Therapeutic Thoracocentesis – Fenestrated Plastic Intravenous Catheter

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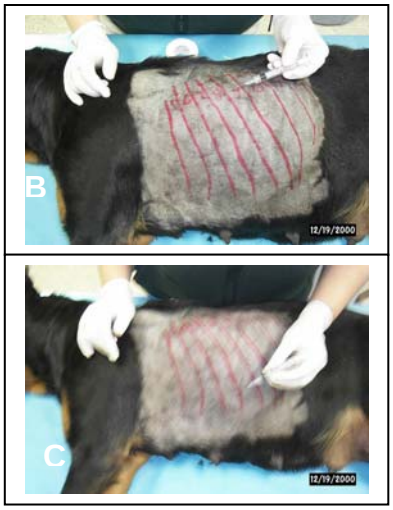
Once you have identified the presence of clinically significant pleural fluid or fluid with the *diagnostic* thoracocentesis procedure, the next step is to remove it. This may be accomplished with the fenestrated plastic catheter described here, or with a 'butterfly' style catheter (described in another handout). The primary advantage of the fenestrated catheter technique is that it the device serves as a 'mini' chest tube that may be left in for up to several hours, permitting complete and repeated removal of air or fluid from the pleural space. This is a big advantage to patients that would otherwise have to endure the pain and risk of multiple needle sticks. The primary disadvantage compared to the butterfly technique is that more time is required: the clinician must prepare the skin aseptically, provide local anesthesia, and the catheter takes more time to correctly insert. We prefer this technique for patients with traumatic pneumothorax or large quantities of pleural effusion.

Materials needed (figure A)

Clippers & skin prep

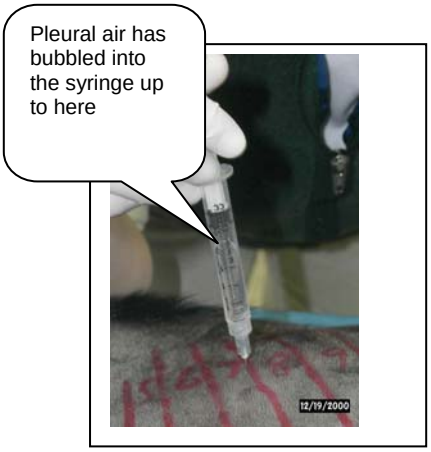
2% lidocaine for injection, in an appropriate needle/syringe
60-ml syringe with stopcock and IV extension set
11 B-P blade
3-ml empty syringe
Catheter:
16-20 ga, 2 – 3.5" (cats)
14-16 ga, 3.5 – 5.25" (dogs)
(18 ga, 2" may work in small dogs)

Although the photos shown here depict a cadaver in lateral recumbency, the procedure should be performed with the dog standing or in sternal recumbency, and the cat in sternal recumbency. Do not force the patient into lateral recumbency if it is having difficulty breathing.



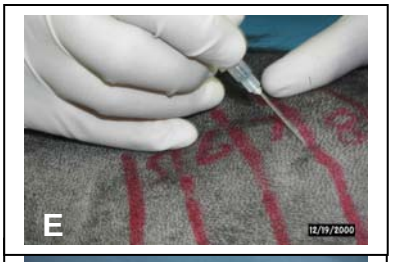
The more severely affected hemithorax should be used. The skin over the 7-8th interspace is clipped and the loose hair and dander is wiped off with a cotton ball soaked in isopropyl alcohol. If treating pneumothorax, the point of entry will be the 7-8th interspace at the junction of the dorsal and middle

thirds of the lateral chest wall (Figure B). If treating effusion, the point of entry should be just above the costachondral junction (Figure C).

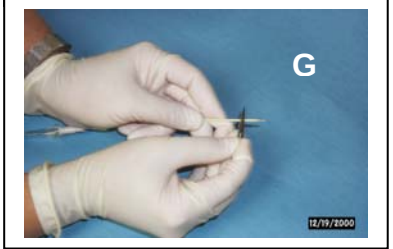


After locating the desired point of entry by palpation, the skin and body wall is blocked with lidocaine to the depth of the pleura. To confirm that the needle has been advanced into the pleura, aspirate on the plunger to withdraw air (Figure D) or fluid. Some lidocaine should be injected into the pleural space as the needle is withdrawn. An 'X' is (*lightly!*) scratched onto the skin at the injection site; this scratch will form a wheal during skin preparation to mark the spot (Figure E).

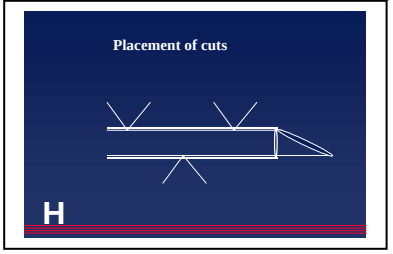
An assistant should prepare the skin aseptically with surgical soap. Povidone-iodine is used for cats and chlorhexidine is used for dogs, allowing 3 minutes of continuous wet contact with the soap before wiping it off with alcohol.



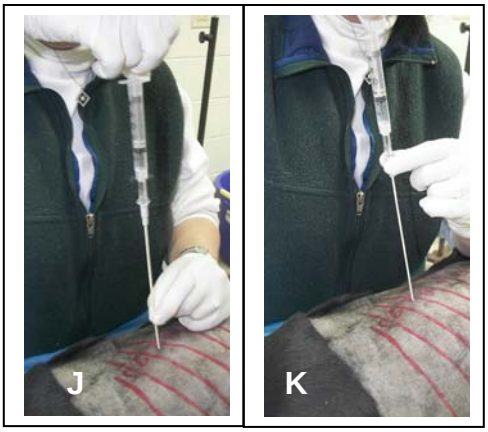
While the skin is being prepared, the operator should create 3 or more fenestrations in the catheter wall with the # 11 blade. This is accomplished by using the #11 B-P blade, and beginning 1 cm proximal to the tip of the catheter. If the operator is skilled at the technique, this may be accomplished while wearing clean exam gloves and using a 'no-touch' technique (Figure F). Otherwise, sterile gloves should be worn to allow the operator to hold the catheter close to the site where fenestrations are being made (Figure G). Leave *no* holes on about 1" of catheter closest to the hub, since this has to traverse the body wall.



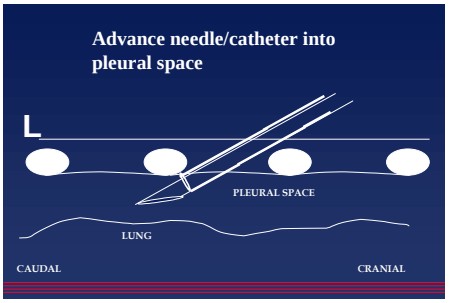
With the needle in place inside the catheter, a cut is made at a 45^{o} angle, then completed with a second cut oriented 90^{o} to the first, to create a 'V'- shaped notch in the catheter wall (Figure H). The hole should be as small as possible for pneumothorax, and no more than 20% of the catheter circumference for fluid. *Avoid* the natural tendency to 'scoop' out the holes – that method will make them too big! Any loose/ragged edges on the cut should be scraped off by 'backsweeping' the blade across it.



