lung to the pleura can occur. In such cases, fluid may be pocketed and difficult to obtain without the use of an ultrasound, and iatrogenic pulmonary puncture could occur.

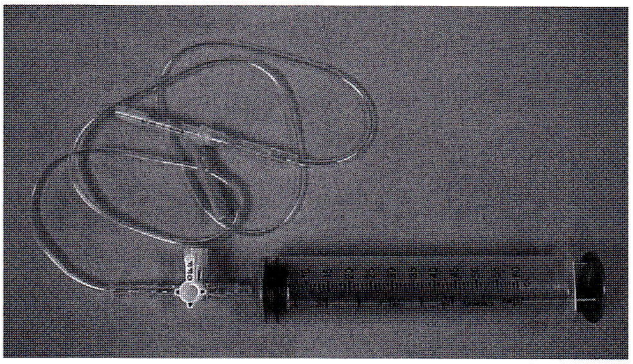

Fig. 3.1. Supplies needed to perform a thoracocentesis include electric clipper and blades, antimicrobial scrub solution, 22–20 gauge 1-inch needles, length of IV extension tubing, three-way stopcock, 60-ml syringe, red- and lavender-topped tubes for sample analysis, Port-a-cul and sterile culturettes for bacterial culture, and a collection basin for fluid.

Fig. 3.2. Place the patient in sternal or lateral recumbency. Clip a 4–8-cm square area of fur in the middle of the chest. Helpful Hint: It is best to perform the thoracocentesis in between the seventh and tenth intercostal space. Visualize the entire lateral thoracic wall as a box, and clip a square in the center of a box. This helps save valuable time often spent counting rib spaces when performing an emergency thoracocentesis.

Fig. 3.3. Aseptically scrub the clipped area with antimicrobial scrub solution.

Fig. 3.4. Palpate the rib spaces in the middle of the box. You will insert the needle in between ribs, avoiding the caudal aspect of each rib, where the intercostal arteries lie.

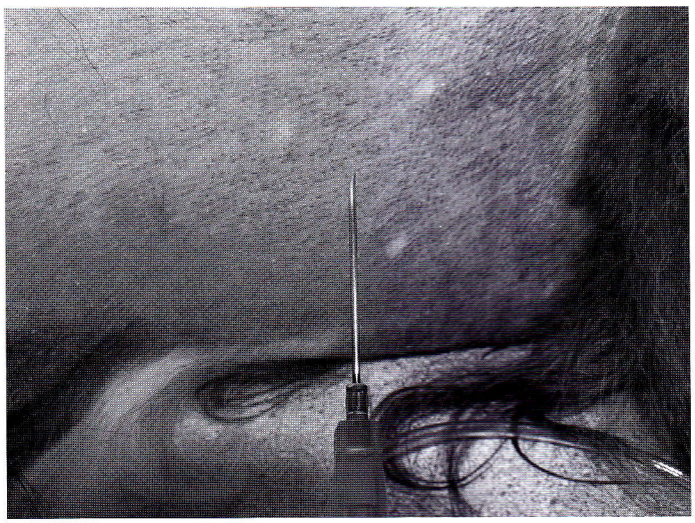

Fig. 3.5. Find the bevel of the needle. Make a mark on the hub of the needle or the extension tubing in line with the bevel. This will allow you to rotate the bevel of the needle toward the center of the patient as you insert the needle through the skin, perpendicular to the body wall.

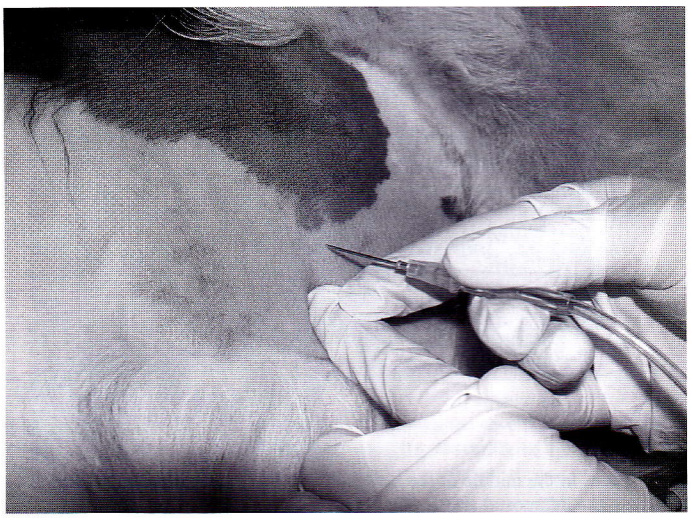

Fig. 3.6. Insert the needle in between rib spaces in the center of the clipped area.

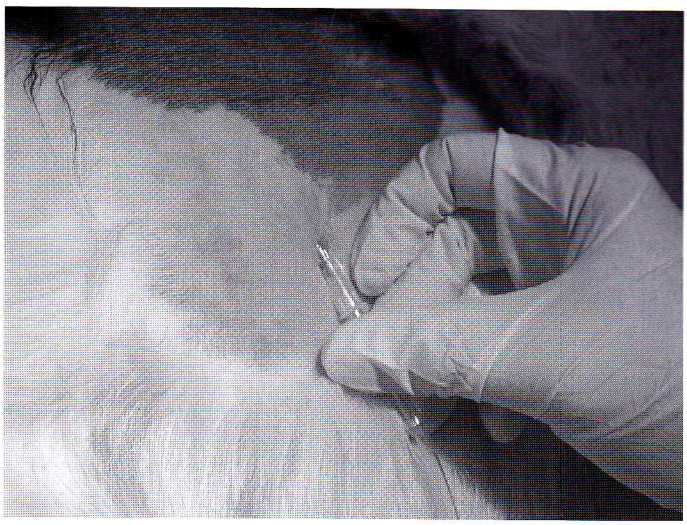

Fig. 3.7. Once you are in the pleural space, direct the needle parallel with the body wall to avoid iatrogenic lung puncture. The needle can be pivoted like the hands of a clock, so that the needle always stays parallel with the body wall. The bevel of the needle should be directed dorsally to obtain air, and ventrally to obtain fluid. Helpful Hint: You may insert the needle directly into the epaxial muscles if you attempt to insert the needle too far dorsally on the chest wall. Inserting the needle in the center of the box, then sweeping the bevel of the needle dorsally, will increase your chances of a positive tap in cases of pneumothorax. Attach the male port of the length of IV extension tubing to the hub of the needle. Never let go of the needle.

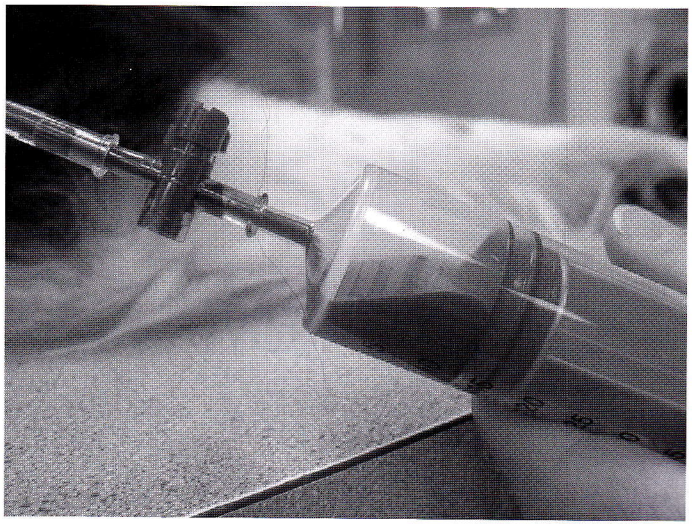

Fig. 3.8. Have an assistant draw off any air or fluid. Helpful Hint: Remember to quantify the volume air or fluid you are obtaining from each side! Remove the needle when you obtain negative pressure. No bandage is necessary. We usually perform thoracocentesis on both sides of the chest, as the mediastinum doesn't always communicate. If negative pressure cannot be obtained or maintained in cases of pneumothorax, placement of a thoracostomy tube is indicated.

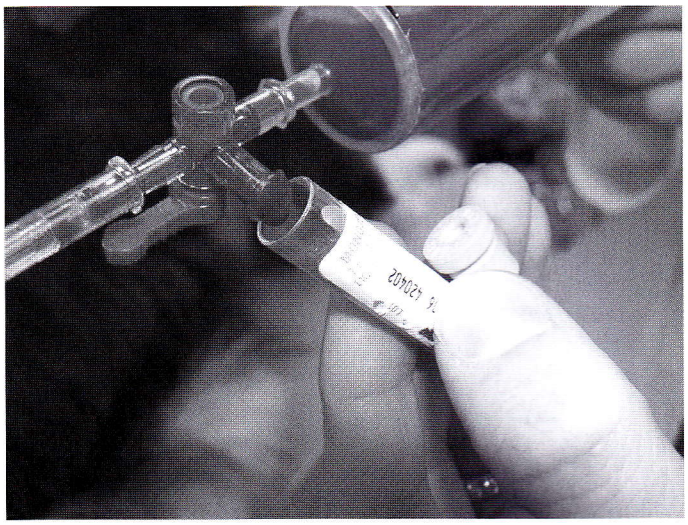

Fig. 3.9. Save any fluid collected in sterile red- and lavender-topped collection tubes, for later culture and fluid analysis.

THORACOSTOMY TUBE PLACEMENT

Introduction

Placement of a thoracostomy tube can be lifesaving in cases of tension pneumothorax or recurrent simple pneumothorax. Once a thoracostomy tube has been placed, it can be connected to a suction apparatus that continuously drains free air from within the pleural space until primary lung pathology has had time to heal. Hypoxemia is treated or prevented by allowing the lungs to remain expanded.

In other cases, the tube can be used to infuse and evacuate sterile saline from the thoracic cavity during the medical management of pyothorax. A small amount of fluid will develop simply because of the presence of the tube within the pleural cavity. Tubes can be removed if air production has ceased for 24 hours. When treating inflammatory pleural effusion, cytology is used to determine the ongoing need for thoracic drainage. White blood cell count and morphology along with the absence of bacteria are useful indices for tube removal. See figs. 3.10–3.23.

Supplies Needed

Sterile gloves
Electric clippers and blades
Antimicrobial scrub solution
2% lidocaine with 24-gauge needle
3–6-ml syringe
Sterile surgical pack
  Sterile field towels (4)
  Towel clamps
  #10 scalpel blade
  Scalpel handle
  Needle holders
  Mayo scissors
  Thumb forceps
  Hemostats
Gauze 4 × 4-inch squares
Argyle thoracic drainage tube with trocar stylet
Sterile drapes
3-0 or 2-0 nonabsorbable suture
1-inch tape
Christmas-tree adapter
Three-way stopcock
IV extension tubing
Wire
Wire cutters
Antimicrobial ointment

Indications

Pneumothorax
  Continuous suction
  Intermittent suction
Pleural effusion
Pleural lavage for medical management of pyothorax

Contraindications

Coagulopathies
Pleural adhesions

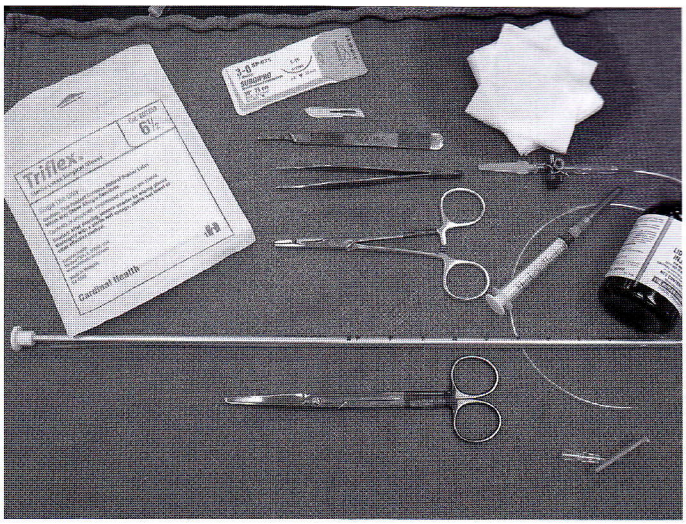

Fig. 3.10. Supplies needed for thoracostomy tube placement include sterile gloves, antimicrobial scrub, 2% lidocaine, sterile needle and syringe, surgical instruments, Argyle thoracic drain with trocar, suture, Christmas-tree adapter, three-way stopcock, IV extension tubing, surgical wire, wire cutters, antimicrobial ointment, and bandaging material.

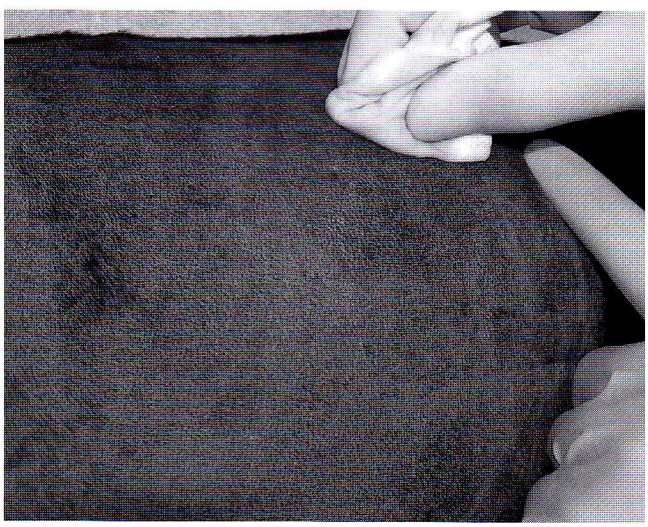

Fig. 3.11. Clip the entire lateral thoracic wall with the clipper blades, then aseptically scrub the clipped area.

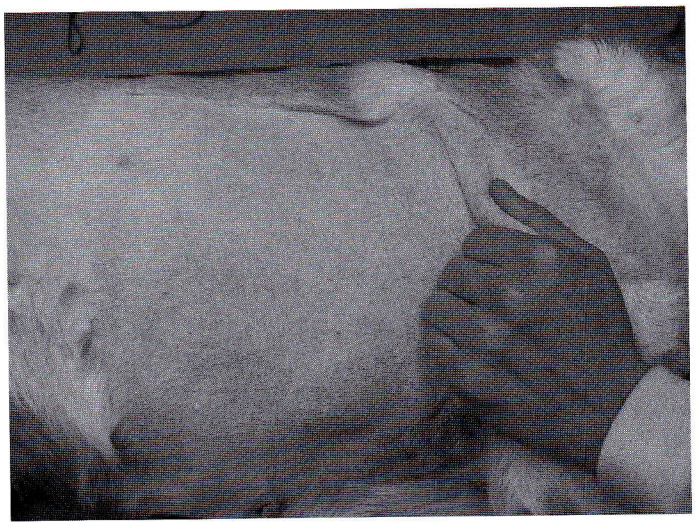

Fig. 3.12. Have an assistant pull the skin of the lateral thoracic wall cranially and ventrally at the point of the elbow. Helpful Hint: This will help you to create a subcutaneous tunnel through which the thoracostomy tube will pass.

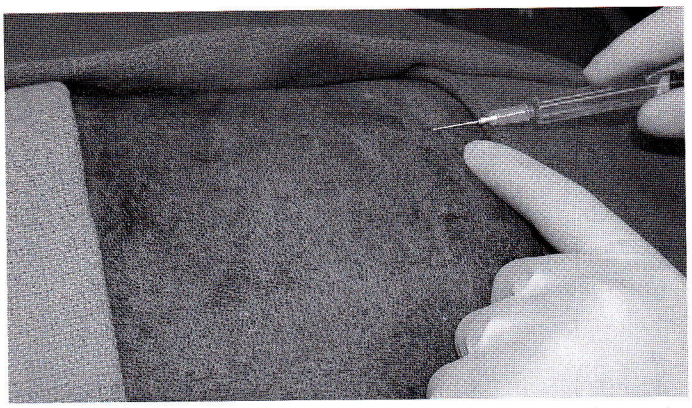

Fig. 3.13. Insert 1 mg/kg 2% lidocaine from the tenth to seventh intercostal space. Make sure the block includes the intercostal muscles through which the tube and trocar will pass. Helpful Hint: Leave the needle in the skin, so you know where you placed the lidocaine.

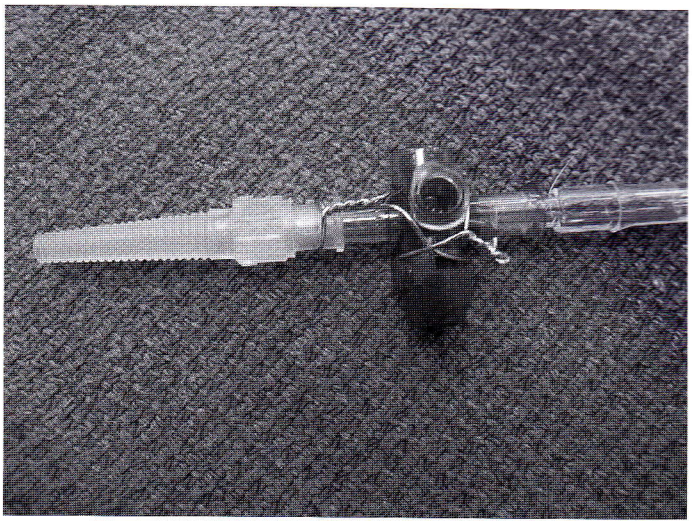

Fig. 3.14. While the lidocaine is taking effect, prepare the thoracostomy tube, and assemble the IV extension tubing, three-way stopcock, Christmas-tree adapter, and 60-ml syringe. Secure the three-way stopcock, Christmas-tree adapter to the tube with orthopedic wire.

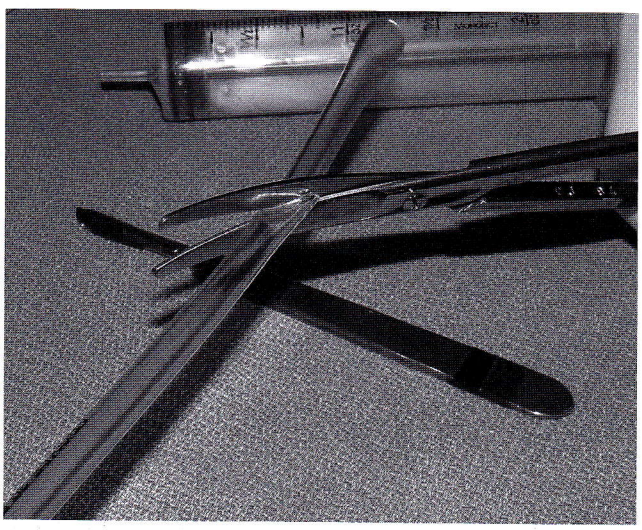

Fig. 3.15. Remove the trocar from the thoracic tube and cut the proximal tip of the tube on a diagonal so that the Christmas-tree adapter will fit securely in the opening.

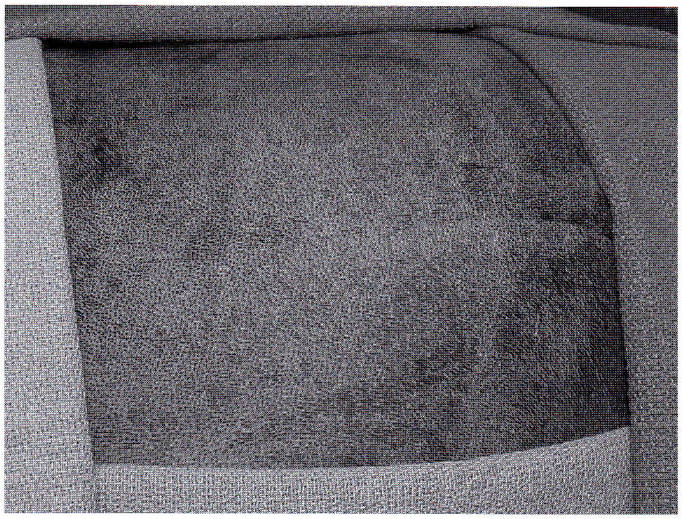

Fig. 3.16. Drape the lateral thorax with sterile field towels secured with towel clamps.

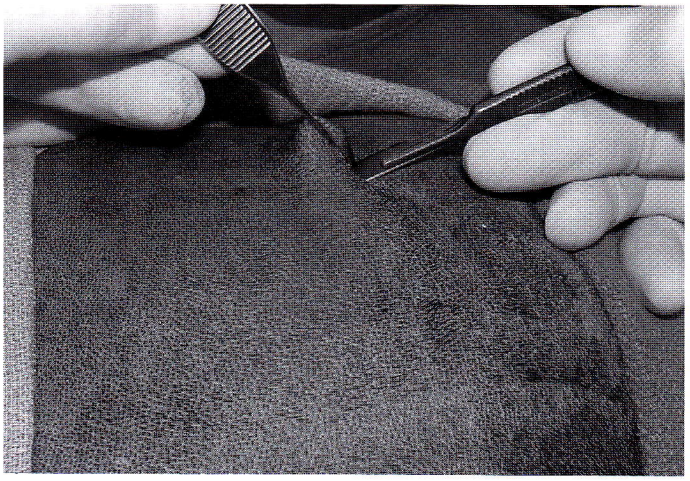

Fig. 3.17. Tent the skin at the dorsal portion of the tenth intercostal space, and make a small stab incision through the skin, making the hole just large enough for the tube to pass. Helpful Hint: If you make the incision too large, air can leak around the tube so that suction may not be efficient.

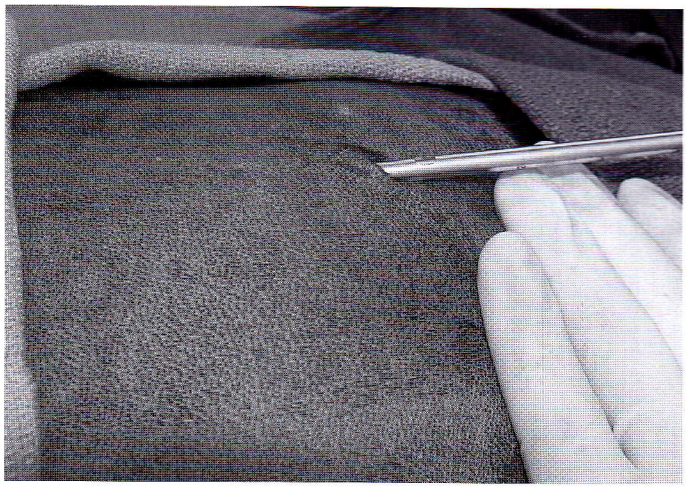

Fig. 3.18. Insert the trocar back into the thoracostomy tube. Insert the trocar and tube through the skin incision, tunneling the apparatus cranially.

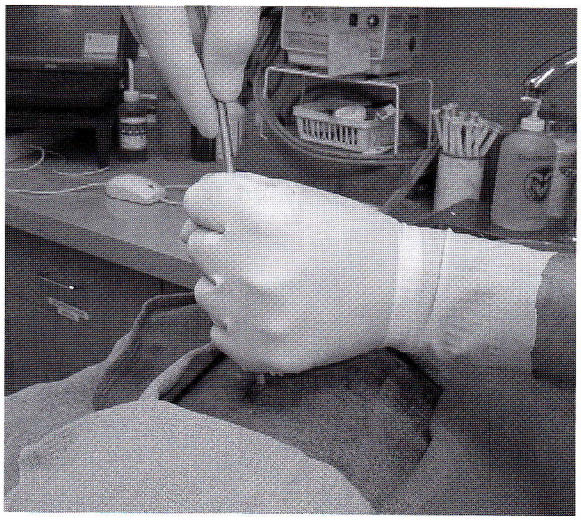

Fig. 3.19. When the tip of the trocar is over the seventh intercostal space, direct the trocar perpendicular to the thoracic wall. Grasp the trocar at the level of the skin firmly, and using the palm of your hand, push the trocar through the intercostal space into the thorax. Helpful Hint: Stand on a stool or lower the table to increase your leverage and make this step easier for you and the patient.

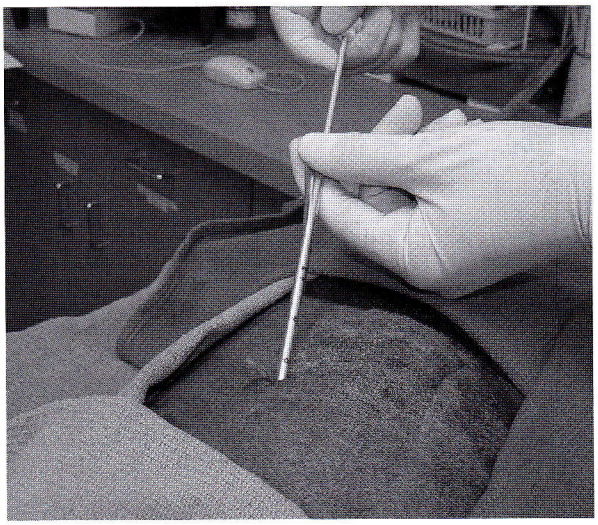

Fig. 3.20. Once the trocar has entered the thorax, push the tube off of the trocar cranially and ventrally, and have the assistant release the skin.

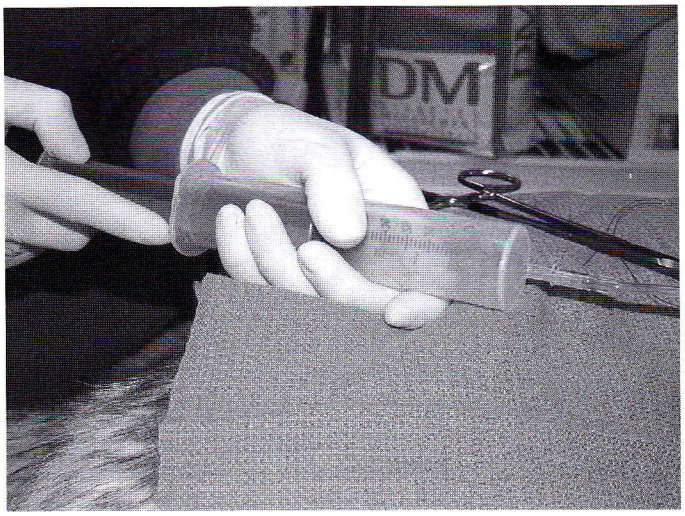

Fig. 3.21. Immediately secure the Christmas-tree adapter setup, and have an assistant evacuate the thorax while you are securing the tube in place.

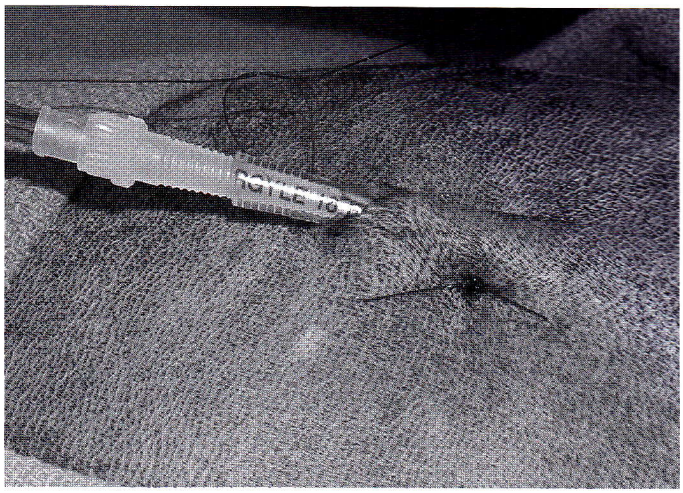

Fig. 3.22. Place a horizontal mattress suture cranially to the purse-string suture, around the tube. Use care to not puncture the tube, and don't make the suture so tight to occlude blood flow and cause skin damage.

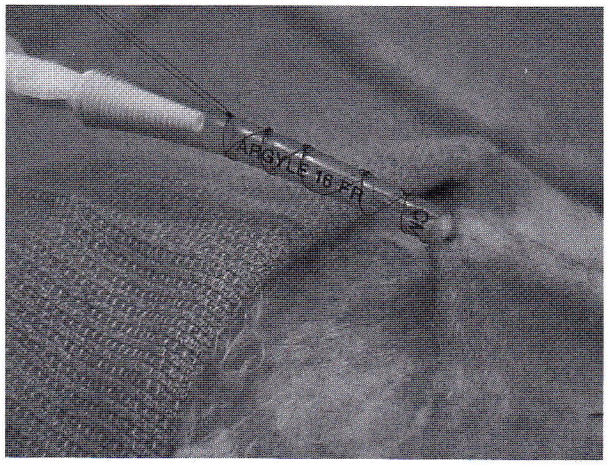

Fig. 3.23. Place a purse-string suture around the tube, and secure with a finger-trap to prevent tube displacement caudally. To protect the tube site from contamination, place a piece of 4 × 4-inch gauze with antimicrobial ointment over the chest tube point of entry into the skin, and secure to the thorax with layers of roll gauze, Kling, and Elasticon. Helpful Hint: Make sure that some of the adhesive tape is attached to the fur at the cranial edge of the bandage, to ensure that the bandage does not slip caudally.

MANAGEMENT OF AN OPEN SUCKING CHEST WOUND

Introduction

Open sucking chest wounds secondary to blunt or penetrating thoracic trauma are a life-threatening emergency that must be treated immediately. Pneumothorax and secondary hypoxemia cannot resolve without restoring negative intrapleural pressure. This requires a tight seal over the wound preventing communication of atmospheric air with the pleural space. Once the chest wound has been sealed, thoracocentesis and thoracostomy tube placement can be performed to allow expansion of the lungs until definitive wound repair can be accomplished. See figs. 3.24–3.28.

Supplies Needed

Electric clippers and blades
Sterile lubricating jelly or antimicrobial ointment
Sterile surgical gloves
Sterile scissors
Cotton roll gauze
Kling or brown gauze
Elasticon or Vetrap

Indications

Penetrating or blunt trauma with open communication through the wound into the thorax

Contraindications

Tension pneumothorax

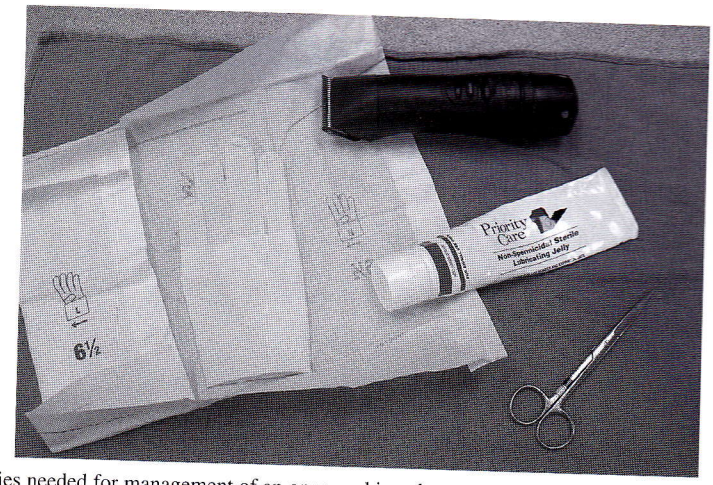

Fig. 3.24. Supplies needed for management of an open sucking chest wound.

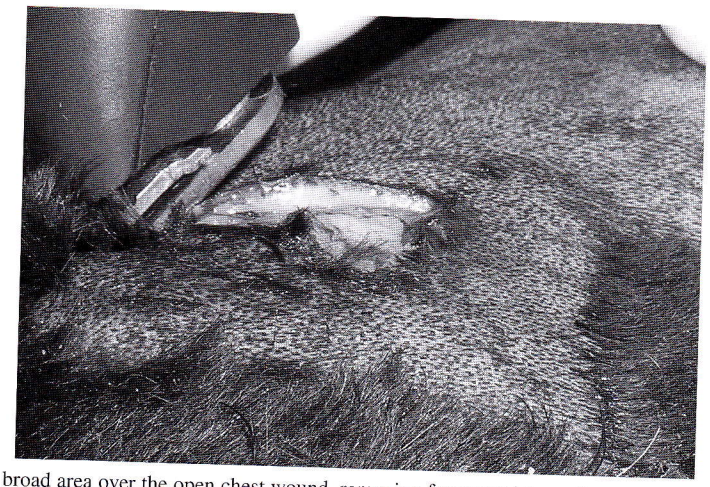

Fig. 3.25. Clip a broad area over the open chest wound, removing fur around the entire wound.

Fig. 3.26. With a sterile scissors, cut the fingers off of a sterile surgical glove and cut open the glove creating a flat sterile latex patch. Alternatively, the use of surgical sticky drape will achieve the same result.

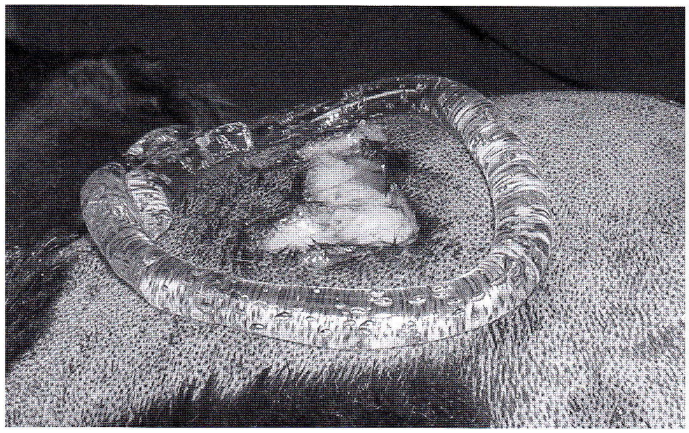

Fig. 3.27. Place a strip of sterile lubricating jelly or antibiotic ointment circumferentially around the chest wound.

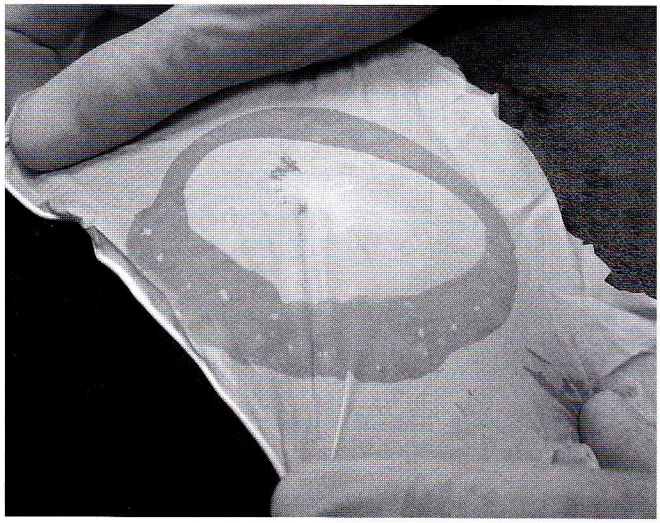

Fig. 3.28. Place the sterile glove over the wound, making sure that the glove is in contact with and covers the lubricating jelly to create a seal. After creating a seal, a thoracic drain can be placed as previously described. Take care to NOT place the tube through the wound. The thoracic drain should stay in place until definitive surgical exploration and repair of the chest wound can occur once the patient is more stable.

LOCAL ANESTHETIC BLOCKS FOR RIB FRACTURES OR FLAIL CHEST

Introduction

The pain associated with rib fractures impairs a patient's ability to adequately ventilate and thus move oxygen into the lungs. Hypoxemia from blunt thoracic trauma, pneumothorax, and underlying pulmonary contusions is exacerbated by impaired ventilatory capacity. Rather than wrapping rib fractures, which causes further restriction to thoracic excursions, applying local anesthesia to the nerves supplying affected ribs can greatly improve ventilatory function. See figs. 3.29–3.35.

Supplies Needed

3–6-ml syringe
22-gauge needles, 3/4 inch and 1-1/2 inch
Lidocaine 2%
Sodium bicarbonate
Electric clippers and blades
Antimicrobial scrub

Indications

Rib fractures

Contraindications

Known sensitivity to local anesthetic agents

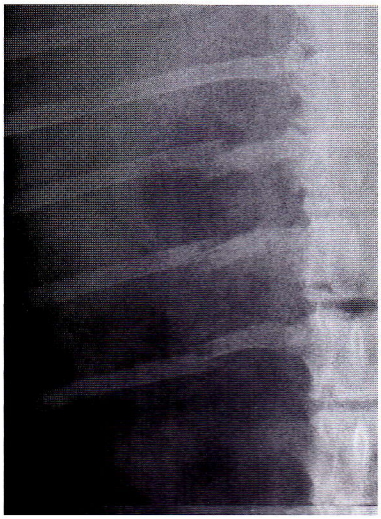

Fig. 3.29. Photograph of a thoracic radiograph(s) with rib fractures.

Fig. 3.30. Supplies needed for analgesic treatment of rib fractures.

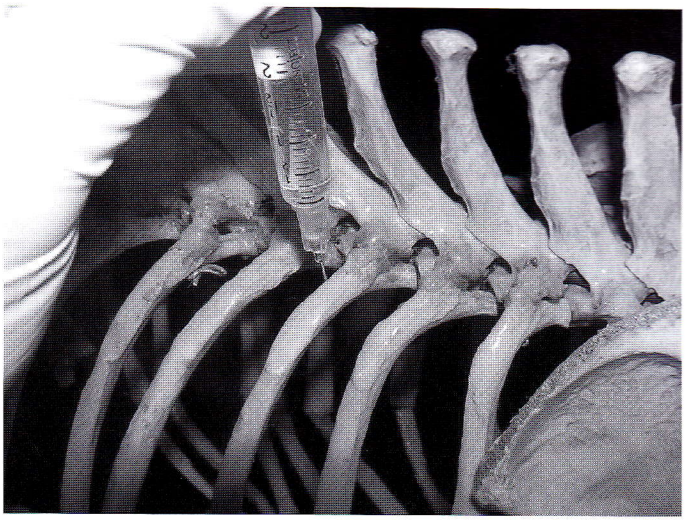

Fig. 3.31. Photo of skeleton and placement of local anesthetic blocks. The local anesthetic will be placed at the dorsal and caudal aspect of each rib.

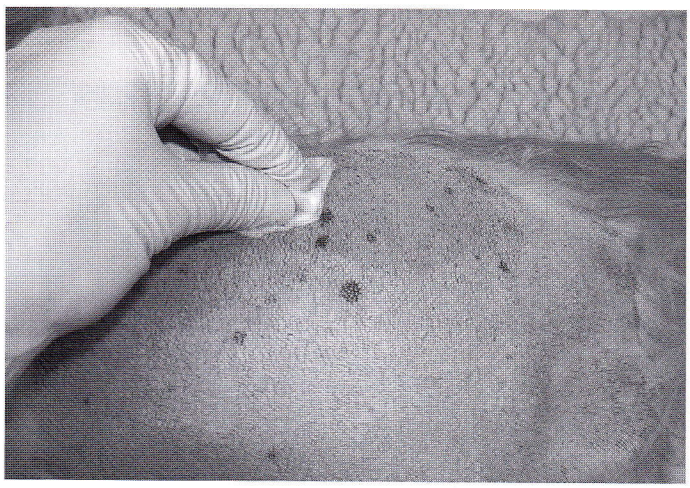

Fig. 3.32. Clip and aseptically scrub the patient's thorax on the dorsal and ventral aspect of the affected ribs, making sure that the rib cranial and caudal to the affected rib(s) is included.

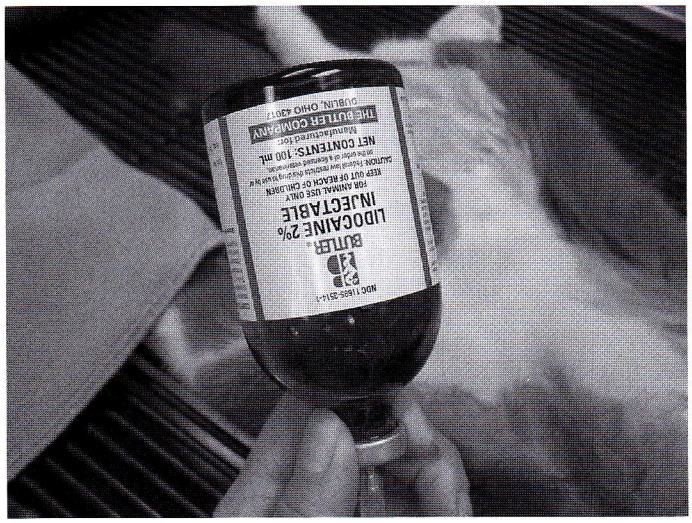

Fig. 3.33. Draw up 1 mg/kg of 2% lidocaine. Helpful Hint: Add a small amount of sodium bicarbonate (1:9 ratio of bicarbonate to lidocaine) to decrease the pain associated with infusion of this acidic solution. It was previously thought that sodium bicarbonate decreased the efficacy of lidocaine. However, recent evidence has demonstrated that the two can be mixed without decreasing the efficacy of this acidic local anesthetic. Warming the lidocaine to body temperature and infusing SLOWLY also aids in decreasing patient discomfort.

Fig. 3.34. Palpate the caudal aspect of each affected rib.

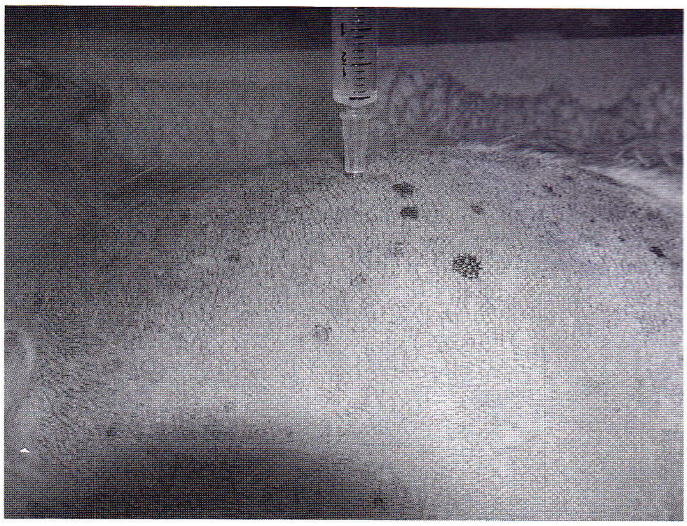

Fig. 3.35. Infuse a small amount of the lidocaine/bicarbonate mixture at the dorsal-caudal and ventrocaudal aspect of each rib. Repeat the process for each affected rib and at least one rib cranial and one rib caudal to the affected rib(s) segment. This process can be repeated up to three times daily, as needed for adjunctive analgesia. Helpful Hint: Always aspirate first prior to injecting, to avoid intravenous injection.

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CHAPTER 4

Oxygen Supplementation

NASAL AND NASOPHARYNGEAL OXYGEN CATHETER PLACEMENT

Introduction

The placement of a nasal or nasopharyngeal tube is a quick and simple means to provide supplemental oxygen to the hypoxic patient. Nasal and nasopharyngeal oxygen catheters are well-tolerated, require minimal equipment, and are easy to maintain. See figs. 4.1–4.9.

Supplies Needed

Argyle feeding tube or red rubber catheter
3-0 nylon suture
Surgical staples
2% lidocaine or 0.5% proparacaine
Permanent marker
Sterile lubricating gel or ointment
1-ml syringe case
Flexible extension tubing
Humidified oxygen source
Rigid Elizabethan collar

Indications

Hypoxemia due to any cause

Contraindications

Laryngeal obstruction, nasal or facial trauma, epistaxis, coagulopathies, nasal mass lesions (neoplasia, foreign bodies, fungal infection); relatively contraindicated in patients with intracranial mass lesions or elevated intracranial pressure due to the risk of sneezing and increasing intracranial pressure during catheter placement.

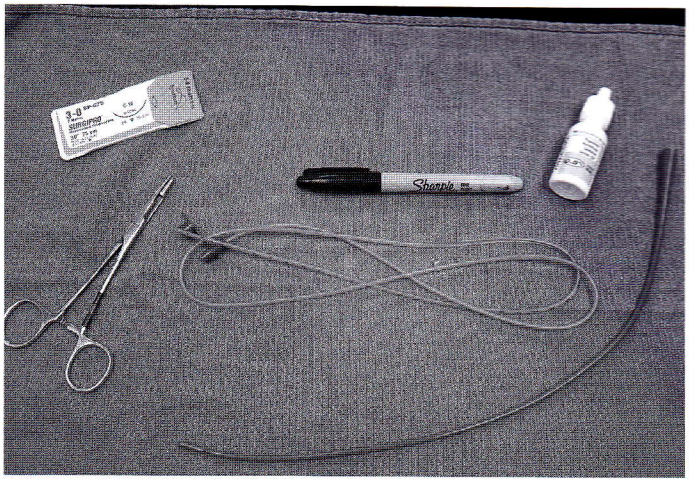

Fig. 4.1. Supplies needed for placement of a nasal or nasopharyngeal oxygen supplementation tube.

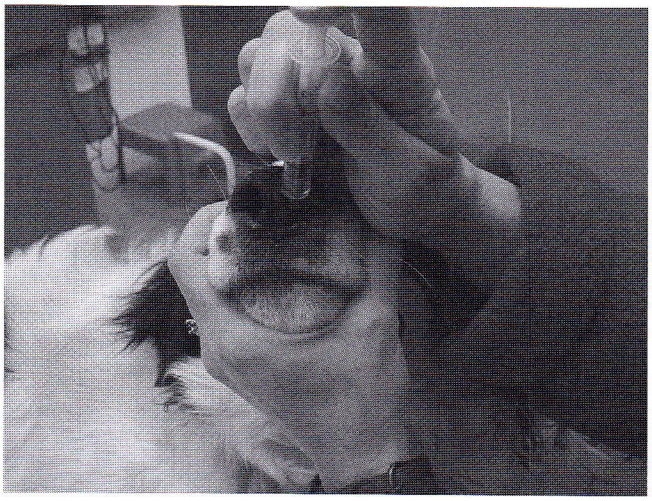

Fig. 4.2. Instill several drops of dilute 2% lidocaine or proparacaine in the nostril, tilting the patient's nose upward to assure coating of the nasal mucosa with the topical anesthetic.

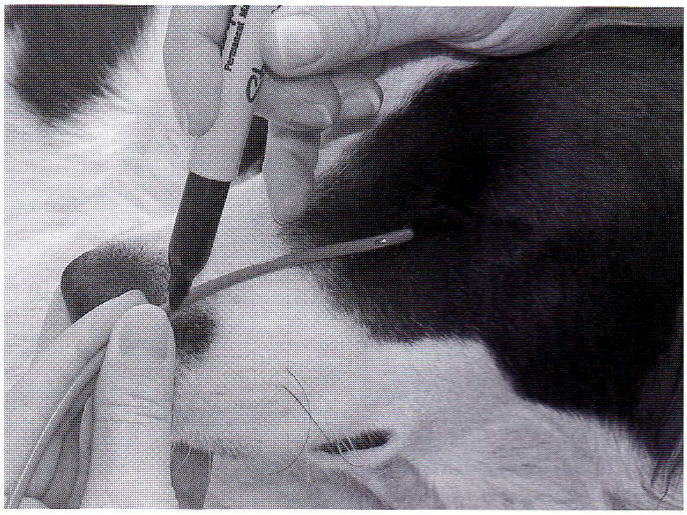

Fig. 4.3. For placement of a nasal oxygen catheter, the tip of the tube is placed to the level of the medial canthus of the eye, and the portion adjacent to the tip of the nose marked with a permanent marker.

Fig. 4.4. For placement of a nasopharyngeal oxygen catheter, the tip of the tube is measured from the ramus of the mandible to the tip of the nose, and marked accordingly.

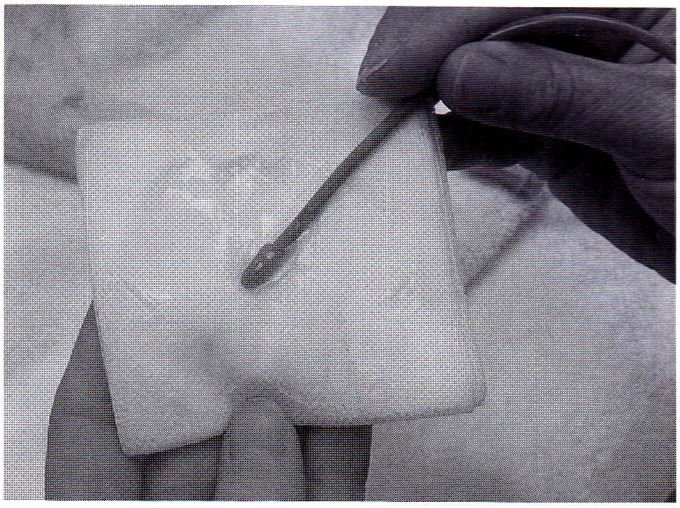

Fig. 4.5. Lubricate the tip of the tube with sterile lubricant jelly or ointment.

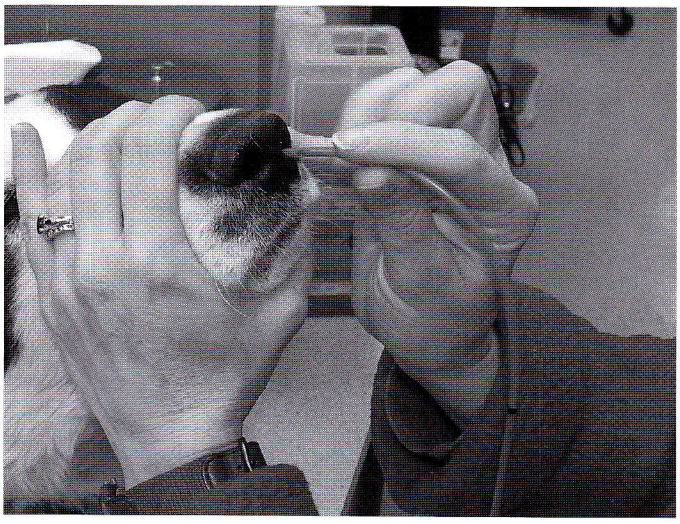

Fig. 4.6. Hold the tube as close to the tip as possible, adjacent and as close to the nostril as possible. Hold the patient's muzzle with the other hand while an assistant restrains the patient. Direct the tube ventrally and medially into the nostril, to the level of the mark on the tube.

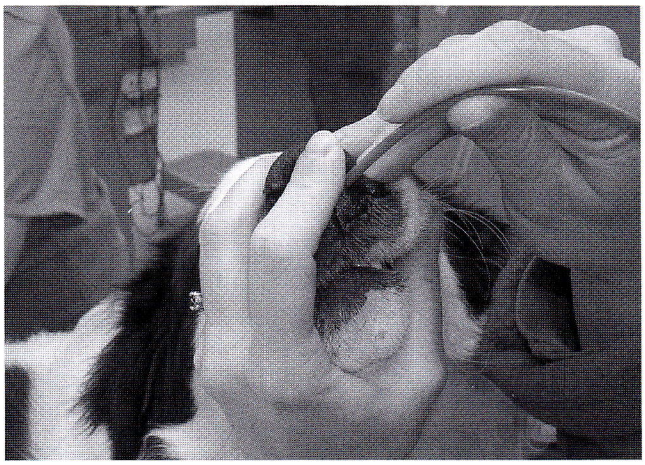

Fig. 4.7. When placing a nasopharyngeal oxygen catheter, pinch the dorsolateral portion of the external nares medially, and push the nasal philtrum dorsally as you attempt to pass the tube into the nasopharynx. This maneuver will help facilitate passing the tube into the ventral nasal meatus, then into the nasopharynx.

Fig. 4.8. Place a stay suture adjacent to the nostril. You will then secure the tube to the stay suture with another length of suture. If the tube becomes dislodged, the stay suture can remain in place, avoiding this somewhat uncomfortable step when you replace the tube.

Fig. 4.9. Suture the tube to the stay suture with a finger-trap. Place a second and third suture either over the dorsal nasal planum and on top of the head, or on the lateral maxilla and zygomatic arch. Helpful Hint: Avoid the whiskers, as trapping whiskers in the suture and tube can cause patient discomfort. Immediately place a rigid Elizabethan collar to avoid patient disruption or removal of the tube. Oxygen flow rates of 50–100 ml/kg/minute are well tolerated, provided that the oxygen source is humidified to prevent drying of the nasal mucosa. Topical proparacaine (0.5%) can be instilled as necessary for patient comfort.

INTRATRACHEAL OXYGEN SUPPLEMENTATION CATHETER

Introduction

The placement of an intratracheal catheter for oxygen supplementation is an effective and well-tolerated means of providing supplemental oxygen to the patient with head trauma, nasopharyngeal obstruction, pulmonary parenchymal disease, and hypoventilation. In some patients, placement may require sedation or general anesthesia.

Note: The initial management and preparation of a patient for placement of an intratracheal oxygen catheter is identical for the placement of a tracheostomy tube. Please refer to "Tracheostomy Tube Placement" below for photos and a general overview of the technique.

Step 1. Heavily sedate the patient or place the patient under general anesthesia. Place the patient in dorsal recumbency. Helpful Hint: It is useful to place the patient in a V-trough to make sure that the patient is in the correct position. This is helpful to assist you in making sure to stay on ventral midline.

Step 2. Clip the ventral cervical region from the ramus of the mandible caudally to the thoracic inlet and dorsally to the epaxial muscles. Helpful Hint: In patients with long fur, clip the long feathers short to ensure and maintain sterility of your surgical field.

Step 3. Aseptically scrub the clipped area and drape the area with sterile field towels secured with towel clamps.

Step 4. Palpate the larynx. Make a 1-cm skin incision perpendicular to the trachea with a #10 scalpel blade, just caudal to the larynx. Helpful Hint: Make sure that you stay on ventral midline (fig. 4.17).

Step 5. Bluntly dissect through the underlying fascia with curved hemostats or Mettzenbaum scissors to the level of the trachea. Helpful Hint: Make sure that you dissect only in the same plane, to prevent traumatic injury to the sternohyoid muscles, and help facilitate exposure of the underlying trachea (fig. 4.18).

Step 6. Retract the skin and underlying musculature with Gelpi retractors to improve exposure and visualization of the trachea (fig. 4.19).

Step 7. Visualize the trachea. Gently pick up the overlying fascia and snip with a Mettzenbaum scissors to expose tracheal rings. Helpful Hint: Make sure that you avoid any vessels, as hemorrhage will obscure visibility in your surgical field (fig. 4.20).

Step 8. Make a small stab incision with a #11 scalpel blade in between tracheal rings. Helpful Hint: Only a small incision is necessary. DO NOT incise more than 50% of the circumference of the trachea. Insert the tips of a curved hemostat into the incision. Next see figs. 4.10–4.14.

Supplies Needed

Cook multiport feline thoracic drainage catheter with trocar stylette *OR*
Venocath 16-gauge over-the-wire long catheter
Electric clippers and blades
Heavy sedation or general anesthesia protocol
Antimicrobial scrub
#10 and #11 scalpel blade on scalpel handle
Small Gelpi retractors (2)
Curved mosquito hemostats

Mayo or Mettzenbaum scissors
Groove director from spay pack
3-0 nylon suture
1-inch white tape
Cotton bandage material
Roll gauze
Elasticon or Vetrap
1-ml syringe case
Flexible oxygen tubing
Humidified oxygen source
Sterile gloves
Sterile field towels (4)
towel clamps (4)

Indications

Refractory hypoxemia with nasal or nasopharyngeal oxygen supplementation
Patient not tolerant of nasal or nasopharyngeal oxygen catheter
Head or facial trauma
Nasal trauma
Epistaxis
Coagulopathies
Nasal obstruction (trauma, mass lesion)
Refractory hypoxemia in patients where mechanical ventilation is not possible
Pharyngeal obstruction

Contraindications

Tracheal injury
Tracheal obstruction distal to site of catheter placement

Fig. 4.10. Supplies needed for intratracheal oxygen catheter.

Fig. 4.11. Insert a grooved director into the incision, then remove the hemostat.

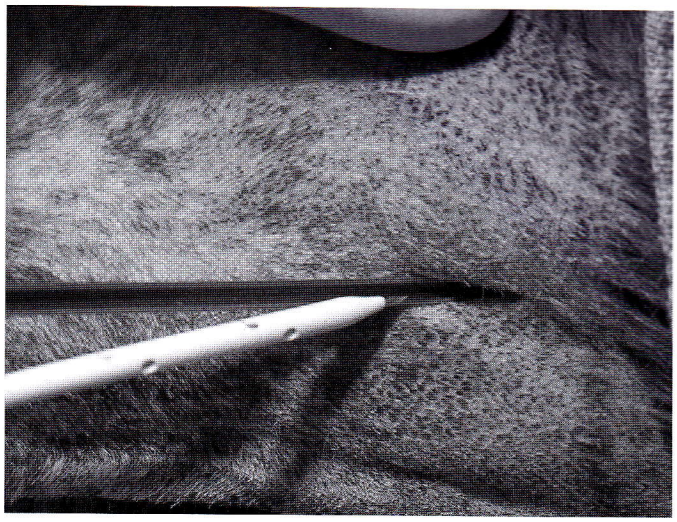

Fig. 4.12. Insert the Cook multiport trocarized catheter (with trocar in place) into the lumen of the trachea. Once the catheter is inserted about halfway, remove the trocar, and continue inserting the catheter so that the distal end of the catheter is situated at the level of the carina. In large dogs, the catheter may be inserted to its hub.

Fig. 4.13. Secure the catheter to the skin with a length of 3-0 nylon suture sutured to a length of white tape secured around the catheter. Place a piece of 1-inch white tape around the catheter and secure it to the neck. Helpful Hint: Make sure that the catheter can move freely with minimal resistance, to prevent kinking of the catheter at the point of insertion into the neck. Loosely bandage the catheter to the neck, then secure syringe adapter and appropriate length of oxygen tubing, and connect to humidified oxygen source.

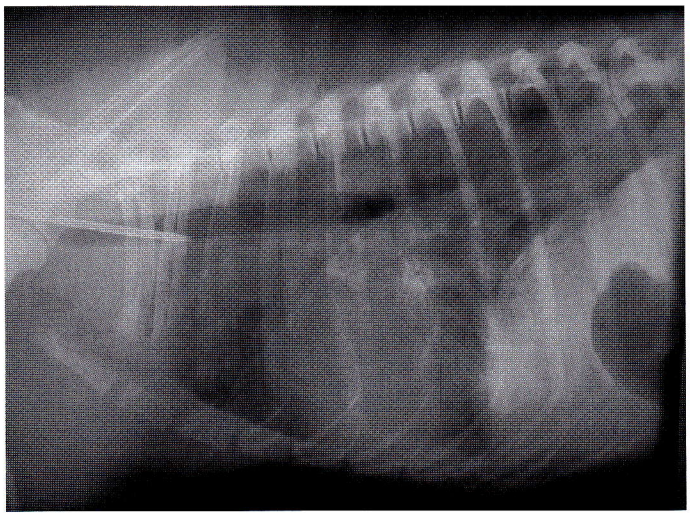

Fig. 4.14. Lateral thoracic radiograph displaying proper placement of the tracheal oxygen catheter. In smaller patients, the catheter is often long enough to reach the level of the carina. This is a lateral thoracic radiograph with an intratracheal oxygen catheter in place in a patient with acute respiratory distress syndrome (ARDS).

TRACHEOSTOMY TUBE PLACEMENT

Introduction and Indications

A temporary tracheostomy tube should be placed in cases of severe upper airway obstruction, trauma, laryngeal or pharyngeal collapse, or if long-term positive pressure ventilation is going to be performed. See figs. 4.15–4.24.

Contraindications

Tracheal injury
Tracheal obstruction distal to tracheostomy site

Supplies Needed

Sterile field towels (4)
Towel clamps (4)
#10 scalpel blade
Scalpel handle
Small Gelpi retractors (2)
Sterile Mettzenbaum scissors
Curved Kelly hemostats (1)
Gauze 4 × 4-inch squares
3-0 to 2-0 nylon suture
#11 scalpel blade
Various-sized Shiley tracheostomy tubes
Umbilical tape
Electric clippers and blades
Antimicrobial scrub
Sterile gloves

Fig. 4.15. Supplies needed for temporary tracheostomy tube placement.

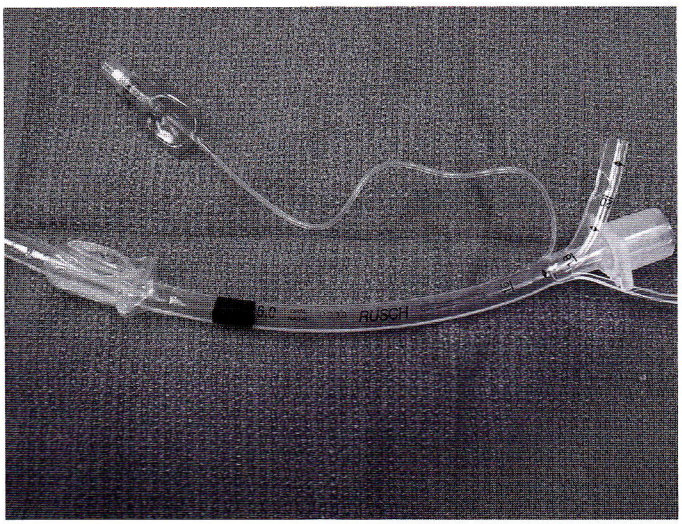

Fig. 4.16. If a Shiley tracheostomy tube is not available, a tracheostomy tube can be made from a low-pressure cuffed endotracheal tube. To create a tracheostomy tube, cut the proximal end of the tube above the tube that inflates the low-pressure cuff distally. The tube can be cut so that the proximal end of the tube folds down to create wings that can be secured to the neck with umbilical tape.

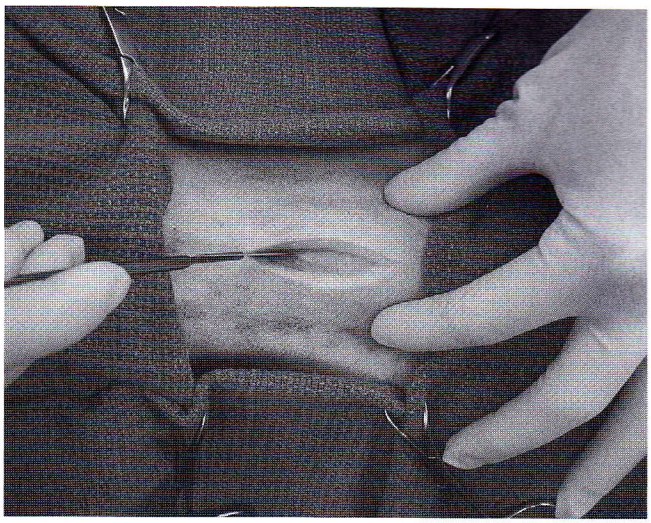

Fig. 4.17. Place the patient under general anesthesia, then place the patient in dorsal recumbency. Clip, then aseptically scrub the ventral cervical region from the ramus of the mandible caudally to the thoracic inlet and dorsally to midline. Drape the sterile field with sterile towels secured with towel clamps. Next, palpate the larynx, and make a 3–6-cm skin incision on ventral midline, perpendicular to the trachea using a #10 scalpel blade. Helpful Hint: It is useful to place the patient in a V-trough to make sure that the patient is in the correct position. This is helpful to assist you in making sure to stay on ventral midline. Make sure that the head and neck are completely straight.

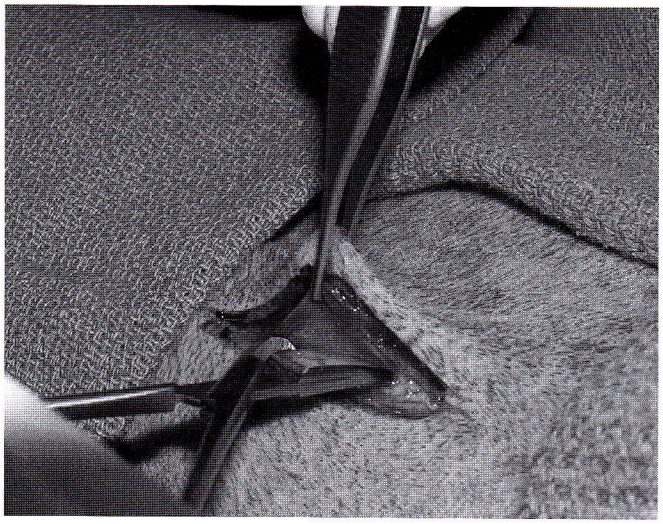

Fig. 4.18. Bluntly dissect the underlying subcutaneous tissue and through the sternohyoideus muscles using a curved hemostats or Mettzenbaum scissors. Helpful Hint: Use care to dissect through the same muscle plane and avoid vessels. This will aid rapid visualization of the trachea and prevent hemorrhage.

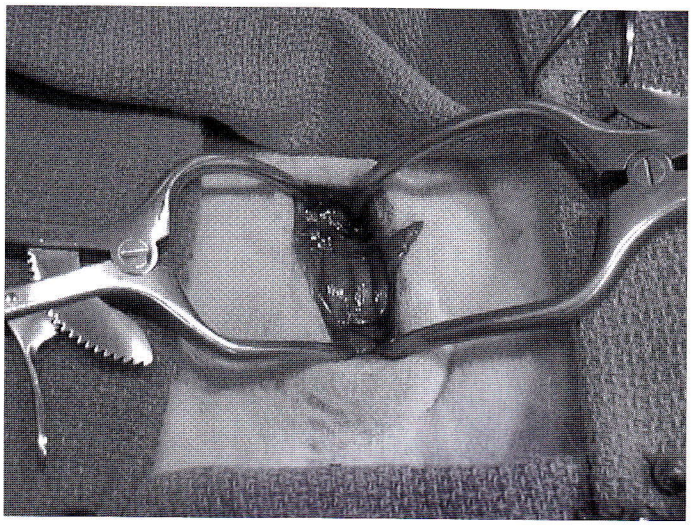

Fig. 4.19. Retract the lateral edges of the skin incision and subcutaneous tissues, including the sternohyoideus muscles, laterally to allow best visualization. Helpful Hint: The use of Gelpi retractors will facilitate a quick dissection.

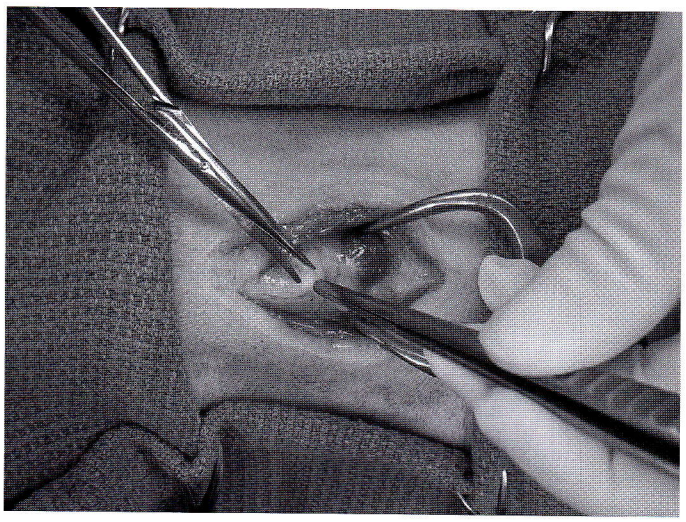

Fig. 4.20. Pick up the fascia overlying the trachea and gently dissect with a Mettzenbaum scissors. Helpful Hint: Use care to avoid vessels to prevent hemorrhage and impaired visualization in your surgical field.

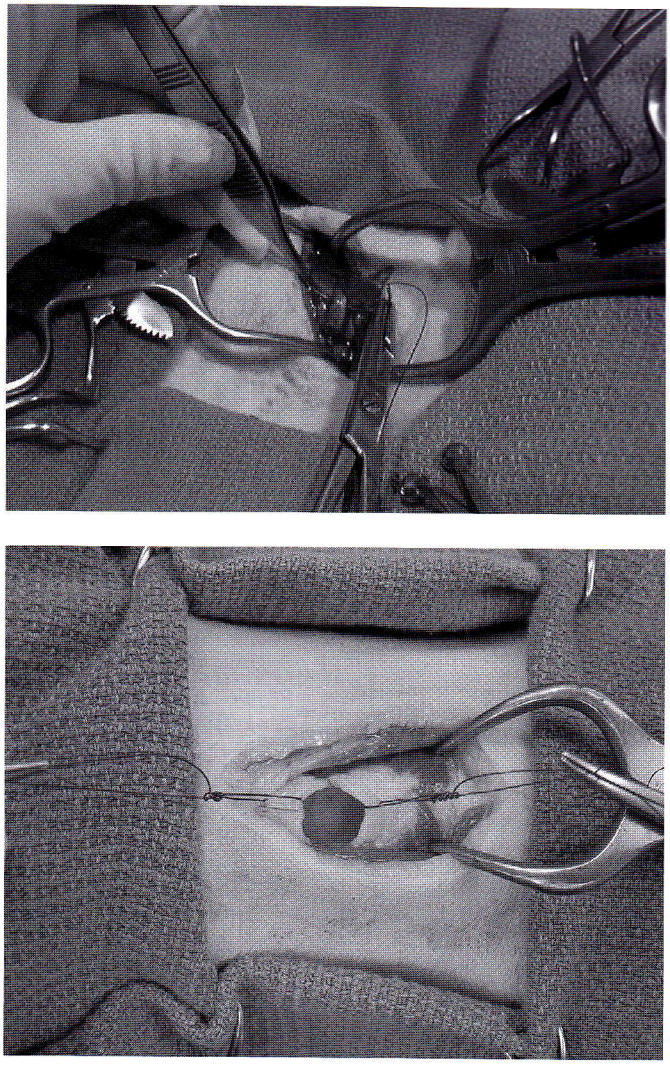

Fig. 4.21. (a)Place two individual stay sutures with 0 or 1 nonabsorbable suture around the fourth and fifth tracheal rings. Keep the ends of the suture long. (b)The sutures will allow you to retract the incision and hold the incision open and place the tracheostomy tube. The stay sutures will remain in place until the patient no longer requires the tracheostomy tube. These sutures will be very important if you need to replace the tube.

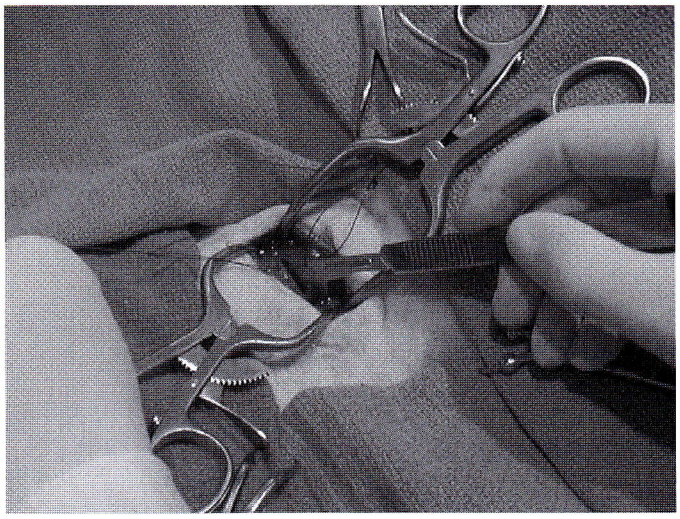

Fig. 4.22. Make a horizontal incision in between the fourth and fifth tracheal rings using a #10 scalpel blade, taking care to avoid cutting more than 50% of the circumference of the trachea.

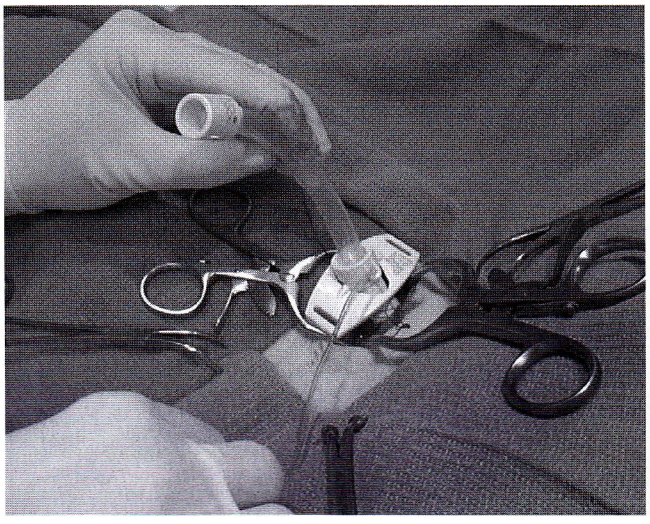

Fig. 4.23. Retract the stay sutures to open the tracheostomy incision, and place a Shiley tracheostomy catheter into the lumen of the trachea. If a Shiley tracheostomy tube is not available, an appropriately sized endotracheal tube can be cut down and splayed open to create a short tube with lateral handles. Care should be taken to preserve the cuff and its inflation tubing.

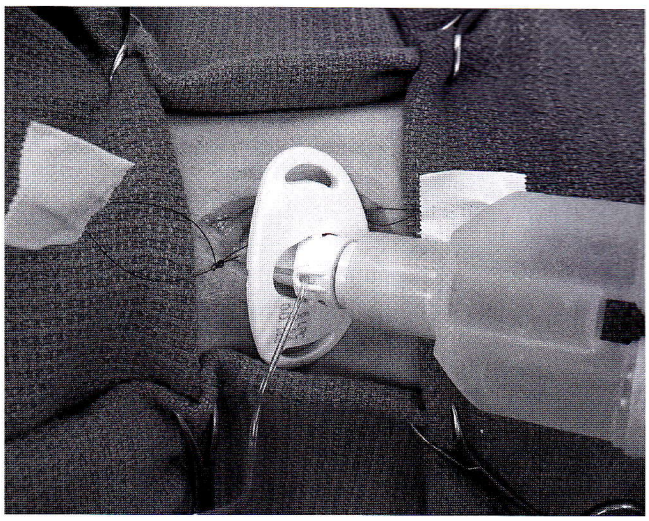

Fig. 4.24. Remove the internal obturator, and secure the inner cannula of the Shiley tracheostomy catheter in place. Smaller Shiley tubes for cats, puppies, and toy-breed dogs do not have an internal cannula. Next, secure the oxygen source, as necessary. Secure the outer cannula to the neck with a length of umbilical tape. Once the patient no longer requires the tracheostomy tube, the tube can be removed. Next, remove the stay sutures, and leave the wound to heal by second intention.

OXYGEN HOOD

Introduction

Oxygen hoods are an excellent method of providing short-term supplemental oxygen support to the hypoxemic patient. Hoods are available commercially, or can be manufactured using a rigid Elizabethan collar, Saran Wrap, and adhesive tape. In some cases, patients will not tolerate an oxygen hood. Also, the patient can become hyperthermic and must be monitored closely to prevent hyperthermia from occurring. Extremely small patients can be placed directly into a hood for supplemental oxygen without the stress of any handling. See figs. 4.25–4.29.

Supplies Needed

White adhesive tape
Humidified oxygen source
Flexible oxygen tubing
Commercially available oxygen hood
Rigid Elizabethan collar
Saran Wrap

Indications

Hypoxemia

Contraindications

Anxiety and intolerance of the hood
Panting
Hyperthermia

Fig. 4.25. Commercially available oxygen hoods.

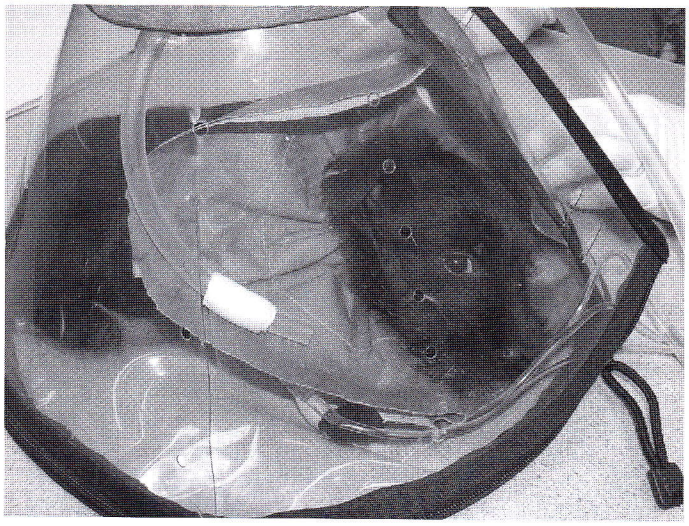

Fig. 4.26. In some cases, a small puppy, kitten, or exotic species can be fit into an oxygen hood to create a small oxygen cage.

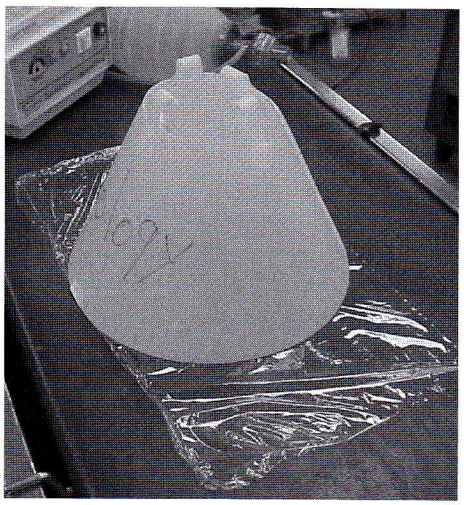

Fig. 4.27. To manufacture your own oxygen hood, take a rigid Elizabethan collar and cover the front three-fourths with Saran Wrap.

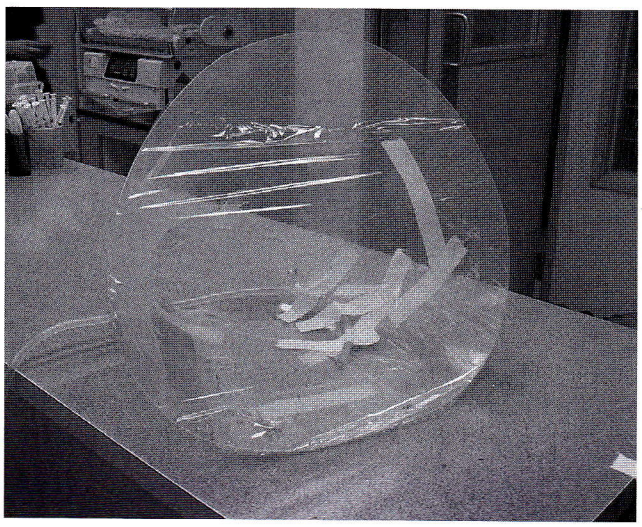

Fig. 4.28. Secure the Saran Wrap in place with white adhesive tape. Helpful Hint: Leave the bottom three-fourths of the hood open, to prevent iatrogenic hyperthermia, condensation, and rebreathing of CO_2.

Fig. 4.29. Secure the hood around the patient's head with a length of gauze. Insert a length of flexible oxygen tubing into the side of the hood, and administer supplemental oxygen at 50–100 ml/kg/minute.

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CHAPTER 5

Urinary Catheter Placement, Urohydropulsion, Antepubic Temporary Cystostomy Catheter Placement

INTRODUCTION

Placement of a urinary catheter often serves a dual purpose in our critically ill small animal patients. In nonambulatory animals, a urinary catheter attached to a closed collection system is valuable in maintaining cleanliness and preventing urine scald and decubital ulceration. Urine collection and quantitation is often necessary when assessing perfusion parameters and renal function. Finally, urethral catheterization and maintenance of an indwelling urinary catheter is necessary in the treatment of urethral obstruction in cases of feline lower urinary tract disease and urethral calculi. This chapter describes the placement of various types of urinary catheters in male and female dogs and cats. See figs. 5.1–5.21.

Supplies Needed

Electric clippers
Electric clipper blades
Sterile gloves
Antimicrobial scrub
Antimicrobial solution
1-inch white tape
20–30 ml syringe
Sterile 0.9% saline solution
Sterile needle holder
Sterile huck towels
Sterile urine collection bag
Sterile IV infusion line
Sterile lubricating jelly
Christmas-tree adapter

Vaginal speculum
Sterile otoscope head
Light source
3-0 nonabsorbable suture
Foley catheter
Red rubber catheter
Infant feeding tube

Indications

Maintenance of patient cleanliness in nonambulatory patients
Urine collection for urinalysis
Urine quantitation
Treatment of urethral obstruction
Urethral trauma
Urethral prolapse

Contraindications

Not indicated in patients that are ambulatory and do not have urinary obstruction or do not require urine quantitation

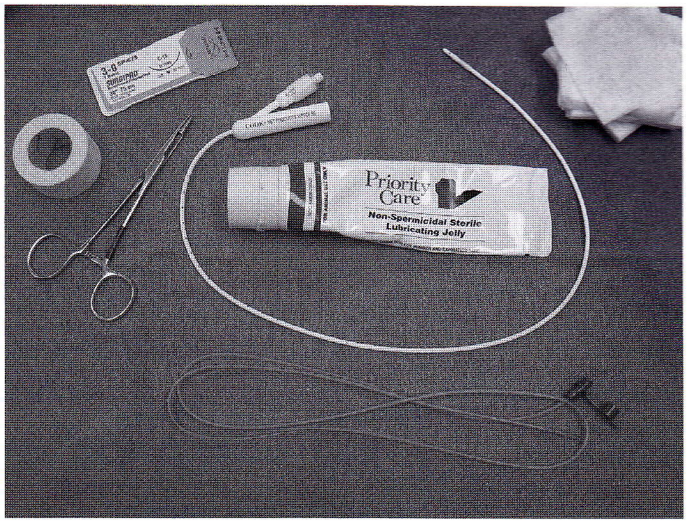

Fig. 5.1. Supplies needed for placement of a urinary catheter differ for males and females. Required supplies include electric clippers and blades, antimicrobial scrub and solution, sterile 0.9% saline, 20–30-ml sterile syringes, 1-inch white tape, 3–6-ml syringes, sterile needle holder, sterile field/huck towels, urinary catheter, sterile lubricating jelly, Christmas-tree adapter, light source, and 3-0 nonabsorbable suture. For female urinary catheter placement, a vaginal speculum or otoscope with a sterile head and light source may come in handy.

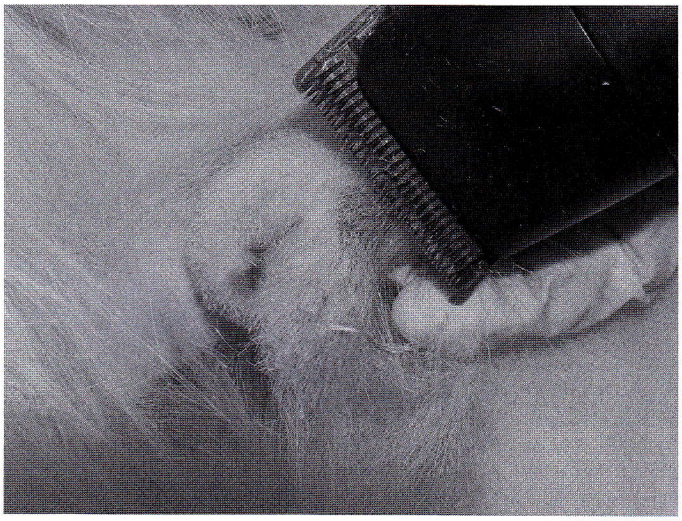

Fig. 5.2. Clip the fur close to the tip of the prepuce. Helpful Hint: Use caution to not cause skin irritation.

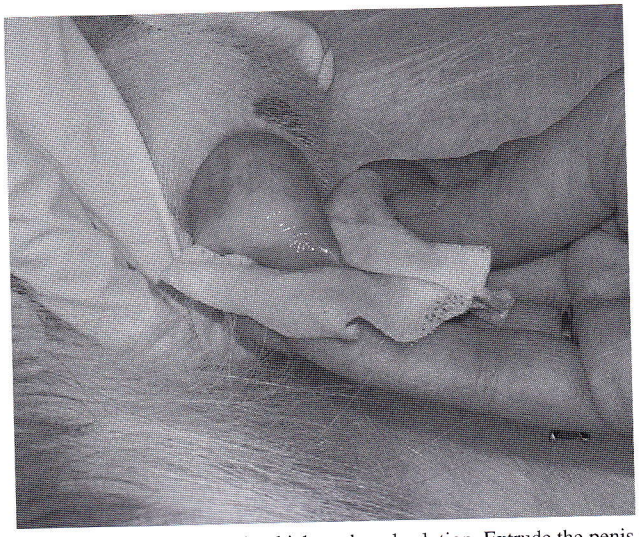

Fig. 5.3. Scrub the tip of the prepuce with antimicrobial scrub and solution. Extrude the penis and scrub the tip of the penis in a similar manner.

Fig. 5.4. Wearing sterile gloves, measure the catheter from the tip of the penis to the urinary bladder. This is to ensure that you don't insert the catheter too far causing it to coil on itself, making removal difficult or impossible. Helpful Hint: Use care to not contaminate the catheter by touching it to the patient's fur!

Fig. 5.5. Wearing sterile gloves, lubricate the tip of the urinary catheter and gently insert it into the distal urethra.

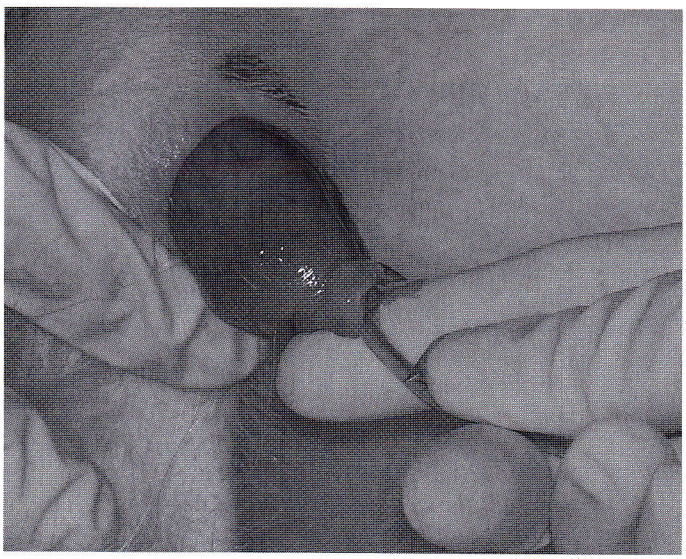

Fig. 5.6. Continue to insert the catheter to the appropriate length. Helpful Hint: Once the catheter is in the urinary bladder, urine should flow freely from the catheter. If a urinary bladder rupture is suspected, use caution, as urine may not flow readily due to leakage into the abdominal cavity.

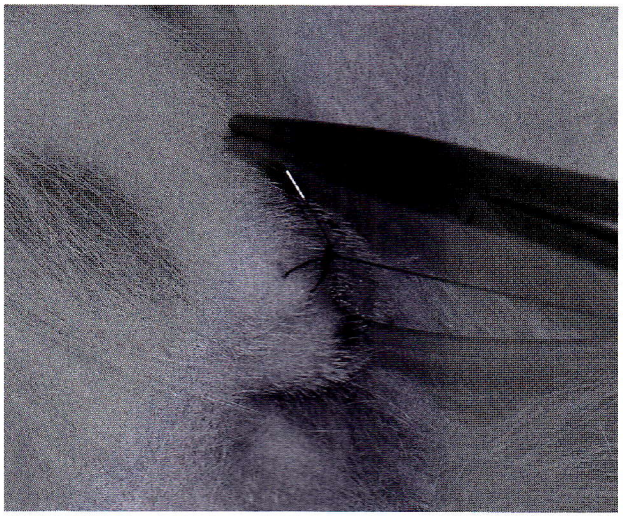

Fig. 5.7. Attach the catheter to a closed system for urine collection. You can now allow the prepuce to fall back into its normal position, then place two stay sutures in the tip of the prepuce. This step can be avoided if you use a Foley catheter.

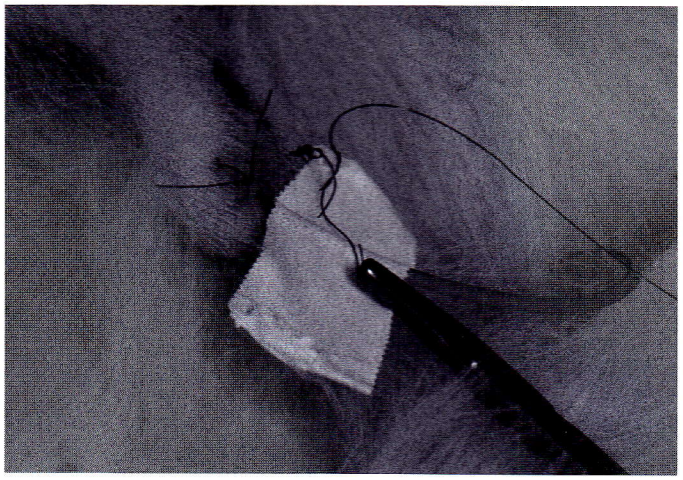

Fig. 5.8. Place a length of white tape around the catheter at the level of the prepuce, then suture the white tape to the stay sutures to secure the catheter in place. Helpful Hint: Make sure that the catheter is completely dry and the tape is securely fastened on the catheter or the catheter will slip out.

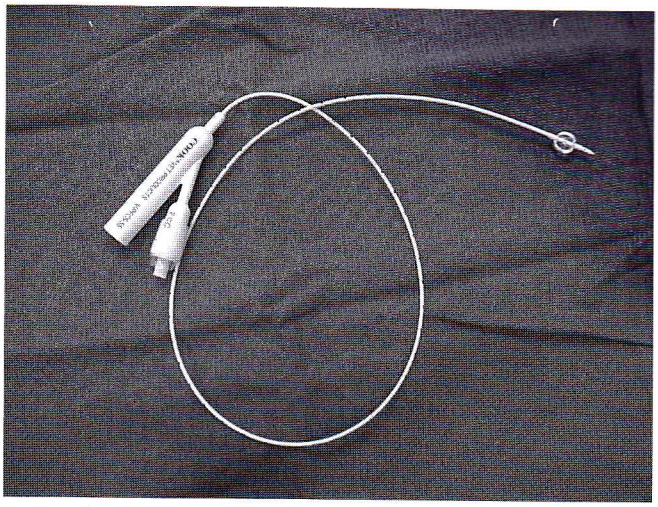

Fig. 5.9. Alternate technique if a Foley catheter is used: After routinely aseptically preparing the prepuce and penis as directed above, lubricate the tip of a Foley catheter with sterile lubricant, and insert it into the penis and urinary bladder as previously described. Inflate the bladder of the Foley catheter with the appropriate amount of sterile saline solution. Gently pull the urinary catheter out until you feel slight resistance as the balloon at the end of the catheter goes snugly into place.

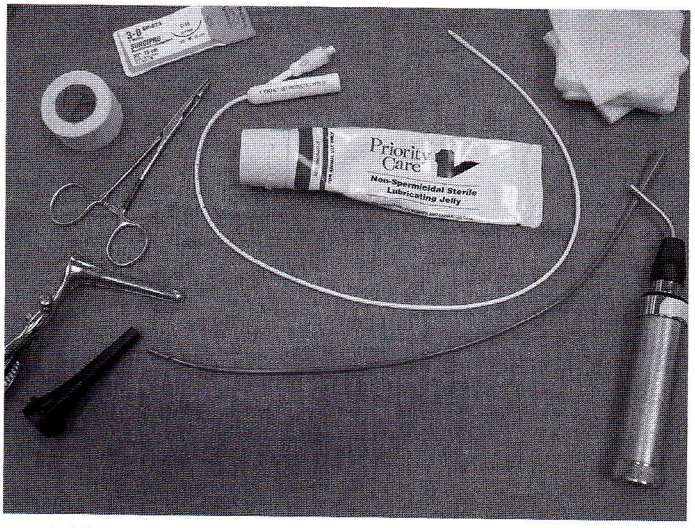

Fig. 5.10. Supplies needed for placement of a urinary catheter in a female dog.

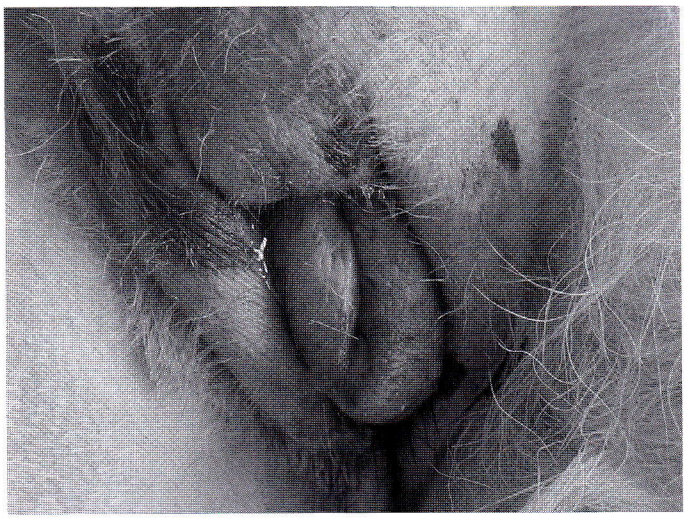

Fig. 5.11. Gently clip the fur from the vulva.

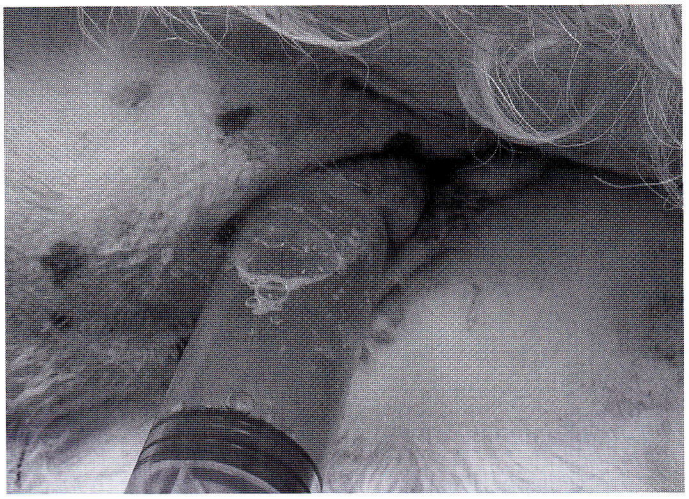

Fig. 5.12. Aseptically scrub the external vulva with antimicrobial scrub and solution, then flush the vulva with dilute antimicrobial solution mixed with 0.9% saline or sterile water.

Fig. 5.13. Wearing sterile gloves, lubricate the tip of the sterile urinary catheter with sterile lubricant or lidocaine jelly.

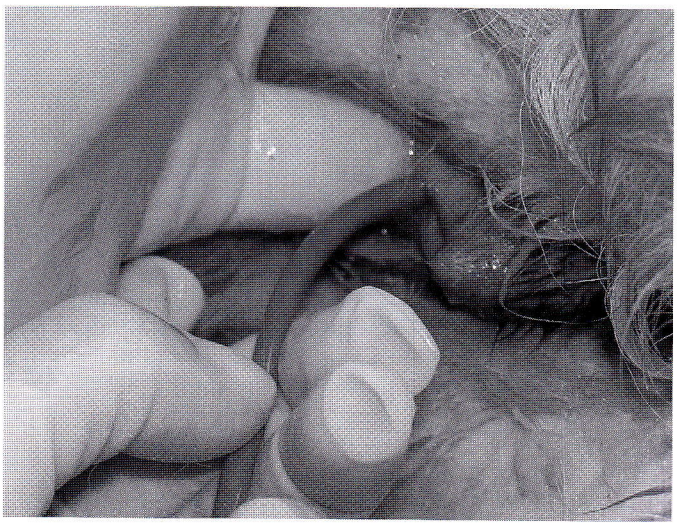

Fig. 5.14. Lubricate the index finger on your nondominant hand, and insert it into the patient's vagina. Palpate for the urethral papilla on the ventral floor of the vagina. Helpful Hint: Curve the tip of your index finger ventrally, so that once you insert the catheter into the vagina, the catheter will "dip" toward the ventral vaginal floor, and slide into the urethra.

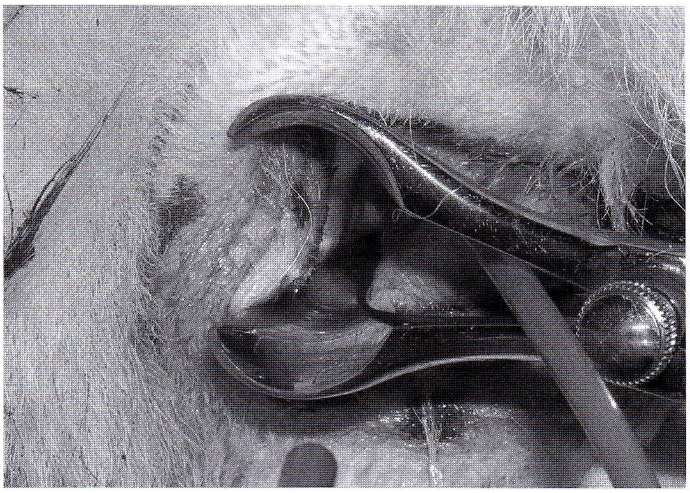

Fig. 5.15. (a & b) If you are unsuccessful in performing the "blind" catheterization technique, you can lubricate and insert a sterile vaginal speculum or sterile otoscope head into the vagina and visualize the urethral papilla, to facilitate catheter insertion.

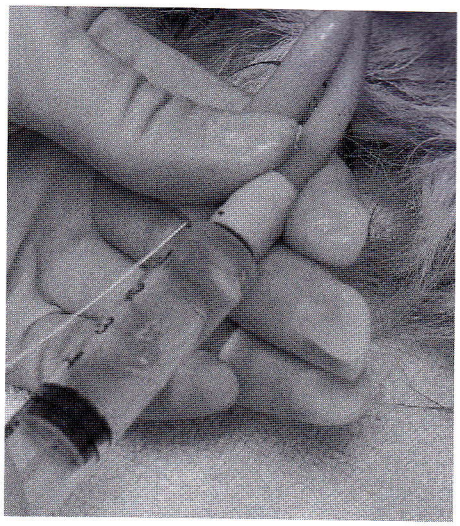

Fig. 5.16. If a Foley catheter is used, insert sterile saline to fill the balloon at the catheter tip.

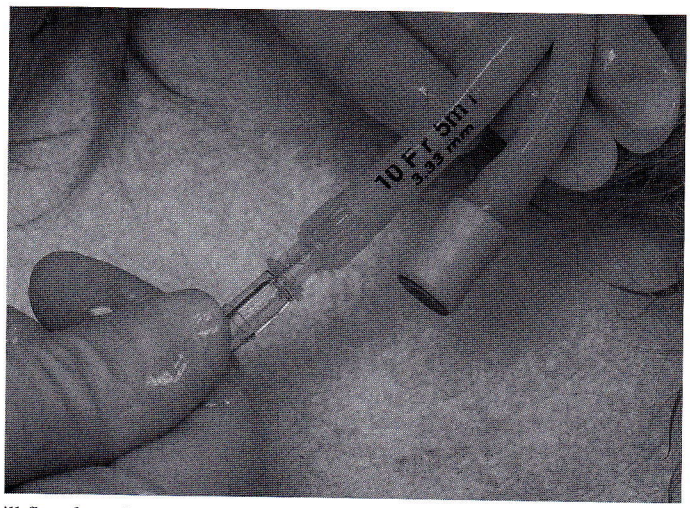

Fig. 5.17. Urine will flow from the catheter once it has been successfully introduced into the urinary bladder. In rare cases, no urine will flow if the bladder is completely empty or if the bladder has ruptured.

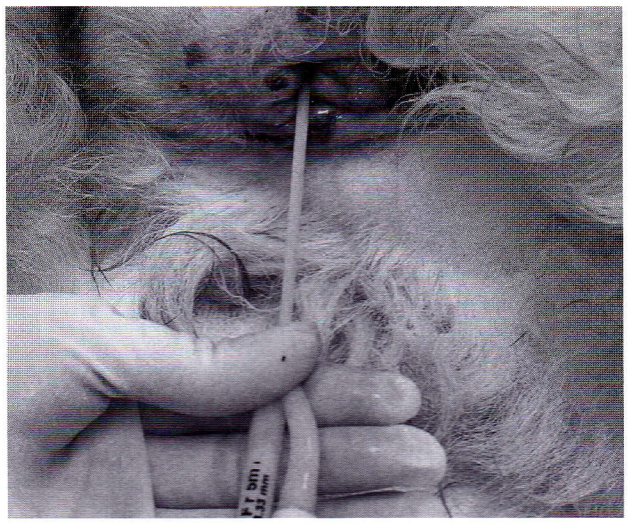

Fig. 5.18. Gently pull on the urinary catheter until you feel slight resistance as the balloon becomes seated snugly in the urinary bladder.

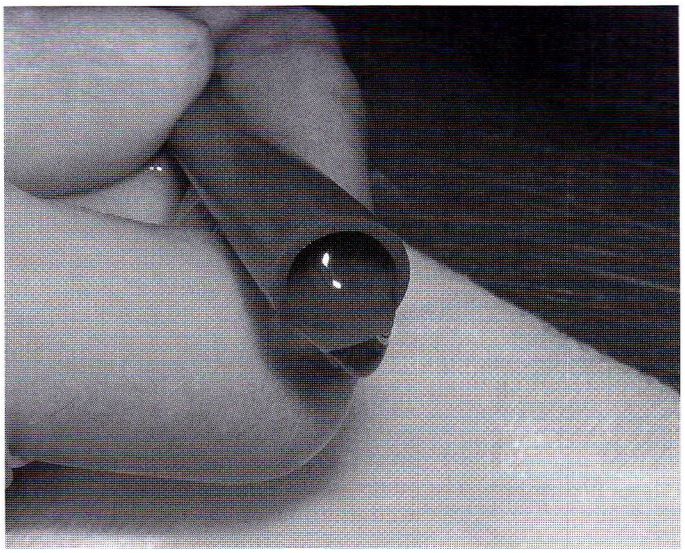

Fig. 5.19. Attach the catheter to a closed urine collection system after you observe urine flowing.

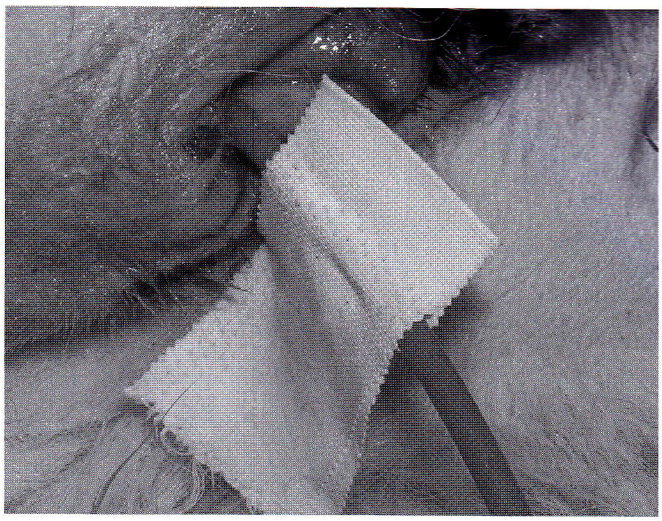

Fig. 5.20. If a Foley catheter was not used, place two stay sutures on either side of the vulva, then attach a length of 1-inch white adhesive tape to the catheter.

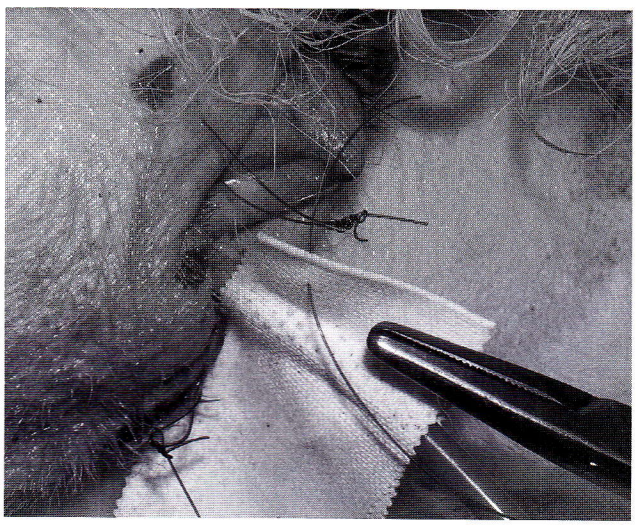

Fig. 5.21. Suture the white tape to the stay sutures, then gently secure the catheter to the base of the tail with 1-inch white adhesive tape. Helpful Hint: Make sure that the catheter is completely dry and that the tape is secured firmly to the catheter or the catheter can slip.

URETHRAL CATHETERIZATION IN MALE CATS

See figs. 5.22–5.40.

Supplies Needed

Sterile gloves
Antimicrobial scrub
3-, 6-, 12-, 20-ml sterile syringe
Sterile lubricating jelly
Sterile saline
Closed end TomCat catheter
Argyle 3 Fr and 5 Fr infant feeding tube
1-inch white adhesive tape
3-0 nonabsorbable suture
Sterile bag for urine collection
Sterile catheter adapter
IV infusion tubing

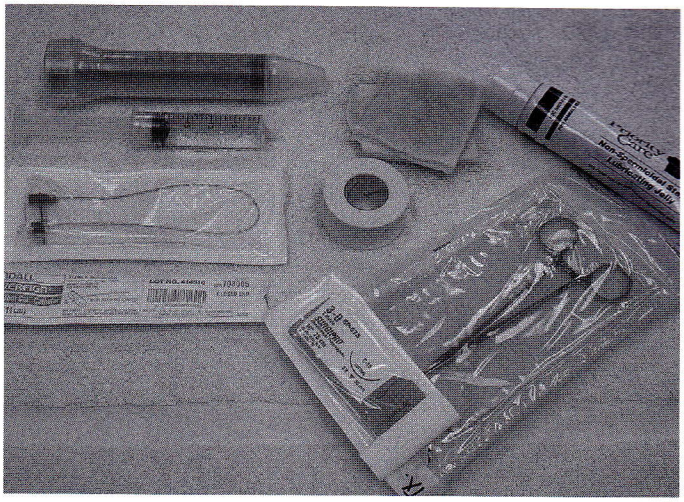

Fig. 5.22. Supplies needed for feline urethral catheterization.

Fig. 5.23. Lay the patient in lateral or dorsal recumbency, according to operator preference.

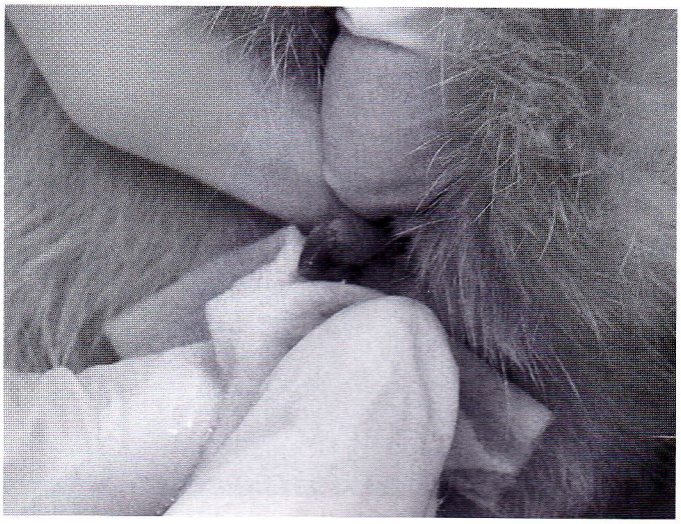

Fig. 5.24. Aseptically scrub the prepuce and penis.

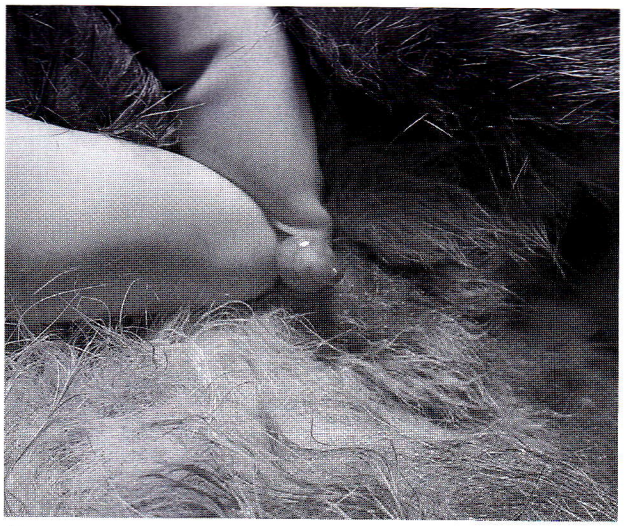

Fig. 5.25. Wearing sterile gloves, reflect the tail dorsally and cranially, and extrude the penis from the prepuce, grasping the prepuce tightly at the base of the penis between your thumb and index finger. This prevents the prepuce from slipping back over the penis. Alternatively, grasp the penis with a rat tooth forcep. After the penis is extruded, palpate the tip and examine the distal urethra for a calculus or crystal debris that may be the source of obstruction.

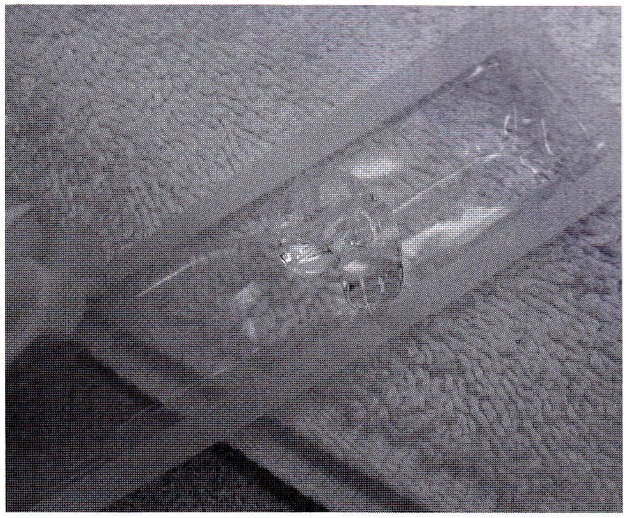

Fig. 5.26. Lubricate the tip of the TomCat catheter with sterile lubricating jelly. Helpful Hint: Keep a couple of TomCat catheters in the freezer. Freezing will cause them to become more rigid and will facilitate urethral catheterization.

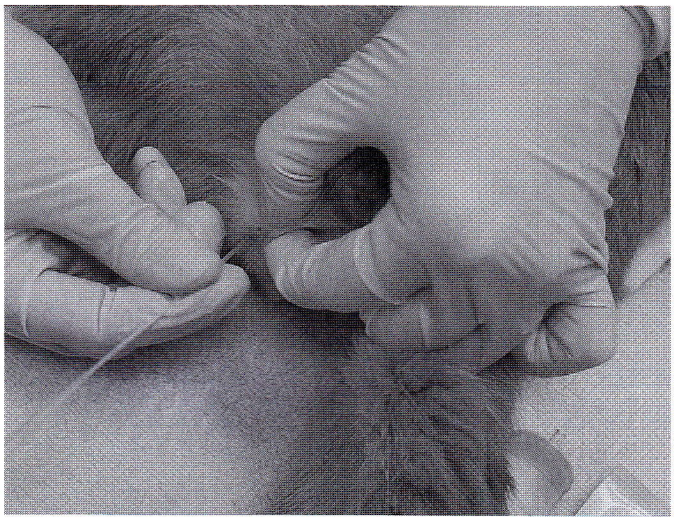

Fig. 5.27. Insert the lubricated catheter into the urethra and advance as far as possible. Helpful Hint: You may feel a "gritty" sensation if urethral calculi are present.

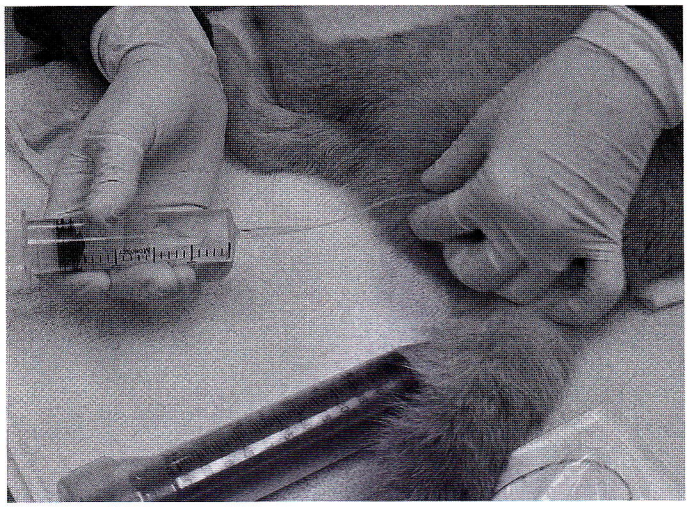

Fig. 5.28. If the catheter cannot be advanced, have an assistant attach a 6- or 12-ml syringe filled with sterile lubricating jelly and sterile saline. Have the assistant gently pulse the fluid into the urethra as you gently push the catheter back and forth in the distal urethra to try to dislodge the urethral calculus/obstruction. As the catheter advances, pull the prepuce and penis straight toward you, toward the caudal aspect of the patient, to straighten out the urethra and facilitate insertion into the urinary bladder. Helpful Hint: Stand back, as fluid frequently sprays back at the operator and assistant.

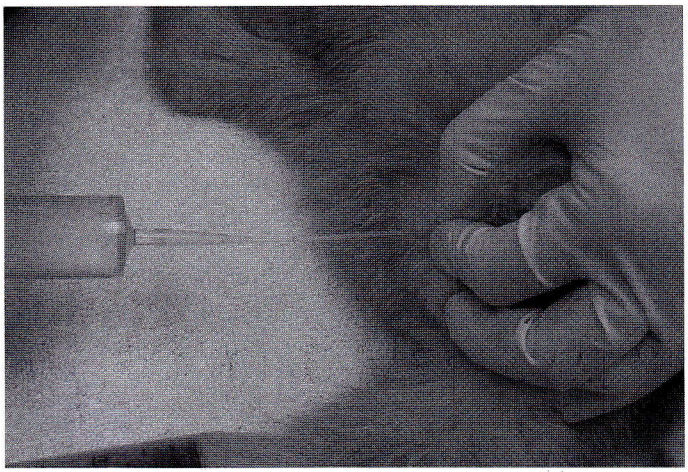

Fig. 5.29. Once the urinary catheter is in place, flush the urinary bladder until the urine comes back clear.

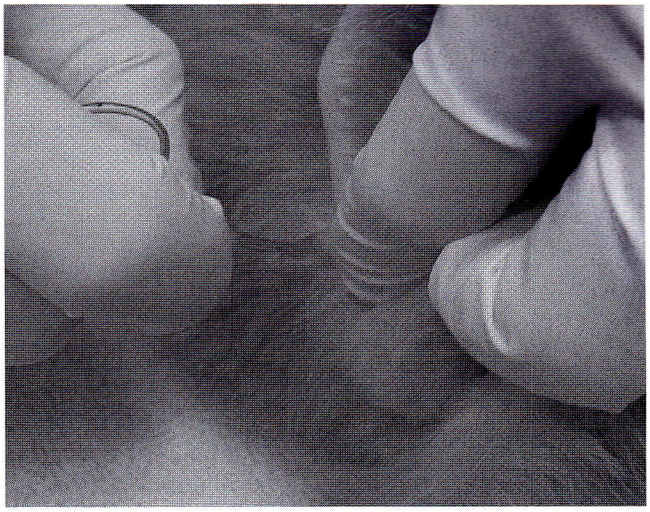

Fig. 5.30. Remove the rigid TomCat catheter and replace with a flexible Argyle infant feeding tube or 3 Fr or 5 Fr red rubber catheter. Helpful Hint: Make sure to measure the catheter first to prevent putting too much of the catheter into the urinary bladder. Use care to not contaminate the catheter by touching it to the patient's fur.

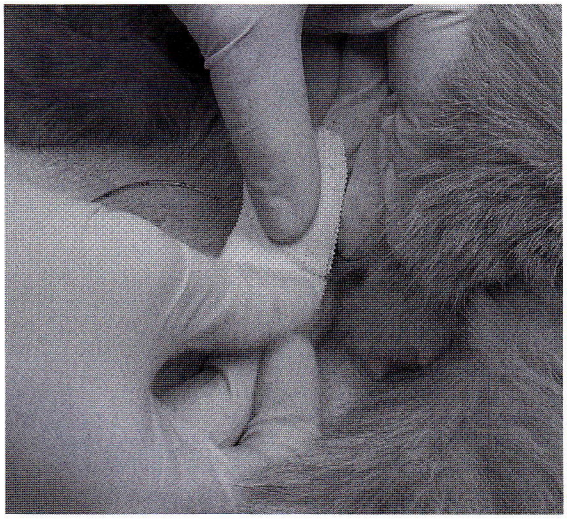

Fig. 5.31. Dry off the catheter and place a length of 1-inch white adhesive tape around the catheter at the level of the prepuce.

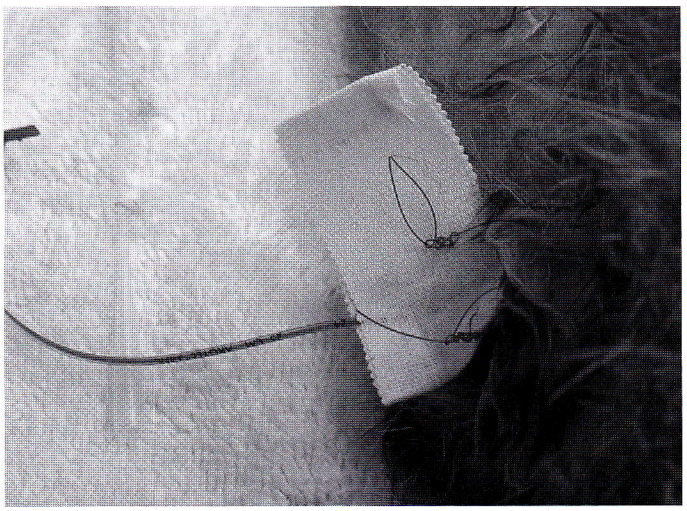

Fig. 5.32. Place two stay sutures in the prepuce. Suture the adhesive tape to the stay sutures. Helpful Hint: Make sure to not kink the catheter, as this will cause obstruction.

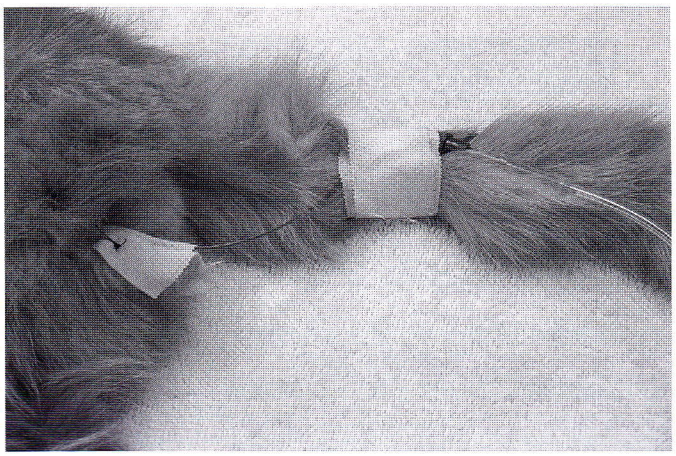

Fig. 5.33. Attach the catheter to a closed collection system. Attach the catheter to the tail with a length of white adhesive tape.

Fig. 5.34. Place an Elizabethan collar on the patient to prevent iatrogenic patient removal of the catheter.

Fig. 5.35. Female urinary catheter placement in the cat. Place the patient in lateral or sternal recumbency, according to operator preference. The equipment required is the same for a male cat urinary catheter.

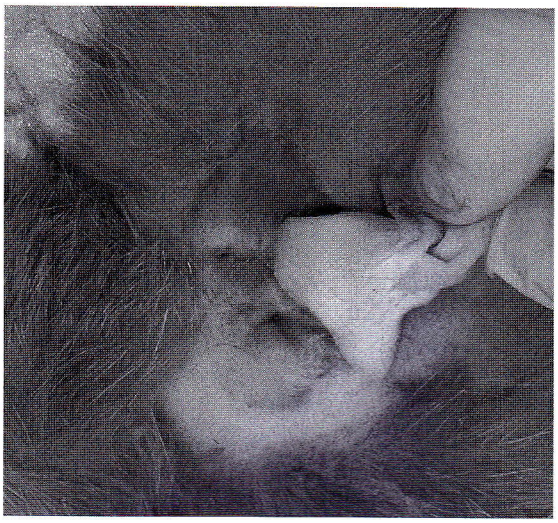

Fig. 5.36. Scrub the vulva with antimicrobial scrub.

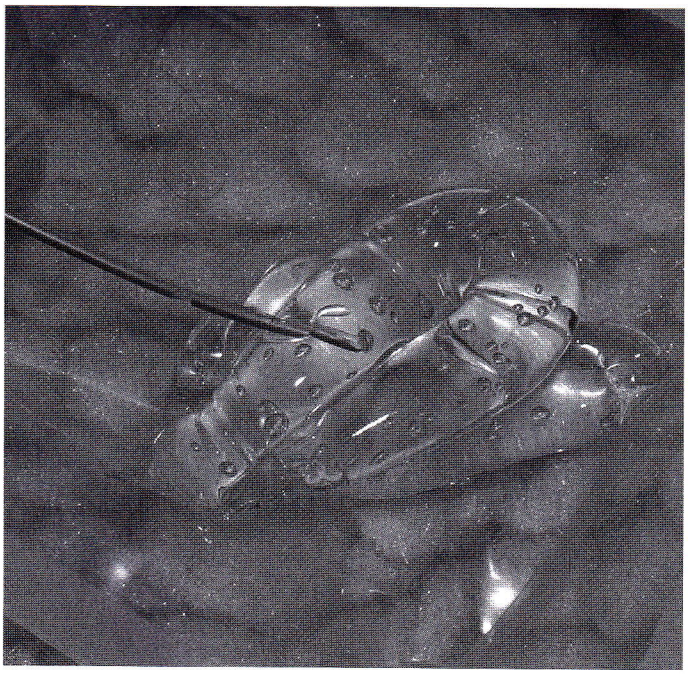

Fig. 5.37. Wearing sterile gloves, lubricate the tip of an Argyle infant feeding catheter or red rubber catheter that has been placed in the freezer to make it more rigid.

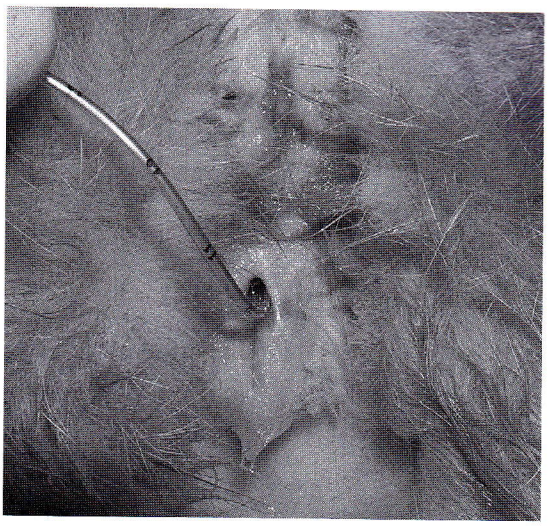

Fig. 5.38. Measure the urinary catheter from the bladder to the vulva, to ensure that you don't insert the catheter too far. Insert the tip of the catheter into the ventral vulva, and push cranially as you pull the edges of the vulva caudally. The catheter tip should slip into the urethral papilla and then into the urinary bladder. Placement is confirmed by aspirating urine from the catheter.

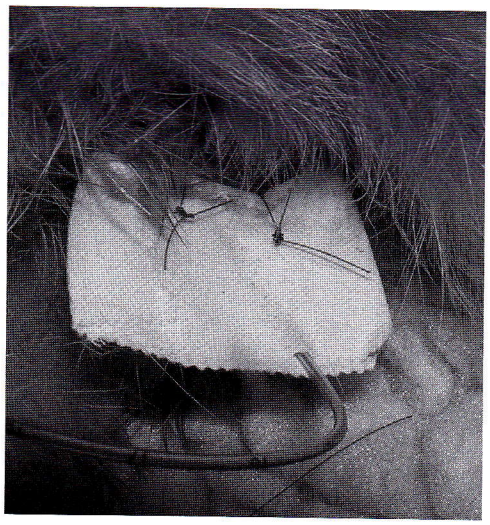

Fig. 5.39. Attach a length of 1-inch white adhesive tape to the catheter just adjacent to the vulva. Place two stay sutures on either side of the vulva using nonabsorbable suture. Suture the adhesive tape to the stay sutures. Helpful Hint: Use caution to not kink the catheter, as this could cause mechanical obstruction.

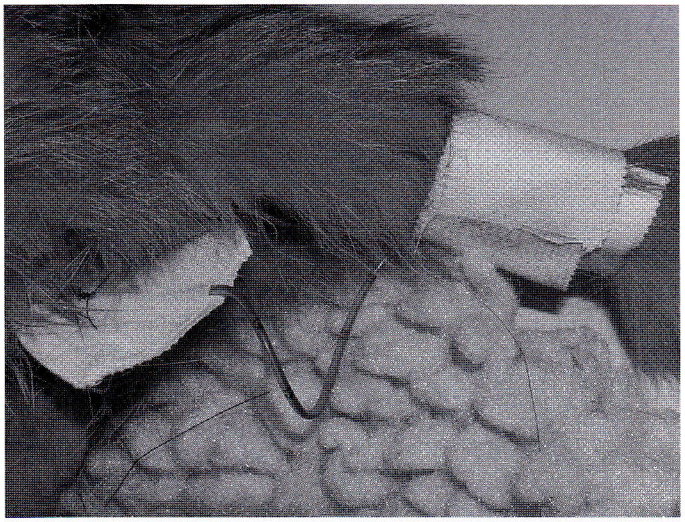

Fig. 5.40. Attach the end of the catheter to a closed collection system for urine quantitation, then tape the tubing to the tail.

UROHYDROPULSION

Introduction

Urohydropulsion is a procedure that is sometimes required in order to pass a urethral catheter in a male dog that has urethral calculi causing obstruction. In most cases, the patient must be heavily sedated or placed under general anesthesia to minimize patient discomfort and optimize successful catheter placement. The goal of urohydropulsion is to push a urethral calculus back into the urinary bladder until definitive removal via cystostomy can be performed. The supplies required for urohydropulsion are the same as for placement of a urinary catheter. See figs. 5.41–5.49.

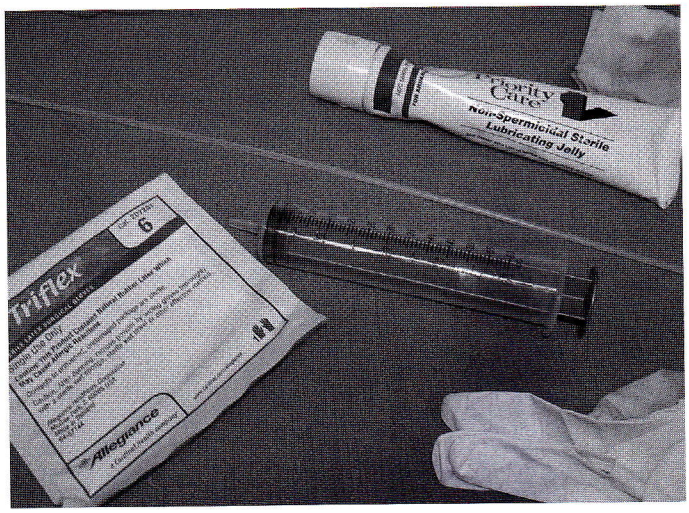

Fig. 5.41. Supplies needed for urohydropulsion.

Fig. 5.42. Place the patient in lateral recumbency and prepare the tip of the penis and prepuce as previously described.

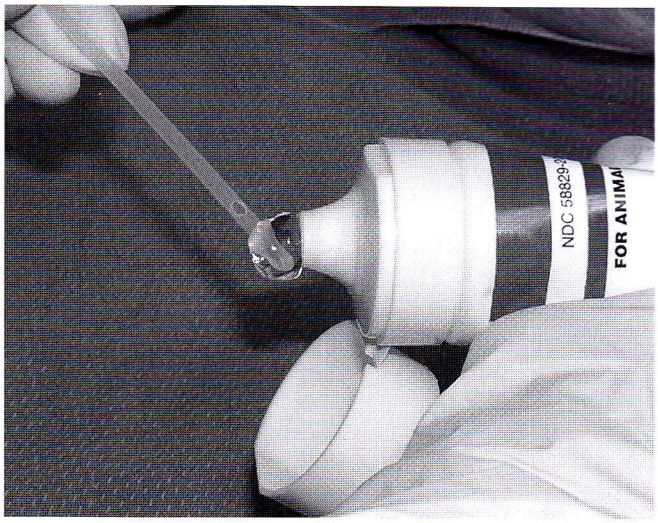

Fig. 5.43. Lubricate the catheter tip with sterile lubricant.

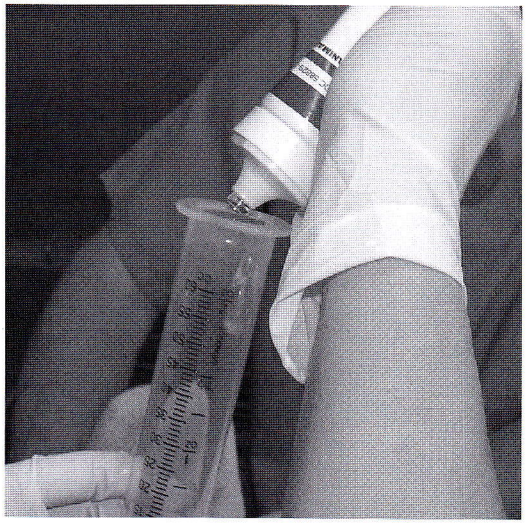

Fig. 5.44. Place a small amount of sterile lubricant and sterile saline into a 20-ml syringe.

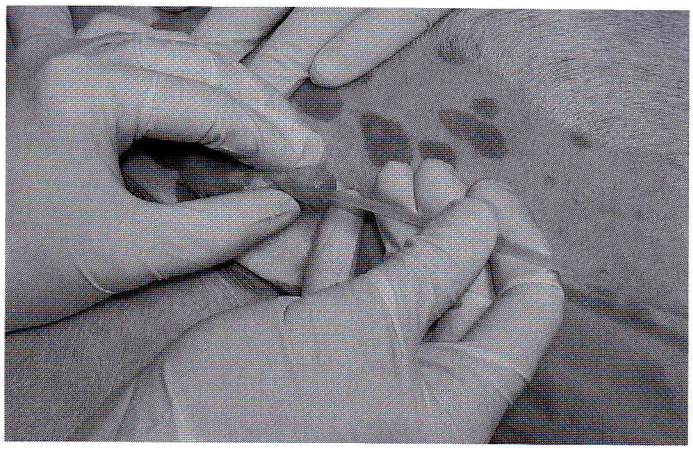

Fig. 5.45. Insert sterile lubricant jelly and sterile saline solution mixture into the tip of the penis with a rigid catheter.

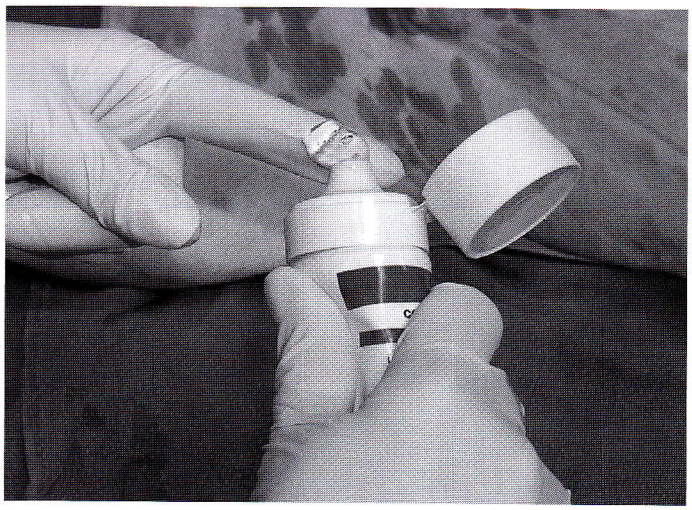

Fig. 5.46. Have an assistant lubricate a gloved index finger.

Fig. 5.47. Have the assistant insert a gloved index finger into the patient's rectum and push ventrally on the floor of the rectum to occlude the urethra as it passes over the floor of the pelvis.

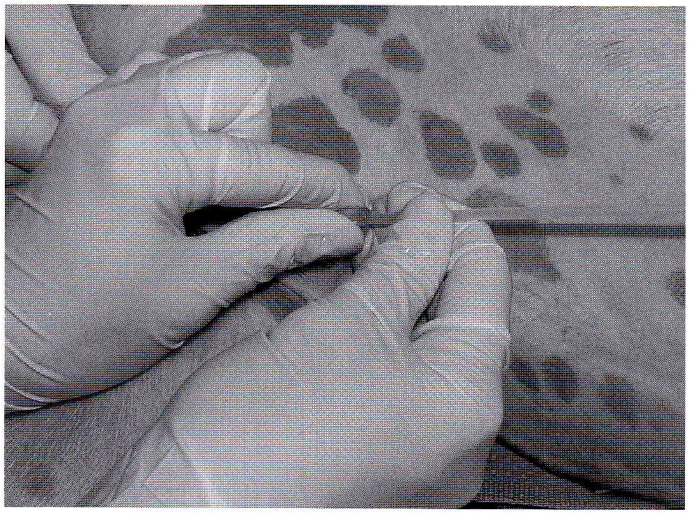

Fig. 5.48. Pinch the distal penis closely around the catheter in between your thumb and index finger.

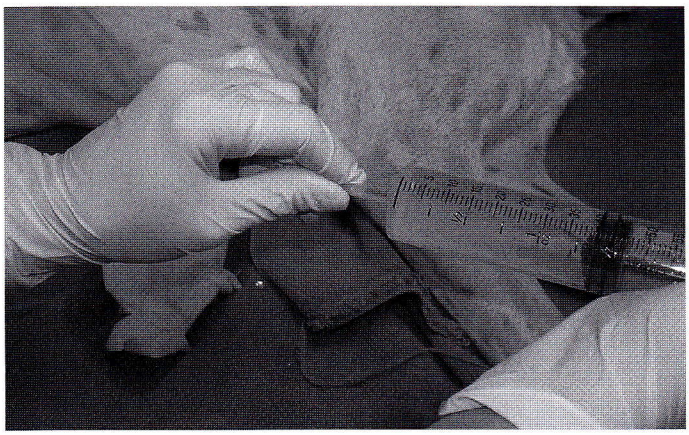

Fig. 5.49. Using a 20-ml syringe, inject and "pulse" the mixture of sterile saline and sterile lubricant into the catheter as the assistant pushes up and down on the pelvic urethra. This technique will alternately increase and decrease the pressure in the urethra to dislodge the urethral calculus and retropulse it back into the urinary bladder. Pass the urinary catheter and secure it in place until removal of the calculus can be performed.

TEMPORARY ANTEPUBIC CYSTOSTOMY CATHETER PLACEMENT

Introduction and Indications

In cases where urethral catheterization is impossible and the patient is too unstable to perform a cystostomy or perineal urethrostomy due to electrolyte and acid-base derangements, the placement of a temporary antepubic cystostomy catheter using local anesthesia can be lifesaving. See figs. 5.50–5.62.

Contraindications

Urethral catheterization is possible.
Pyometra
Transitional cell carcinoma of the urinary bladder

Supplies Needed

Foley balloon-tipped catheter
2% lidocaine
Electric clippers
Electric clipper blades
Antimicrobial scrub
Sterile huck towels
Towel clamps
#10 scalpel blade
#11 scalpel blade
Kelly hemostats
Mettzenbaum scissors
Absorbable suture
Nonabsorbable suture

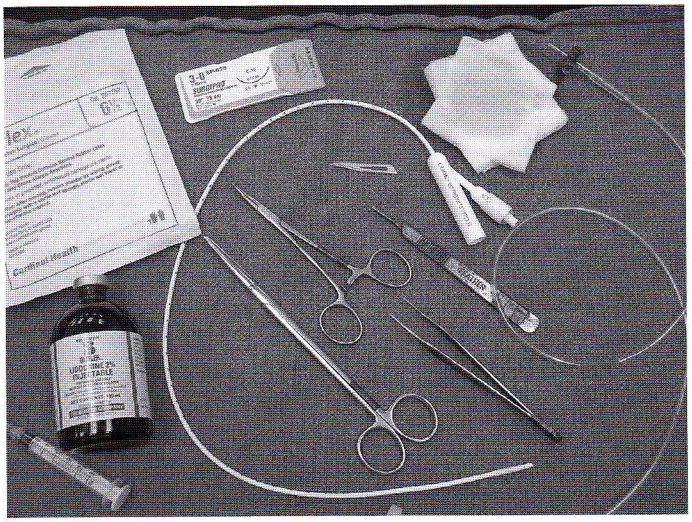

Fig. 5.50. Supplies needed for temporary antepubic cystostomy catheter.

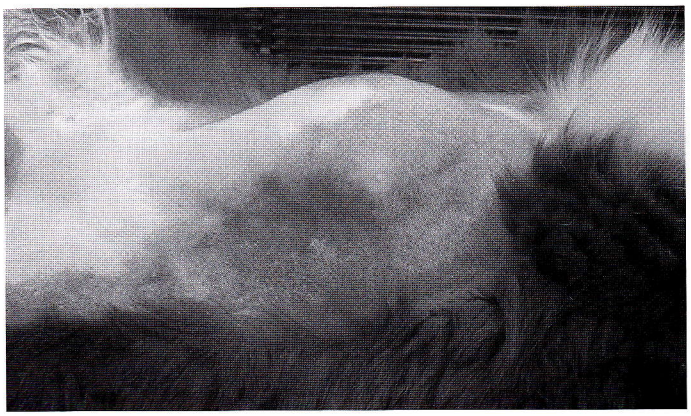

Fig. 5.51. Place the patient in dorsal recumbency and clip the ventral midline from the umbilicus to the pubis and laterally to the folds of the flank.

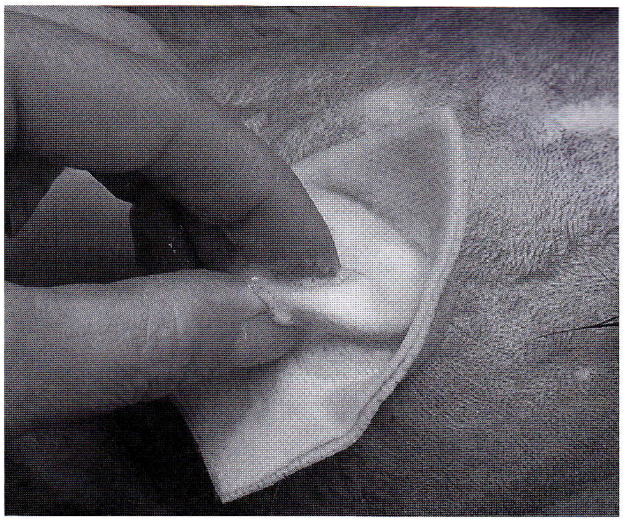

Fig. 5.52. Aseptically scrub the clipped area, then drape with sterile towels secured with towel clamps.

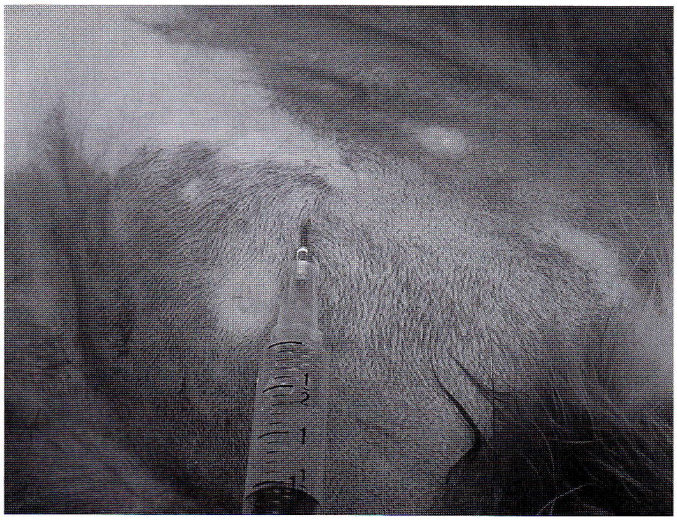

Fig. 5.53. Wearing sterile gloves, tent the skin over the urinary bladder in between your thumb and index finger, and inject 2% lidocaine into the level of the peritoneum, injecting the local anesthetic as you withdraw the needle.

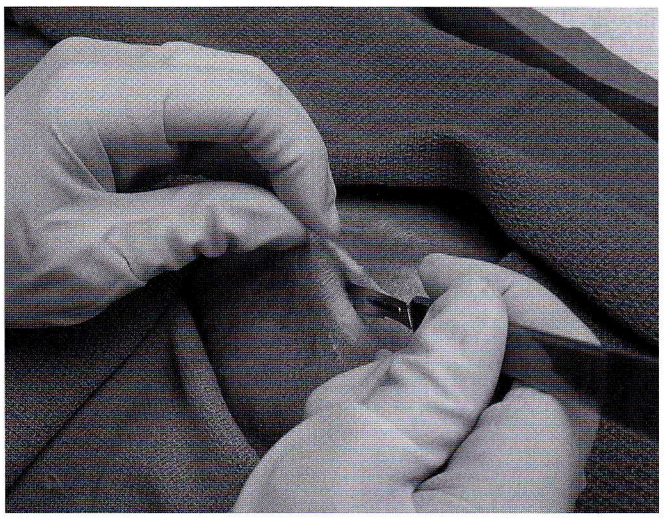

Fig. 5.54. Make a small stab incision into the anesthetized area with a #10 scalpel blade.

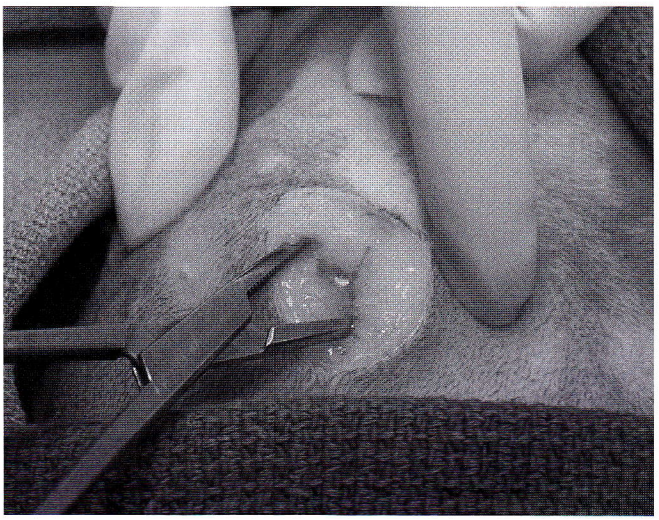

Fig. 5.55. Bluntly dissect through the subcutaneous tissue and fat to the level of the external rectus abdominus muscles. Visualize the linea alba in midline.

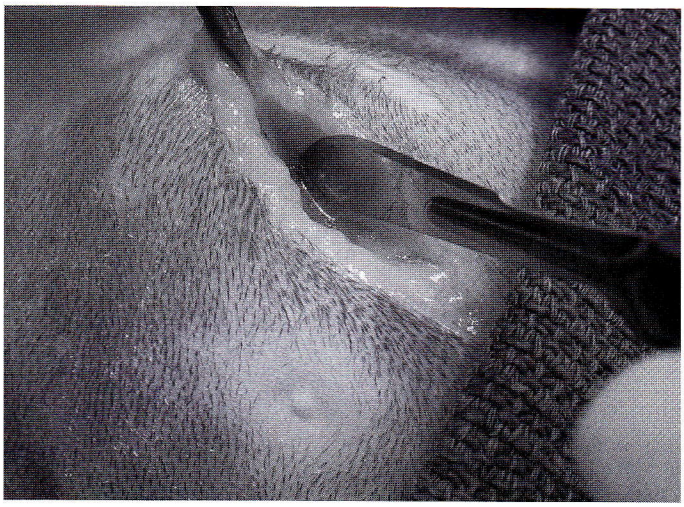

Fig. 5.56. Pick up the linea alba over the urinary bladder with a thumb forceps and make a small stab incision.

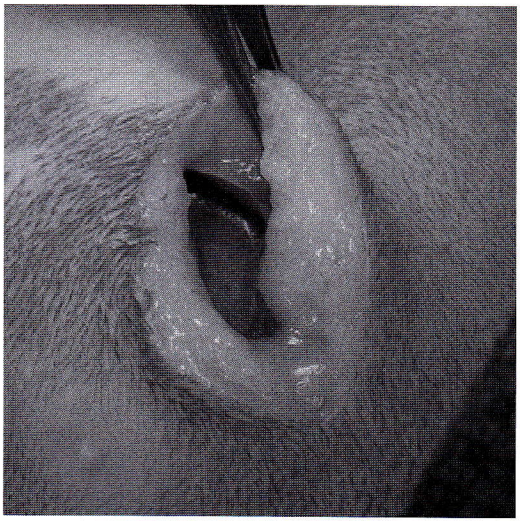

Fig. 5.57. Visualize the urinary bladder.

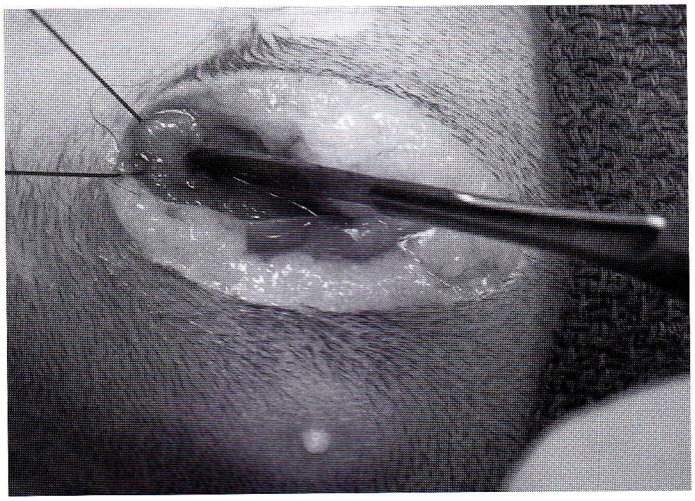

Fig. 5.58. Place a purse-string suture through the urinary bladder; leave the ends long to allow you to retract the urinary bladder to the level of the skin as you insert the urinary catheter. Make a small stab incision into the urinary bladder with a #11 scalpel blade.

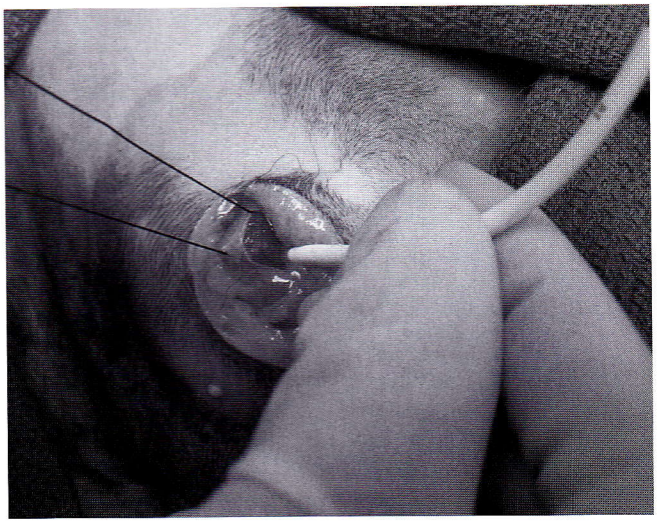

Fig. 5.59. Insert the Foley catheter through the incision in the urinary bladder and then inflate the balloon with the appropriate amount of sterile saline. Pull the urinary bladder snugly against the body wall while you suture the linea, subcutaneous tissues, and skin.

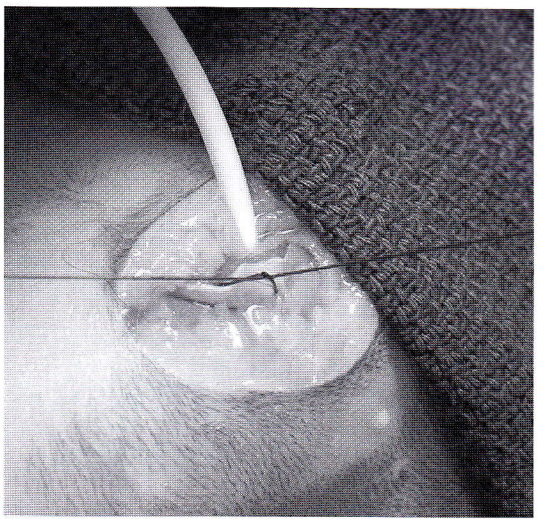

Fig. 5.60. Secure the urinary catheter in place by cinching the purse-string suture securely around the tube and tying in place. Snip the ends of the suture short.

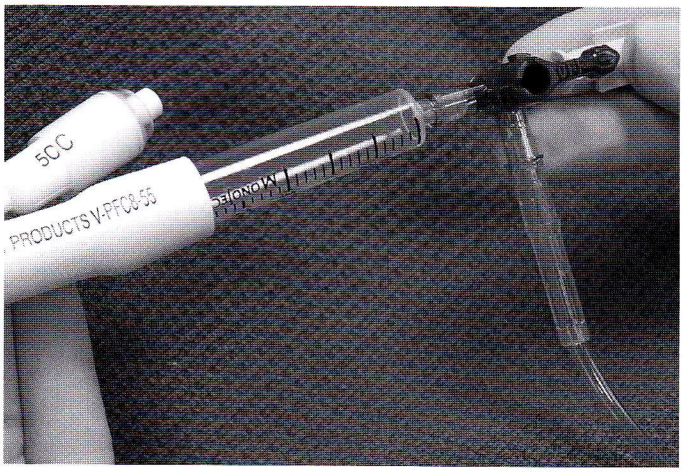

Fig. 5.61. Connect the catheter to a closed urine collection system using a sterile catheter adapter.

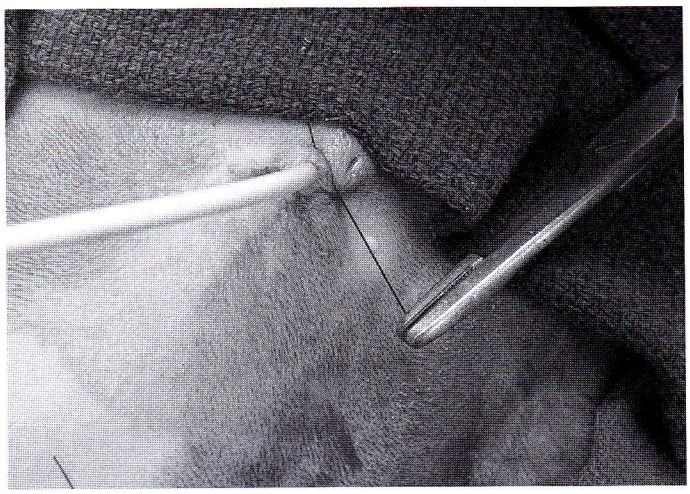

Fig. 5.62. Close the subcutaneous tissues with absorbable suture, then close the skin with a purse-string suture of nonabsorbable suture. Leave the ends of the suture long, and secure them in a finger-trap suture around the urinary catheter. Place triple antibiotic ointment over the place of catheter insertion, and cover with 4 × 4-inch sterile gauze squares. Bandage the catheter in place to the ventral abdomen with cotton roll gauze, Kling, and Vetrap or Elasticon. Make sure to label the location of the catheter to prevent you from accidentally cutting it later during a routine bandage change.

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Crow SE, Walshaw SO. Urethral catheterization. In: Manual of Clinical Procedures in the Dog and Cat. J.B. Lippincott Company, Philadelphia, 1987, pp. 110–127.

Hayashi K, Hardie RJ. Use of cystostomy tubes in small animals. Compend Contin Educ Pract Vet 25(12):928, 934, 2003.

Salinardi BJ, Marks SL, Davidson JR, Senior DF. The use of a low-profile cystostomy tube to relieve urethral obstruction in a dog. J Am Anim Hosp Assoc 39(4):403–405, 2003.

CHAPTER 6

Abdominocentesis and Diagnostic Peritoneal Lavage

ABDOMINOCENTESIS

Introduction

Abdominal paracentesis (abdominocentesis) is a useful and inexpensive technique to identify abdominal effusion, particularly in patients with clinical signs of acute abdominal pain or unexplained fever. Evaluation of any fluid obtained often aids in the diagnosis and helps guide treatment. Abdominal effusion can be classified according to its cellularity and protein content as transudates, modified transudates, and exudates. Causes of modified transudates and exudates include neoplasia, septic and nonseptic inflammation, and hemorrhage. Additionally, biochemical evaluation of the fluid for blood urea nitrogen, creatinine, potassium, amylase, lipase, bilirubin, and glucose can aid in the diagnosis of various conditions, including uroabdomen, pancreatitis, bile peritonitis, and septic peritonitis. Limitations of this technique: if small (< 6 ml/kg) amounts of abdominal effusion are present, a false negative abdominocentesis may occur. See figs. 6.1–6.6.

Supplies Needed

20–22-gauge 1- to 1-1/2-inch needles
Latex gloves
Electric clipper and blades
3–6-ml syringes
Antimicrobial scrub
Sterile EDTA and red-topped tubes
Port-a-cul sterile culturettes for bacterial isolation

Indications

Diagnosis and treatment of hemoabdomen, uroabdomen, bile or septic peritonitis, and/or neoplastic effusions

Contraindications

Penetrating abdominal wounds (exploratory laparotomy required)

Limitations

Is insensitive in the diagnosis of retroperitoneal effusions (hemorrhage, urinary tract leakage, neoplasia, abscess)

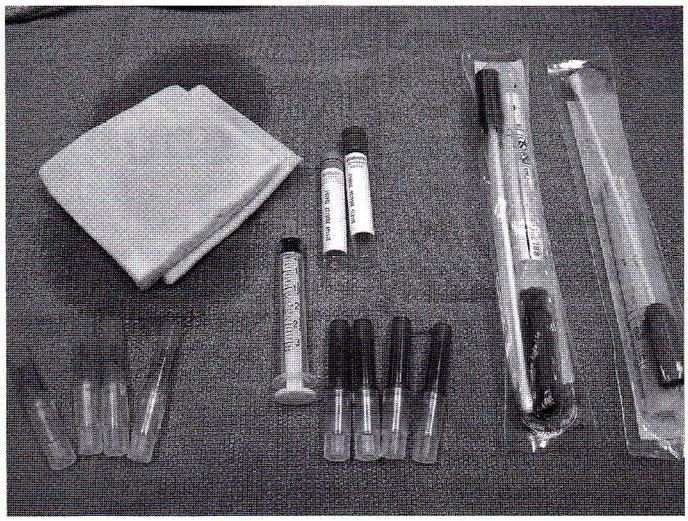

Fig. 6.1. Equipment needed for abdominocentesis.

Fig. 6.2. Photo of four quadrant locations for needle placement.

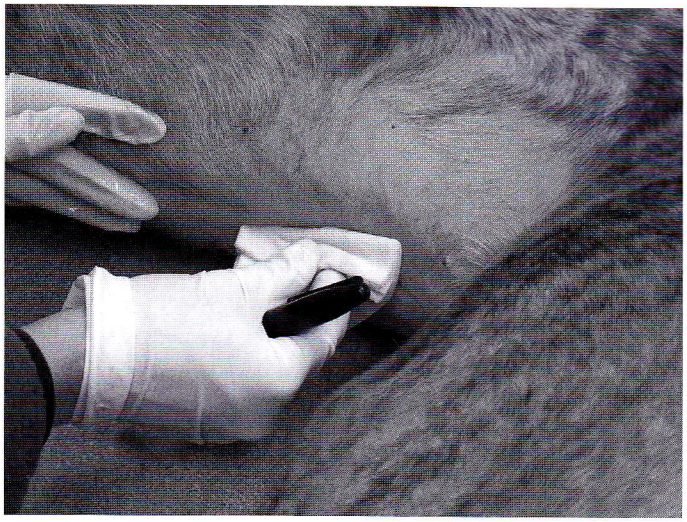

Fig. 6.3. Clip and aseptically scrub a 10-cm square area of the ventral abdomen with the umbilicus in the center of the clipped area.

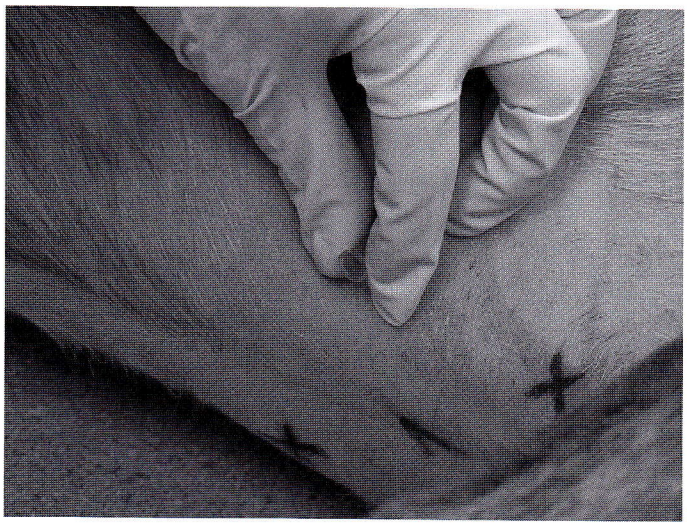

Fig. 6.4. Insert the needle cranial and to the right of the umbilicus, twisting gently as the needle is inserted into the peritoneal cavity to push any hollow organ away from the tip of the needle. If fluid doesn't flow freely, repeat this step by inserting a needle left and cranial, right and caudal, and left and caudal to the umbilicus. Helpful Hint: In some cases, fluid will not flow freely until a second needle is inserted into the peritoneal cavity.

Fig. 6.5. Gently aspirate fluid if fluid does not flow freely. Helpful Hint: Abdominocentesis may be falsely NEGATIVE with this technique if less than 5–7 ml/kg of fluid are present within the peritoneal cavity.

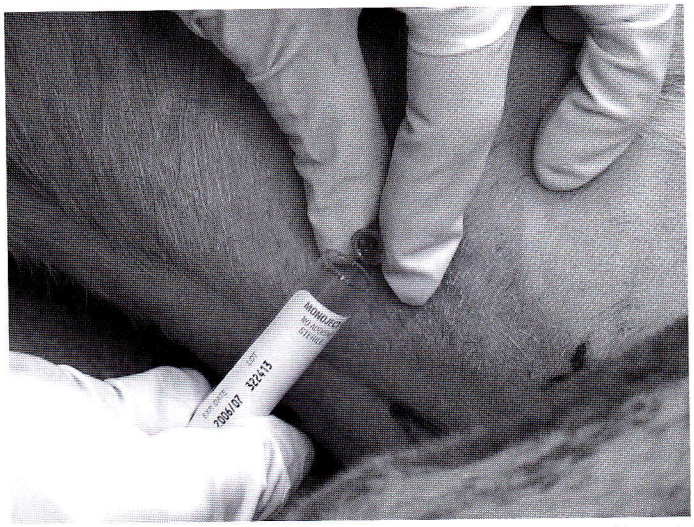

Fig. 6.6. Save fluid in sterile red-topped and EDTA tubes for cytology, biochemistry, and bacterial analyses.

DIAGNOSTIC PERITONEAL LAVAGE

Introduction and Indications

Diagnostic peritoneal lavage (DPL) can be performed in patients with acute abdominal pain and unexplained fever when four-quadrant abdominocentesis is negative. DPL is more sensitive when small amounts of abdominal effusion are present, and when there is rupture of a hollow viscus, particularly after blunt or penetrating trauma. A limitation of this technique is that any fluid collected must be interpreted carefully, as dilution of total cell count and chemical analysis always occurs. See figs. 6.7–6.13.

Indications

Identification and characterization of small amounts of abdominal effusion when abdominal paracentesis is negative

Contraindications

Penetrating injury to the abdominal cavity that requires exploratory laparotomy

Limitations

Is insensitive in the diagnosis of retroperitoneal effusions (hemorrhage, urinary tract leakage, neoplasia, abscess)

Supplies Needed

20–22 gauge 1–1-1/2-inch needles or
16–20 gauge 1 1/2-inch over-the-needle catheter
Sterile glass red- and purple-topped tubes for sample collection
3–6-ml syringes
Electric clippers and fresh blades
Antimicrobial scrub
Warm (37 degrees Celsius) isotonic crystalloid fluid (Normosol-R, Lactated Ringer's, 0.9% saline)
Intravenous fluid administration set
Rapid infusion IV pressure bag
Sterile gloves, field towels (4)
Towel clamps

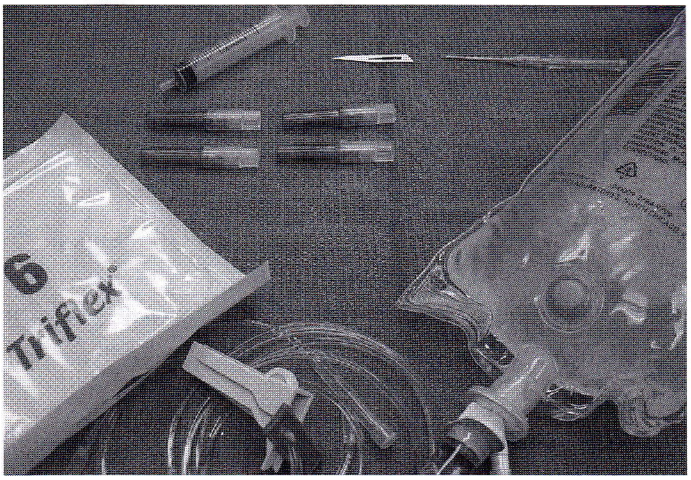

Fig. 6.7. Equipment needed for diagnostic peritoneal lavage.

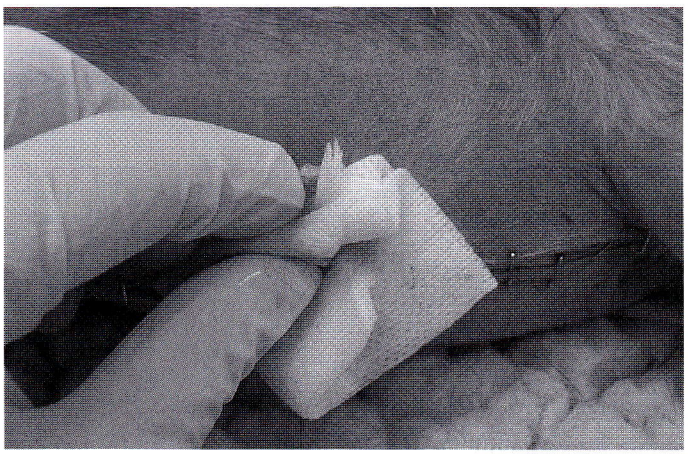

Fig. 6.8. Place the patient in lateral recumbency and clip and aseptically scrub a 10-cm area of the ventral abdomen with the umbilicus in the center. Drape the clipped area with sterile field towels secured with towel clamps.

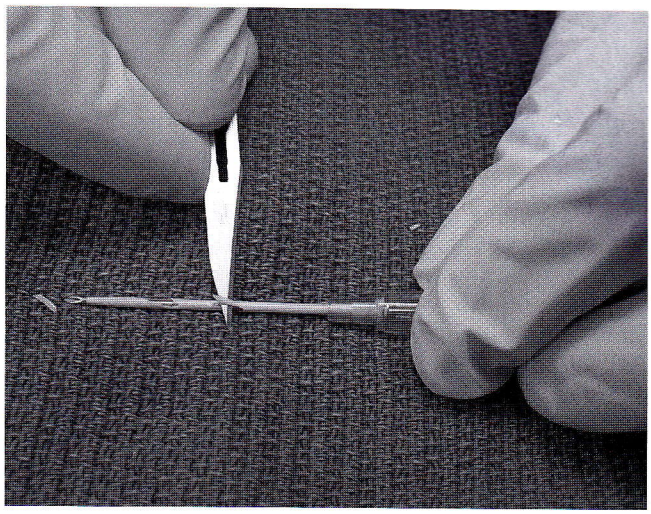

Fig. 6.9. Wearing sterile gloves, use a #10 scalpel blade to fenestrate side-ports in an over-the-needle catheter. Helpful Hint: Use care to avoid making a hole greater than 50% the circumference of the catheter. A large hole will weaken the catheter and increase the risk of breaking off into the peritoneal cavity.

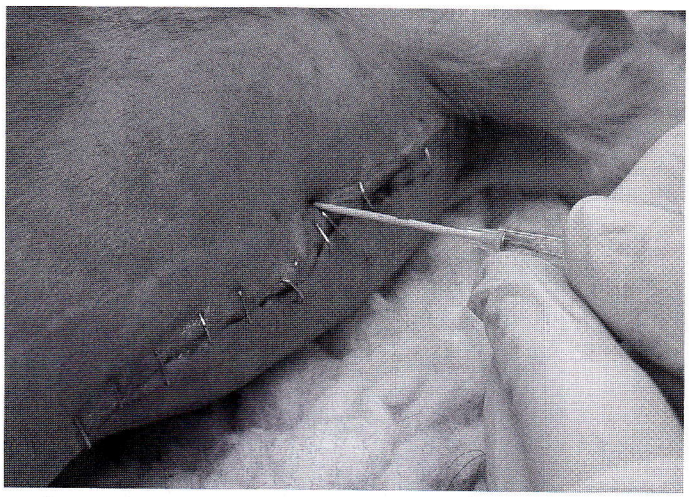

Fig. 6.10. Wearing sterile gloves, insert the over-the-needle catheter into the abdominal cavity caudal and to the right of the umbilicus, at the level of the nipples. Advance the catheter slowly and with a gentle twisting motion to avoid iatrogenic puncture of any abdominal organs.

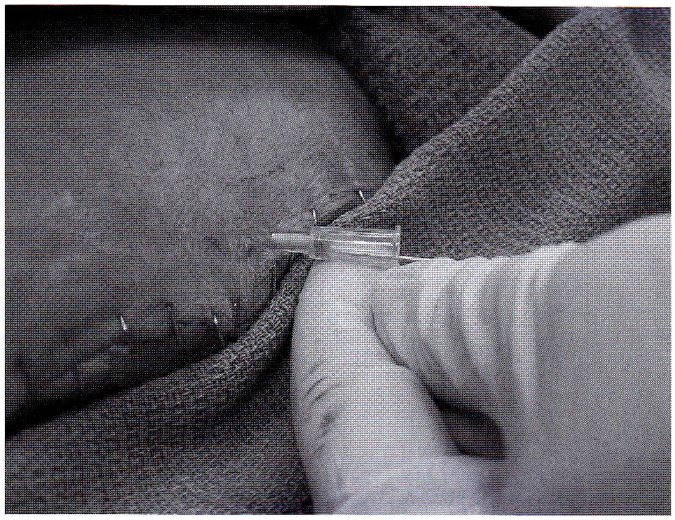

Fig. 6.11. Withdraw the stylet from the catheter, and examine the catheter hub for the presence of any fluid. If fluid is present, withdraw the fluid using a sterile 3-ml syringe.

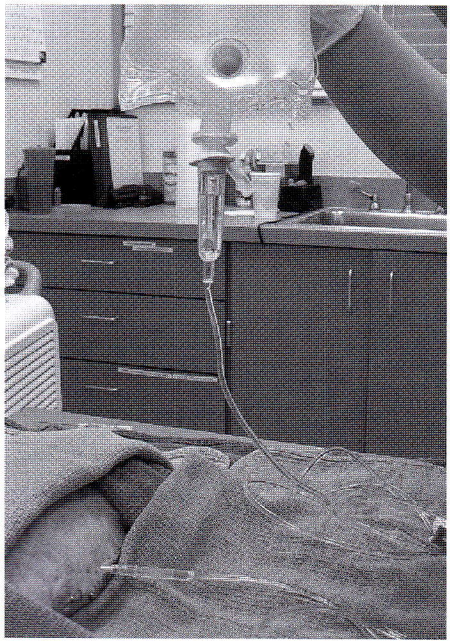

Fig. 6.12. If no fluid is present, instill 10–20 ml/kg of warmed lactated ringers or 0.9% saline solution into the abdominal cavity over a period of 3–5 minutes. Watch the patient carefully for the presence of discomfort or respiratory difficulty and if this occurs, abandon the fluid infusion.

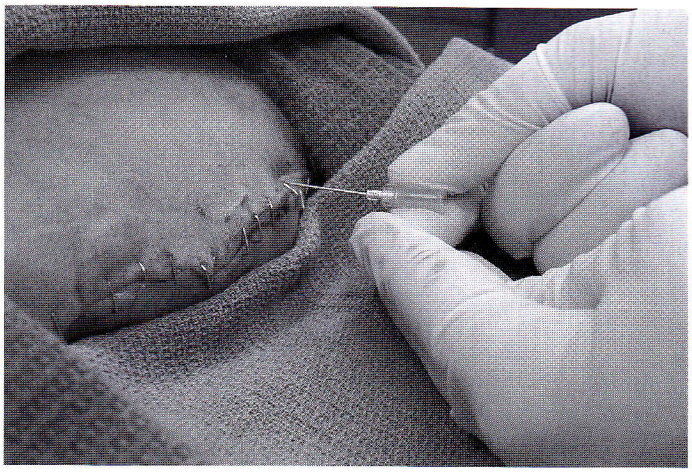

Fig. 6.13. Remove the catheter, and gently roll the patient from side to side or allow an ambulatory patient to walk while you massage the abdomen to redistribute the fluid that you have just infused into the abdominal cavity. Lay the patient in lateral recumbency and aseptically prepare the abdomen to perform a four-quadrant abdominocentesis. Ideally, remove at least 0.5 to 1 ml of the lavage fluid to analyze for cytology and culture. Helpful Hint: In most cases, the majority of the fluid you have infused will not be recovered. Only small amounts of the infused fluid will be recovered for analyses. Any biochemical analyses performed will be diluted if a diagnostic peritoneal lavage has been performed.

ABDOMINAL DRAINAGE CATHETER

Introduction

Placement of a temporary abdominal drainage catheter is useful in situations of temporary peritoneal dialysis or drainage of uroabdomen. The drainage catheter can be used until definitive exploratory laparotomy can be performed, or until the catheter becomes clogged with omentum. See figs. 6.14–6.24.

Supplies Needed

Electric clippers and blades
Sterile field towels (4)
Towel clamps (4)
#10 scalpel blade
Scalpel handle
3-ml syringe with 3/4- to 1-1/2-inch needle (22 gauge)
2% lidocaine
Curved mosquito hemostats
Thumb forceps
Mayo scissors
Argyle trocarized thoracic drainage tube *OR* (16–22) Fr
Red rubber catheter (16–22 Fr)
2-0 nylon suture
3-0 absorbable suture
Christmas-tree adapter
1-ml syringe
IV infusion tubing
Sterile bag for collection and drainage of fluid
Antimicrobial ointment

Indications

Temporary drainage of uroabdomen until definitive repair of urethral or urinary bladder leakage is performed
Intermittent lavage and dilution of inflammatory processes such as peritonitis

Contraindications

Known bowel perforation or septic peritonitis
Hypoalbuminemia

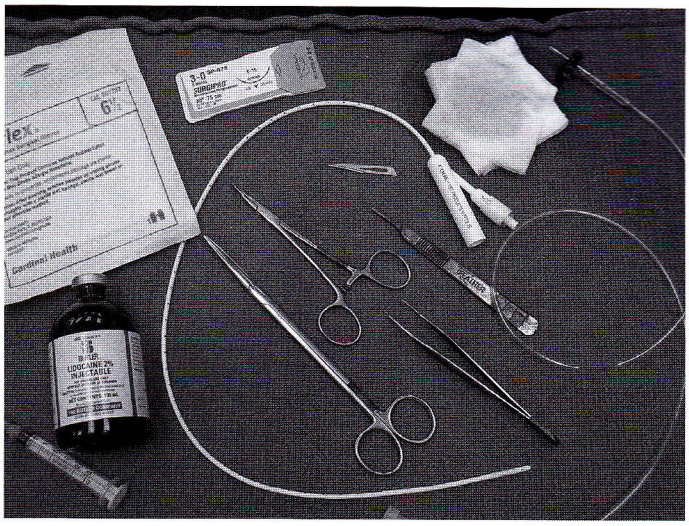

Fig. 6.14. Equipment needed for placement of an abdominal drainage catheter.

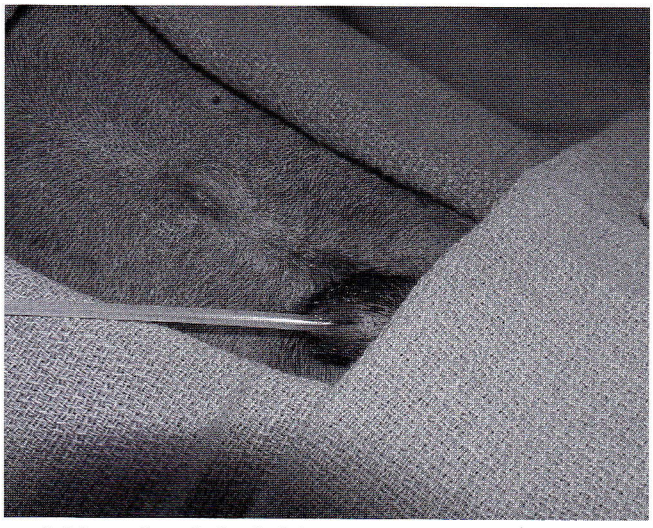

Fig. 6.15. Clip the ventral abdomen from the level of the umbilicus caudally to the level of the pubis and laterally to the folds of the flank. It is beneficial to place a urinary catheter first, to drain the urinary bladder.

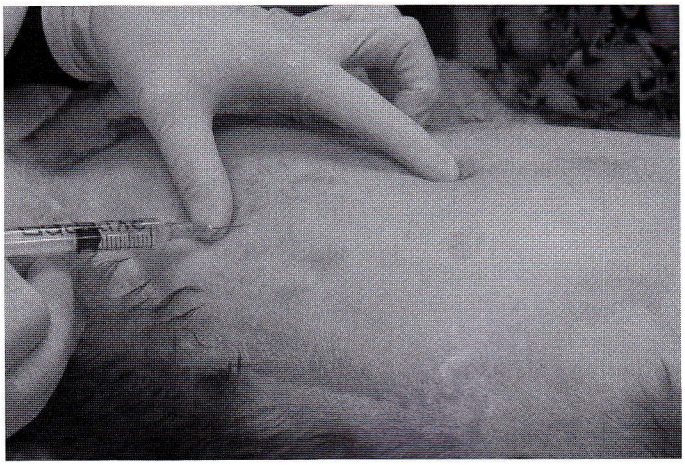

Fig. 6.16. Aseptically scrub the clipped area, then drape with sterile field towels secured with towel clamps. Infuse 1 mg/kg 2% lidocaine mixed with a trace of sodium bicarbonate just caudal and to the right of the umbilicus. Insert the needle through the ventral abdominal musculature and infuse the local anesthetic as you withdraw the needle. Helpful Hint: Disconnect the syringe from the needle so that you remember where your tunnel of local anesthetic has been infused.

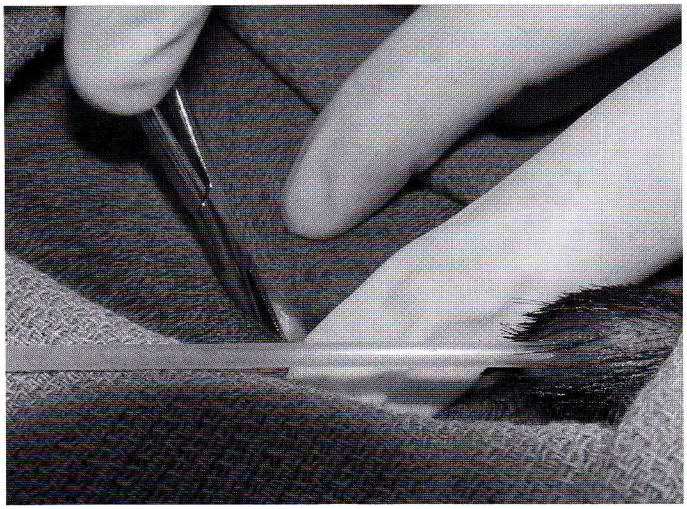

Fig. 6.17. With a thumb forceps, pick up the skin at the site of local anesthesia infusion, and make a stab incision through the skin into the subcutaneous tissue with a #10 scalpel blade.

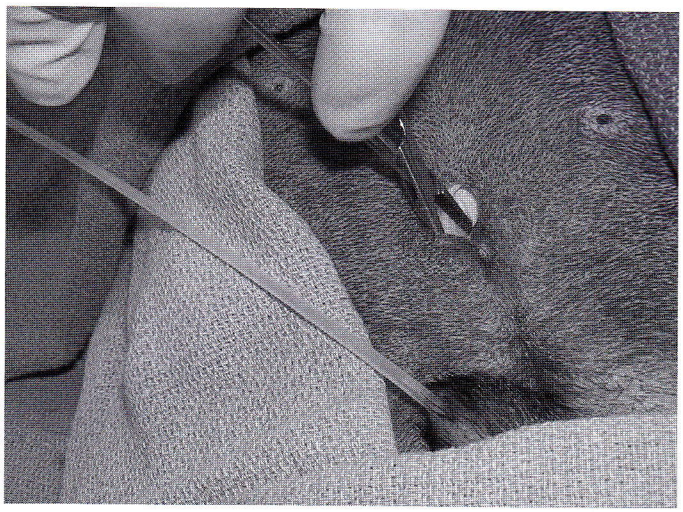

Fig. 6.18. Bluntly dissect through the subcutaneous tissue to the level of the external rectus abdominal muscles with a mosquito hemostat.

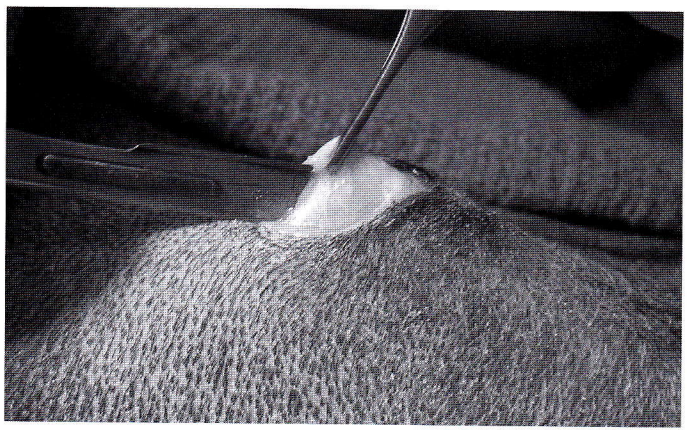

Fig. 6.19. Visualize the external rectus abdominus muscle and pick up with a thumb forceps. Make a small stab incision through the rectus abdominus with a #10 scalpel blade into the peritoneal cavity.

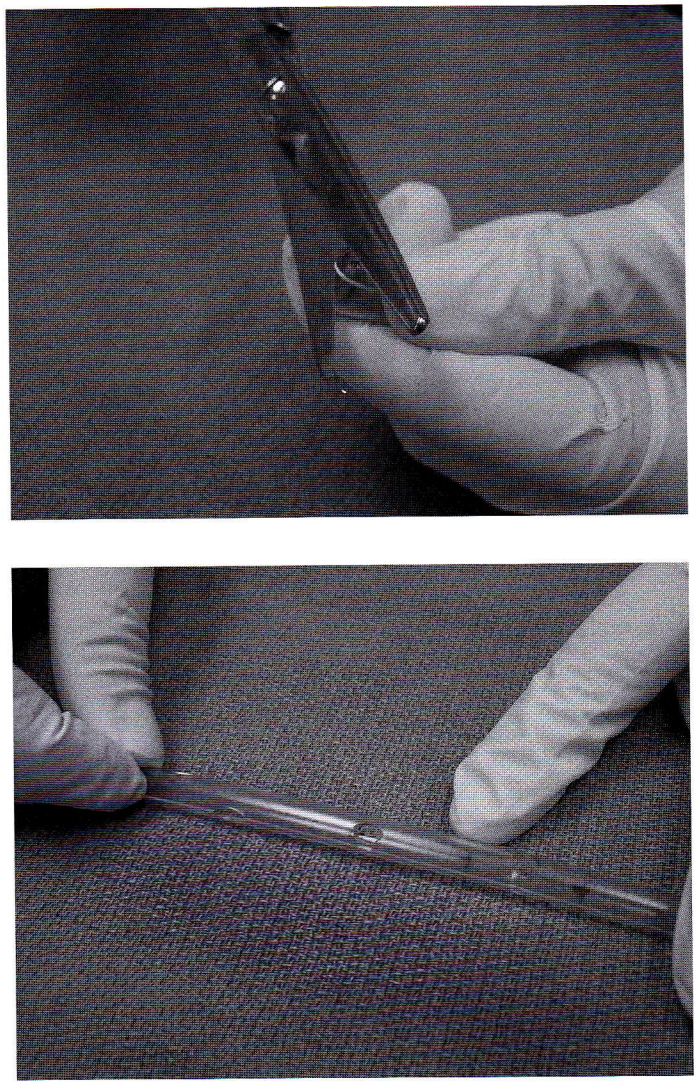

Fig. 6.20. (a & b) Cut additional side-holes in either an Argyle trocarized thoracic drain tube or a red rubber catheter, making sure that none of the holes is larger than 50% the circumference of the catheter to prevent iatrogenic weakening. Helpful Hint: If an Argyle catheter is used, make sure that the most proximal hole is located on the radio-opaque stripe, so that you can make sure that the entire functional length of tube is within the peritoneal cavity and to check if the tube has migrated.

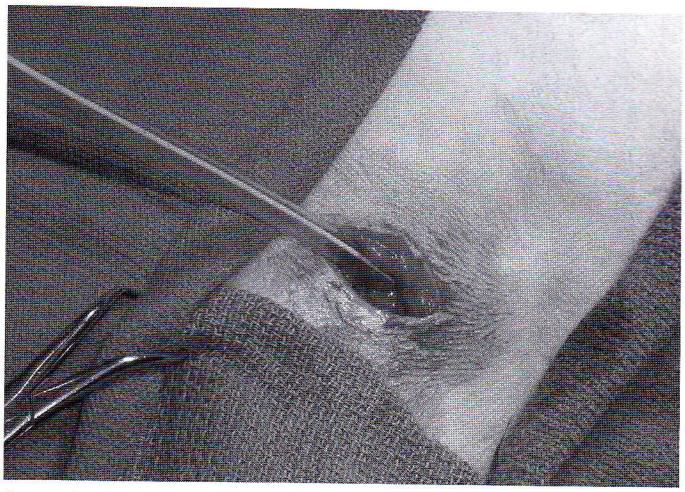

Fig. 6.21. Insert either an Argyle trocarized thoracic drainage catheter or a red rubber catheter into which additional side-ports have been cut into the peritoneal cavity.

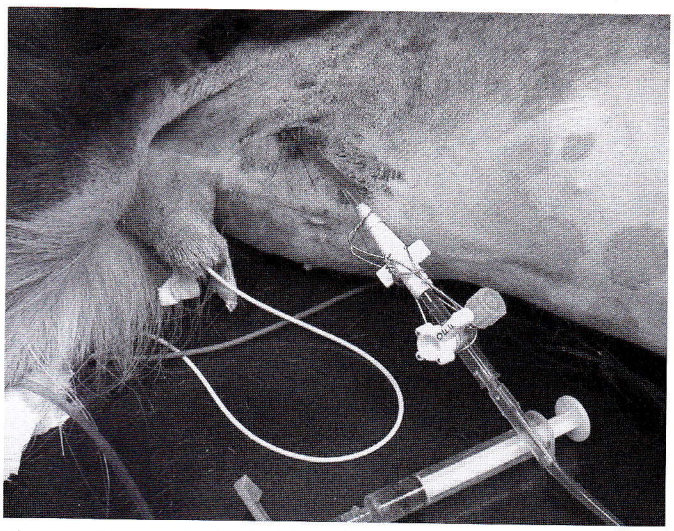

Fig. 6.22. Immediately connect the proximal end of the catheter to a Christmas-tree adapter or 1-ml syringe casing connected to an IV infusion set and closed collection bag.

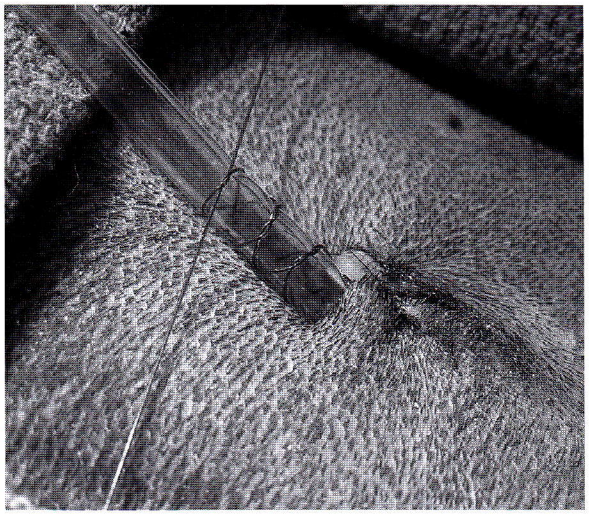

Fig. 6.23. Using absorbable suture, secure a purse-string suture into the external rectus abdominus around the tube. Make sure that the suture is not too tight, to prevent tube removal at a later date. Using nonabsorbable suture, secure a second purse-string suture in the skin around the tube. Leave the ends of the suture long, and create a finger-trap suture around the tube. Helpful Hint: Make sure that the throws of suture and knots pinch or crimp the tube snugly to prevent tube migration.

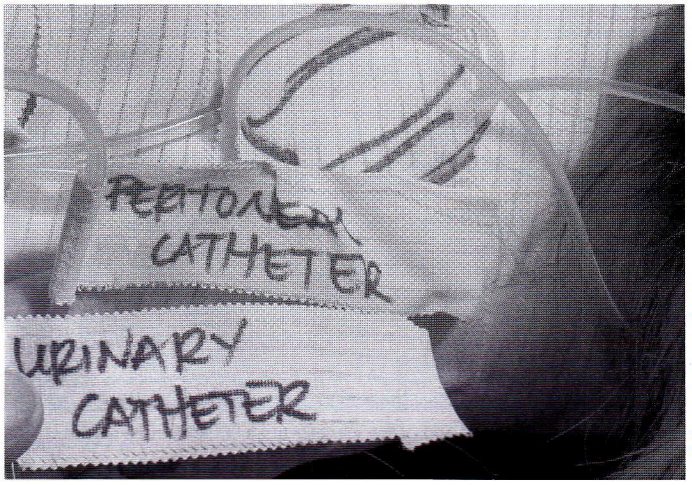

Fig. 6.24. Place a cut piece of 4 × 4-inch gauze square and antimicrobial ointment over the tube entrance site. Bandage the tube to the abdomen with layers of cotton roll gauze, Kling, and Elasticon or Vetrap. Helpful Hint: Make sure that the cranial layer of adhesive tape adheres to a piece of fur, to prevent the bandage from migrating caudally. Label the bandage and draw the outline of the tube, to prevent iatrogenic cutting of the tube during bandage removal or bandage change.

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CHAPTER 7

Pericardiocentesis

INTRODUCTION

Pericardial tamponade and the presence of even small amounts of fluid within the pericardial space can greatly impede cardiac preload and, subsequently, cardiac output. The recognition of and rapid removal of pericardial effusion can be lifesaving in some patients. See figs. 7.1–7.13.

Supplies Needed

Electric clippers and blades
Antimicrobial scrub solution
3–6-ml syringe with 22-gauge 3/4-inch needle
#11 scalpel blade
Abbott 16-gauge long over-the-needle catheter *OR* Turkel drainage catheter
60-ml catheter-tip syringe
Three-way stopcock
Intravenous extension tubing
Bowl or graduated cylinder for collection
Red-topped and EDTA tubes
ECG monitor

Indications

Pericardial effusion impairing cardiac preload and cardiac output
Diagnosis of inflammatory and neoplastic effusions

Contraindications

Coagulopathies secondary to vitamin K antagonist rodenticide intoxication

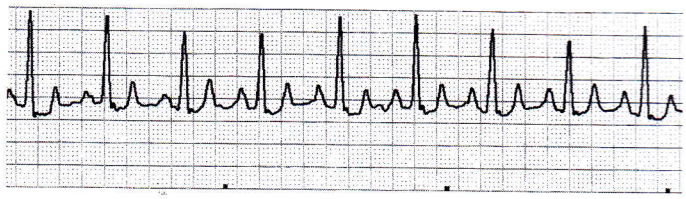

Fig. 7.1. Electrical alternans is a characteristic ECG abnormality observed when the heart is floating and swinging within the fluid in the pericardial sac, creating small, then larger ECG complexes. Low-amplitude ECG waveforms can also be associated with pericardial effusion, although they are also associated with severe obesity, hypothyroidism, hypothermia, and hypovolemic shock.

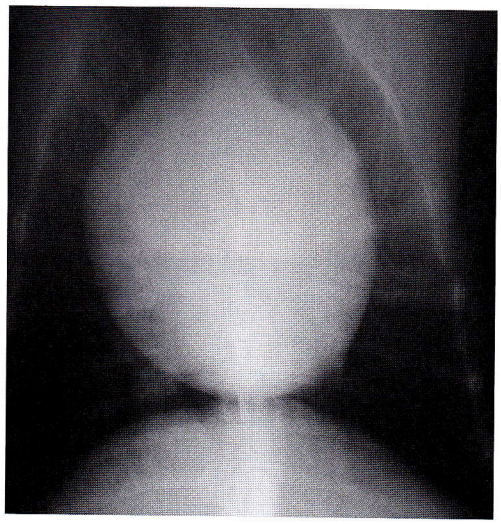

Fig. 7.2. VD thoracic radiograph from a patient with pericardial effusion, demonstrating a large globoid cardiac silhouette. Helpful Hint: The cardiac silhouette may appear normal in the VD, DV, or lateral radiographs if pericardial effusion is acute, leading to severe cardiovascular compromise without radiographic appearance of abnormalities.

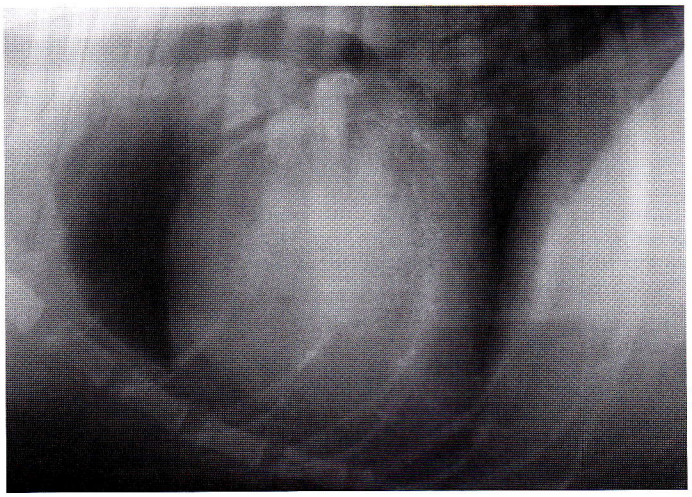

Fig. 7.3. Lateral thoracic radiograph from a patient with pericardial effusion, demonstrating an enlarged cardiac silhouette.

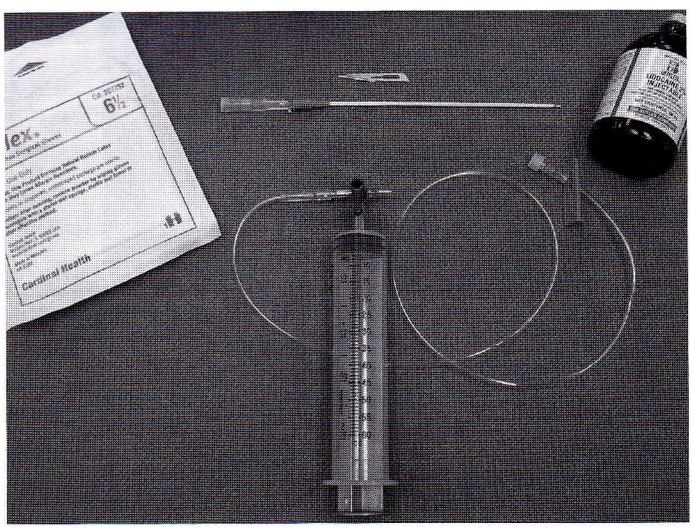

Fig. 7.4. Supplies needed to perform a pericardiocentesis include a #11 scalpel blade, 2% lidocaine, electric clippers and blades, antimicrobial scrub solution, Abbott over-the-needle catheter, ECG, three-way stopcock, IV extension tubing, 30- or 60-ml syringe, red- and lavender-topped tubes. Whenever possible, perform a prothrombin time prior to performing any pericardiocentesis, as vitamin K antagonist rodenticide intoxication can cause hemorrhagic pericardial effusion.

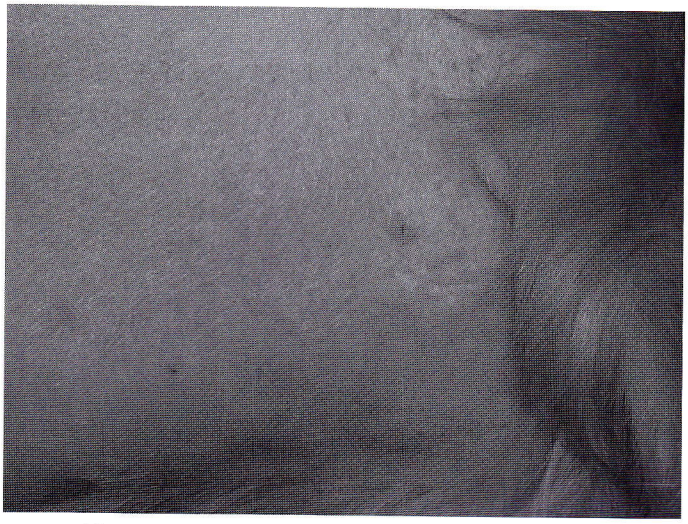

Fig. 7.5. Clip a large area of fur caudal to the elbow on the right lateral thoracic wall, over the fifth to eighth ribs.

Fig. 7.6. Aseptically scrub the clipped area with antimicrobial scrub.

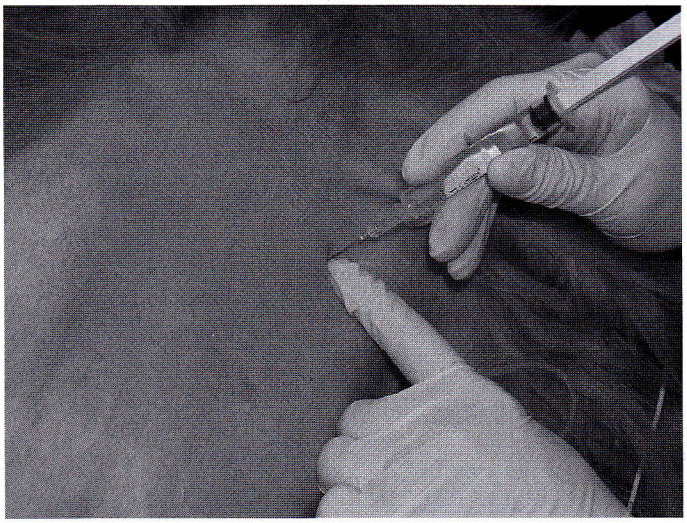

Fig. 7.7. Insert a bleb of lidocaine dorsal to the sternum and just caudal to the point of the elbow or at the sixth intercostal space. Helpful Hint: Make sure that you infuse the local anesthetic into the intercostal muscles and infuse as you draw the needle out, creating a tunnel of anesthetized tissue through which to insert your needle.

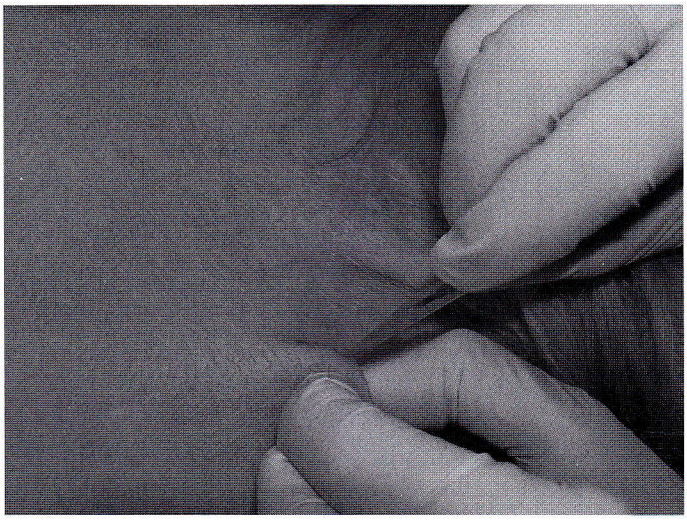

Fig. 7.8. Rescrub the clipped area and drape with field towels secured with towel clamps. Make a small stab incision through the skin where you infused the local anesthetic.

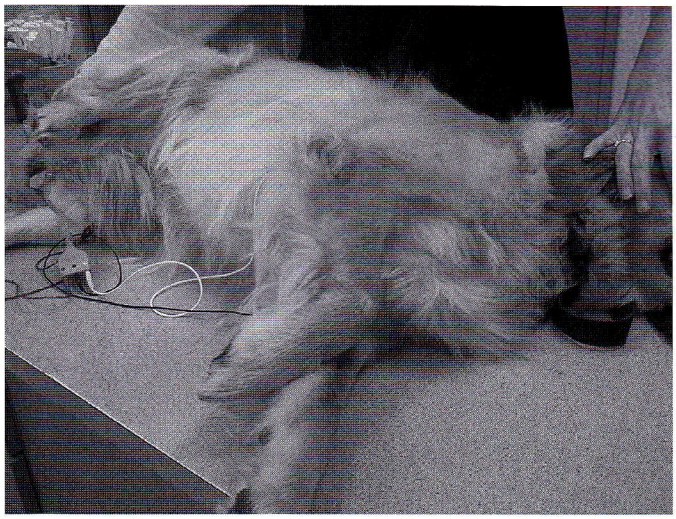

Fig. 7.9. Attach the patient to an ECG monitor, if available, to monitor for cardiac dysrhythmias while performing the pericardiocentesis.

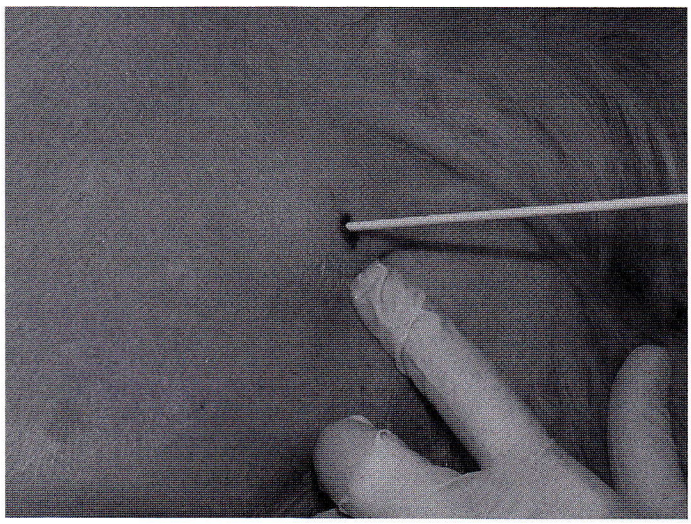

Fig. 7.10. Insert the over-the-needle catheter through the skin incision and through the body wall in the anesthetized area of muscle. Watch carefully for dysrhythmias on the ECG monitor, and for a flash of blood in the hub of the needle.

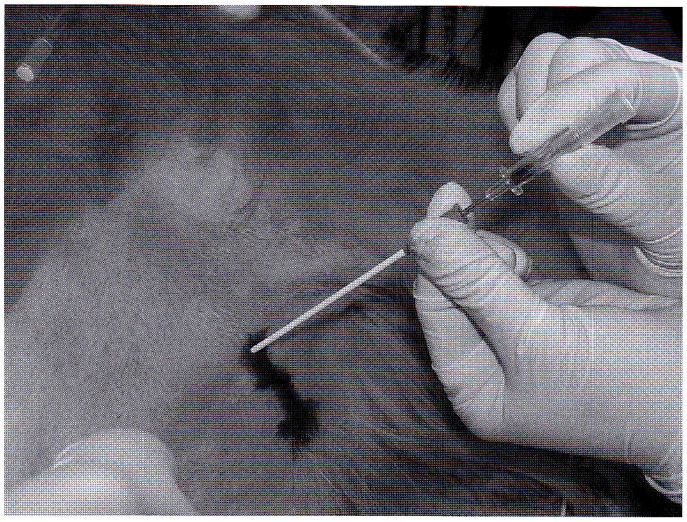

Fig. 7.11. Once a flash of blood is observed, push the catheter off of the stylet, and remove the stylet. Attach the hub of the catheter to the length of IV extension tubing, and draw the fluid off the pericardial sac.

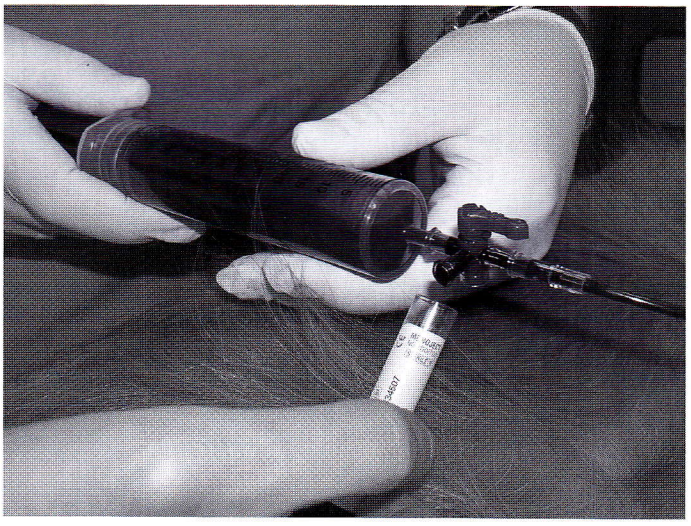

Fig. 7.12. Place a small amount of the pericardial fluid in red- and lavender-topped tubes, for fluids analysis. Watch the red-topped tube carefully for the presence of a clot. Clot formation may indicate an active bleed, but more commonly suggests that you have inserted the catheter into the heart itself, and not the pericardium. Set aside some of the fluid for culture, in the event that the fluid is due to an infectious cause.

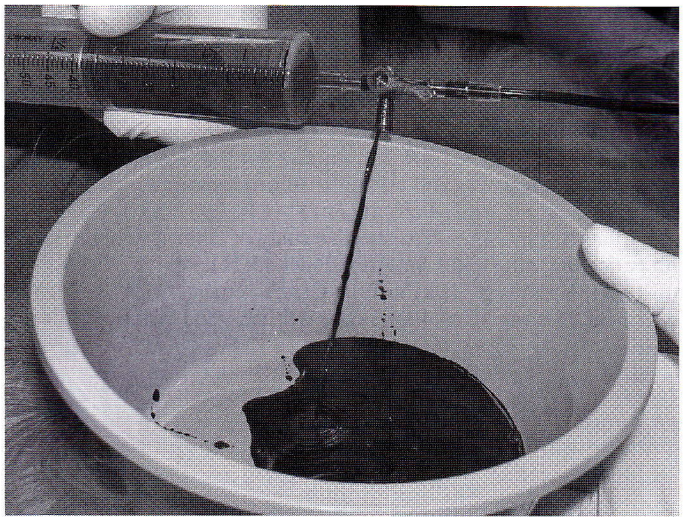

Fig. 7.13. Removal of even a small amount of blood can drastically improve cardiac output by improving cardiac filling.

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CHAPTER 8

Central Venous Pressure (CVP)

INTRODUCTION

In the absence of vascular obstruction, central venous pressure is the measure of the hydrostatic pressure within the thoracic vena cava. Central venous pressure is often used as an indicator of vascular preload, or the volume of blood/fluid within the vascular space. Central venous pressure also is affected by the contractile function of the right heart, the change in intrathoracic pressure throughout the phases of respiration, positive pressure ventilation, upper airway obstruction, and the cardiac cycle. Because pulmonary artery catheters are not routinely used in veterinary medicine, persons often use changes in a patient's central venous pressure as a rough indicator or reflection of the potential for pulmonary vascular overload. It is to be noted, however, that CVP is a measure of right heart function, and does not directly measure left heart function at all. Normal CVP is 0–5 cm H_2O. Values less than 0 cm H_2O reflect hypovolemia or peripheral vasodilation, and values greater than 16 cm H_2O are associated with right-sided cardiac failure. The CVP measurement should be used to monitor trends in intravascular volume and right-sided cardiac function and used to gauge fluid resuscitation. As a rule, a patient's CVP should not increase by more than 5 cm H_2O during any 24-hour period to avoid pulmonary vascular overload. If a central venous catheter cannot be placed in a patient's jugular vein, use of a long catheter in the medial saphenous vein in cats can be used to monitor trends in CVP. See figs. 8.1–8.10.

Supplies Needed

Electric clippers
Electric clipper blades
Antimicrobial scrub
4 × 4-inch gauze squares
Central venous catheter

Cotton roll gauze
Kling or gauze bandage material
Elasticon or Vetrap
T-port
IV extension tubing (2)
Heparinized 0.9% saline flush
20-ml syringe
Three-way stopcock
Manometer or ruler with metric scale in cm

Indications

Monitor fluid therapy in cases of septic shock, cardiac disease, renal failure, and severe hypovolemia

Contraindications

Coagulopathies
  Thrombocytopenia
  Thrombocytopathia
  Vitamin K antagonist rodenticide intoxication
Hypercoagulable states
  Hyperadrenocorticism
  Protein-losing nephropathy
  Protein-losing enteropathy
  Immune-mediated hemolytic anemia
Elevated intracranial pressure
  Head trauma
  Intracranial mass lesions
  Intractable seizures

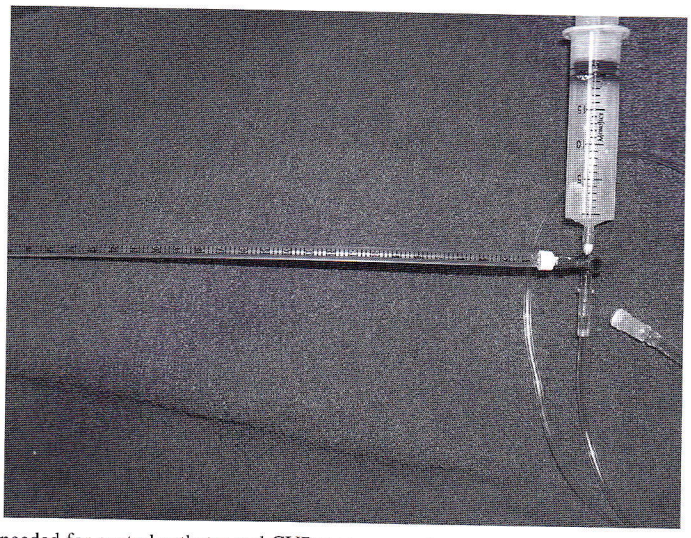

Fig. 8.1. Supplies needed for central catheter and CVP measurement.

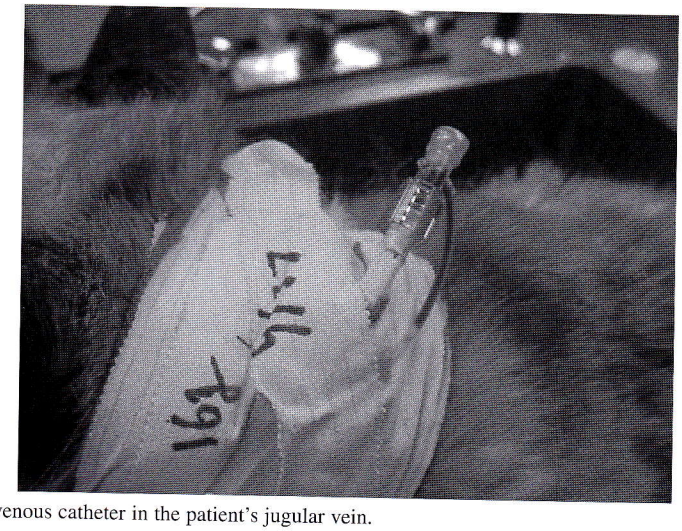

Fig. 8.2. Central venous catheter in the patient's jugular vein.

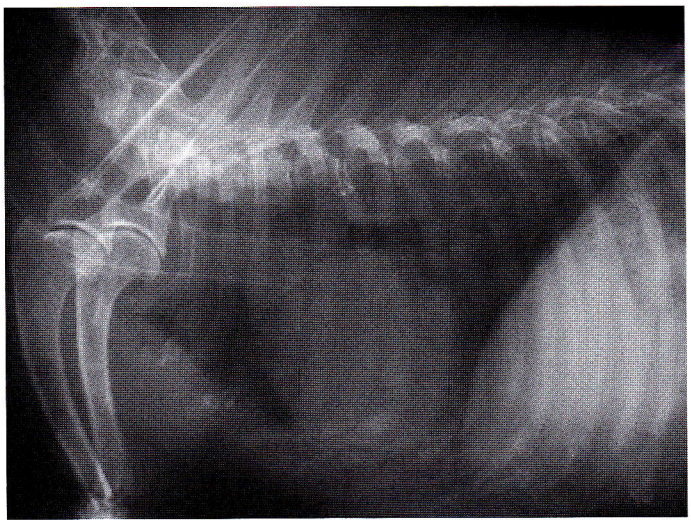

Fig. 8.3. For accurate CVP measurements, the tip of the jugular catheter should lie just outside of the right atrium of the heart (lateral thoracic radiograph confirming correct placement of a jugular catheter for CVP measurements).

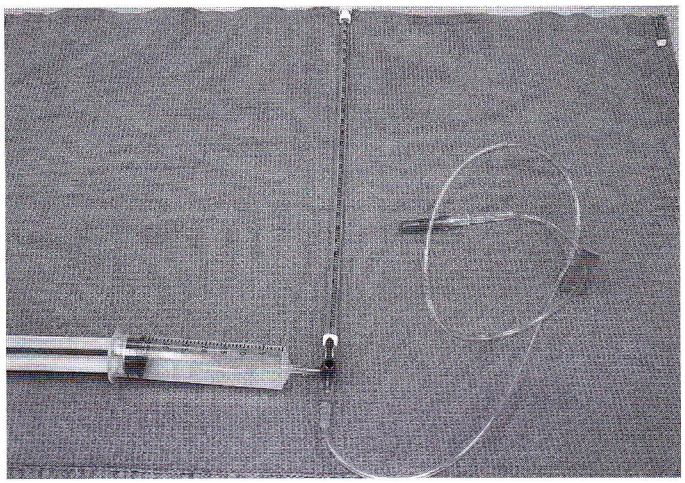

Fig. 8.4. Connect the female end of a length of IV extension tubing to the male port of a three-way stopcock. Connect either a flushed length of IV extension tubing or a manometer to one of the female ports of the three-way stopcock. Connect a 20-ml syringe of heparinized 0.9% saline to the other female port of the three-way stopcock.

Fig. 8.5. Connect the CVP apparatus to the T-port in the patient's jugular catheter.

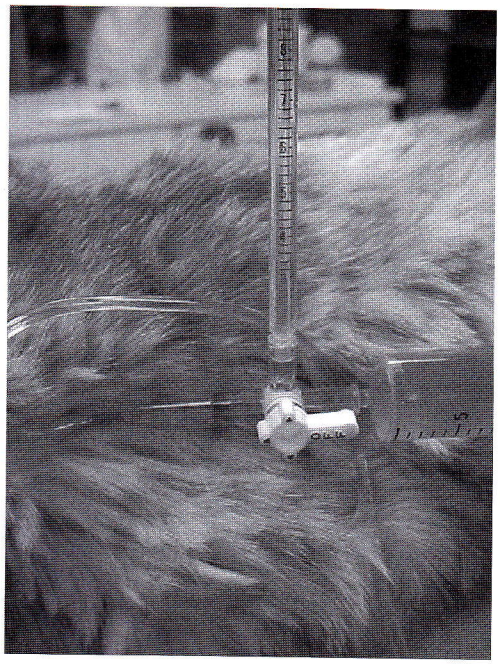

Fig. 8.6. Lower the 0 cm H_2O mark to the level of the patient's manubrium when the patient is in lateral recumbency, and at the point of the elbow for a patient in sternal recumbency. Whatever method you use, make sure that the same method and patient positioning is used for all subsequent measurements.

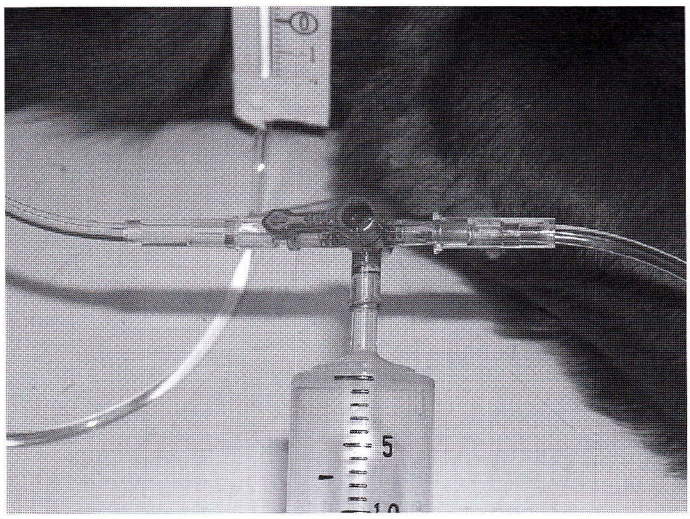

Fig. 8.7. Turn the stopcock OFF to the manometer, and ON to the patient, to flush the patient's catheter with a small amount of heparinized saline.

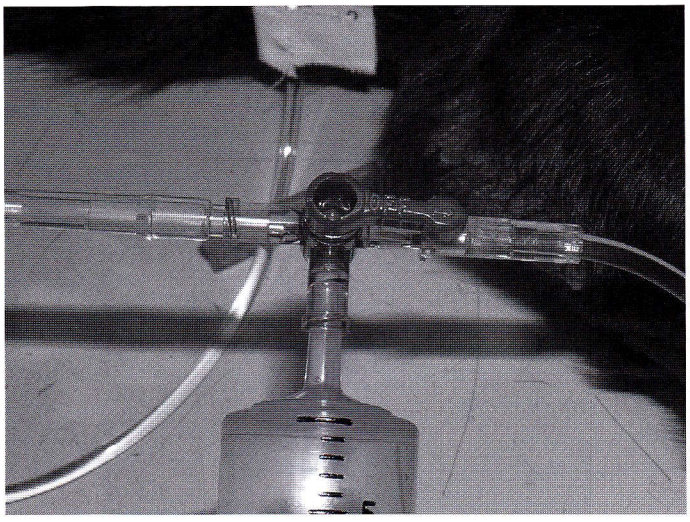

Fig. 8.8. Turn the stopcock OFF to the patient, and slowly inject into the manometer. Helpful Hint: Use care to not create any air bubbles that will interfere with accurate CVP measurement.

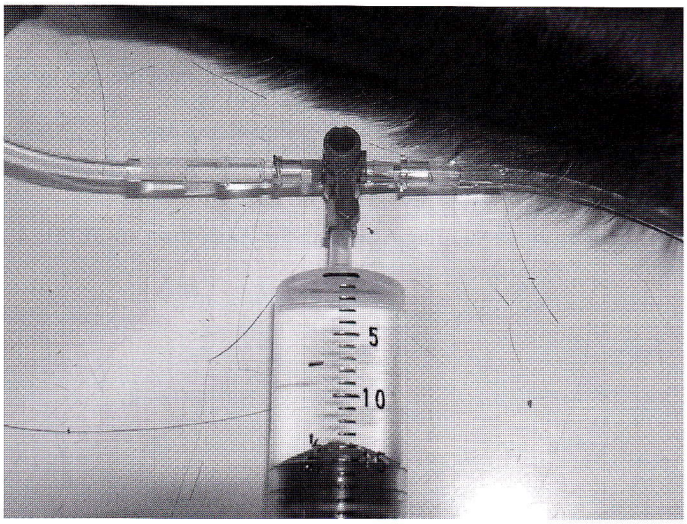

Fig. 8.9. Again, lower the 0 cm H_2O point on the manometer to the level of the patient's manubrium (or shoulder, if in sternal recumbency), and turn the stopcock OFF to the syringe. The fluid column in the manometer will equilibrate with the column of fluid in the patient's vascular space.

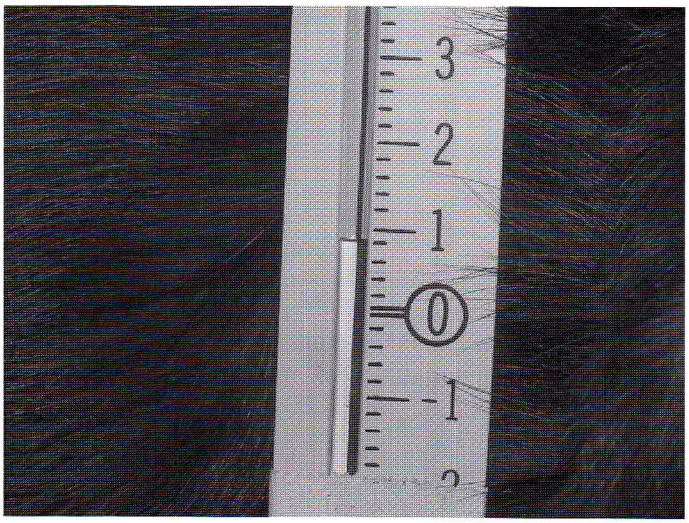

Fig. 8.10. Once the column of fluid in the manometer stops decreasing and rises and falls with the patient's heartbeat, measure the level on the lower point of the meniscus in the manometer to obtain the CVP measurement. Repeat the process three to five times, to confirm accuracy of measurement, as outliers can occur.

REFERENCES

Jennings PB, Anderson RW, Martin AM. Central venous pressure monitoring: a guide to blood volume replacement in the dog. J Am Vet Med Assoc 151:1283–1293, 1967.

Machon RG, Raffee MR, Robinson EP. Central venous pressure measurements in the caudal vena cava of sedated cats. J Vet Emerg Crit Care 5(2):121–129, 1995.

Oakley RE, Olivier B, Eyster GE, et al. Experimental evaluation of central venous pressure monitoring in the dog. J Am Anim Hosp Assoc 33:77–82, 1997.

Waddell LS. Direct blood pressure monitoring. Clin Tech Sm Anim Pract 15(3):111–118, 2000.

CHAPTER 9

List of Supplies Needed

CENTRAL VENOUS CATHETERS

14-gauge 5 1/2" Venocath Abbocath-T Radiopaque FEP IV Catheter
Abbott Ireland, Sligo, Republic of Ireland
18-gauge Abbott Venisystems Venocath Radiopaque IV Catheter
Abbott Ireland, Sligo, Republic of Ireland
16-gauge Abbott Venisystems Venocath Radiopaque IV Catheter
Abbott Ireland, Sligo, Republic of Ireland
Abbott Lifeshield High Flow Central Venous 3 Lumen Catheter, 7 Fr, 20 cm
Abbott Laboratories, North Chicago, IL 60064
Arrow-Howes Multilumen CVC Kit with BlueFlex Tip Catheter 7 Fr, 3 lumen, 20 cm length
Arrow International, Inc., 2400 Bernville Road, Reading, PA 19605

DRUGS

Heparin sodium injection 1000 USP units/ml
American Pharmaceutical Partners, Inc., Schaumburg, IL
2% lidocaine Butler 2% lidocaine injectable
The Butler Company, Dublin, OH 43017
0.5% Proparacaine Bausch and Lomb proparacaine HCl ophthalmic solution 0.5%
Saline 0.9% sodium chloride injection USP
Baxter Healthcare Corporation, Deerfield, IL 60015

FEEDING AND OXYGEN SUPPLEMENTATION TUBES AND URETHRAL CATHETERIZATION

8 Fr Argyle infant feeding tube, Kendall Argyle Feeding Tube 42 inch,
Tyco Healthcare Group, Mansfield, MA 02048
10 Fr Argyle infant feeding tube, Kendall Sovereign Feeding Tube and Urethral Catheter
Tyco Healthcare Group, Mansfield, MA 02048
Red rubber sterile polyvinyl chloride sovereign urethral catheter; 10–18 Fr Kendall Sovereign Red Rubber Feeding Tube and Urethral Catheter
Tyco Healthcare Group, Mansfield, MA 02048

HYPODERMIC AND SPINAL NEEDLES, SYRINGES

16-gauge spinal needle with stylet Monoject Spinal Needle,
Sherwood Medical/Medi-vet Animal Health, Covington, LA, 1-800-668-9698
18-gauge spinal needle with stylet BD Spinal Needle
BD Medical, Franklin Lakes, NJ
20-gauge 1-inch hypodermic needle, Kendall Monoject Veterinary Latex-free Polypropylene luer-lock hub hypodermic needles
Tyco Healthcare Group, Mansfield, MA 02048
20-gauge 1-1/2-inch hypodermic needle, Kendall Monoject Veterinary Latex-free polypropylene luer-lock hub hypodermic needles
Tyco Healthcare Group, Mansfield, MA 02048
22-gauge 1-inch hypodermic needle, Kendall Monoject Veterinary Latex-free Polypropylene luer-lock hub hypodermic needles
Tyco Healthcare Group, Mansfield, MA 02048
22-gauge 1-1/2-inch hypodermic needle, Kendall Monoject Veterinary Latex-free Polypropylene luer-lock hub hypodermic needles
Tyco Healthcare Group, Mansfield, MA 02048
24-gauge 3/4-inch needle, Kendall Monoject Veterinary Latex-free Polypropylene luer-lock hub hypodermic needles
Tyco Healthcare Group, Mansfield, MA 02048
3-ml regular luer tip syringe with needle, Monoject Veterinary Products
Tyco Healthcare, Mansfield, MA 02048

OXYGEN SUPPLEMENTATION SUPPLIES

Cook 10.2 multipurpose 30-cm polyurethane thoracic drainage catheter with trocar stylet tip
Global Veterinary Products, New Buffalo, MI 49117; 269-469-8882
Grooved director with Probe end and tongue tie
Spectrum Surgical Instruments, Stow, OH 80044
Flexible oxygen tubing
Baxter Healthcare, Deerfield, IL 60015
CV7144 oxygen flowmeter and mounting apparatus humidifier system
Webster Veterinary Supply, Sterling, MA; 1-800-225-8211

PERICARDIOCENTESIS

Abbott-T 14-gauge radiopaque FEP IV catheter
Abbott Laboratories, North Chicago, IL 60064
Turkel drainage catheter, Turkel polyurethane 8 Fr 16-gauge 9-cm thoracocentesis catheter
Tyco Healthcare Group, Mansfield, MA 02048
60-ml syringe, Monoject, 60-ml regular tip syringe
Tyco Healthcare Group, Mansfield, MA 02048

PERIPHERAL INTRAVENOUS CATHETERS

22-gauge over-the-needle Abbott Teflon IV catheter
Abbott Laboratories, North Chicago, IL 60064
22-gauge over-the-needle Terumo Surflash polyurethane catheter
Terumo Medical Corporation, Elkton, MD 21921
20-gauge over-the-needle Abbott Teflon IV catheter
Abbott Laboratories, North Chicago, IL 60064
20-gauge over-the-needle Terumo Surflash polyurethane catheter
Terumo Medical Corporation, Elkton, MD 21921
18-gauge over-the-needle Abbott Teflon IV catheter
Abbott Laboratories, North Chicago, IL 60064
18-gauge over-the-needle Terumo Surflash polyurethane catheter
Terumo Medical Corporation, Elkton, MD 21921

THORACOCENTESIS, THORACIC, AND ABDOMINAL DRAINAGE CATHETERS

Thoracic drain Argyle trocar thoracic catheter with radiopaque sentinel line
Kendall Tyco Healthcare

TRACHEOSTOMY TUBE PLACEMENT SUPPLIES

Shiley low pressure cuffed tracheostomy tube
Mallinckrodt, Inc., St. Louis, MO 63134; 1-888-744-1414
Umbilical tape nonsterile braided white polyester umbilical tape
Jorgensen Labs, Loveland, CO 80538

GENERAL MISCELLANEOUS SUPPLIES

Three-way stopcock Argyle EZ-Flo three-way stopcock with port covers
Sherwood Medical, St. Louis, MO 63103
IV extension tubing Abbott 30-inch latex-free extension set
Abbott Laboratories, North Chicago, IL 60064
EDTA tube monoject lavender stopper (EDTAK3) nonsilicone coated tubes
Tyco Healthcare Group, Mansfield, MA 02048

Red-topped tube, Monoject Red Stopper Blood Collection Tube
Tyco Healthcare Group, Mansfield, MA 02048
Sterile culturettes, BBL CultureSwab Plus Collection and Transport System,
Becton Dickinson and Company, Sparks, MD 21152
IV extension tubing, Abbott 30-inch latex-free extension set
Abbott Laboratories, North Chicago, IL 60064
Male adapter SurFlo single-use sterile injection plug
Terumo Medical, Somerset, NJ, 1-800-283-7866
T-port Lifeshield latex-free microbore extension set with T connector
Abbott Laboratories, North Chicago, IL 60064
Rigid Elizabethan collar MWI
Elizabethan Collars, Meridian, ID; 1-800-824-3703
Elizabethan collar, 3M Custom Care Collars
3M Corporation, St Paul, MN 55144; 1-800-848-0829
3M single-use clear plastic steri-drape
3M Corporation, St Paul, MN 55144; 1-800-848-0829
Christmas-tree adapter sterile disposable threaded luer-lock catheter adapter, Kendall Argyle
Female Luer Lock Sterile Polypropylene Connector
Tyco Healthcare Group, Mansfield, MA 02048
22-gauge orthopedic wire, 22-gauge orthopedic wire on a plastic spool
IMEX Veterinary Inc., 1-800-828-IMEX
Sterile lubricating jelly, Priority 1 Care nonspermicidal sterile lubricating jelly
First Priority, Inc., Elgin, IL 60123-1146
Sterile surgical gloves, Allegiance Triflex Sterile Latex Surgical Gloves
Allegiance Healthcare Corporation, McGaw Park, IL 60085
Gelpi retractors
Universal Surgical Instrumentation, Glen Cove, NY; 1-877-587-6278

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Written by two leading emergency and critical care specialists with extensive clinical experience, *Veterinary Emergency and Critical Care Procedures* is a must have reference for all practicing veterinarians.

Timothy B. Hackett is an Associate Professor and Chief of Emergency and Critical Care Medicine at the James L. Voss Veterinary Teaching Hospital, Colorado State University.

Elisa M. Mazzaferro is the Director of Emergency Services at Wheat Ridge Veterinary Specialists in Denver, Colorado.

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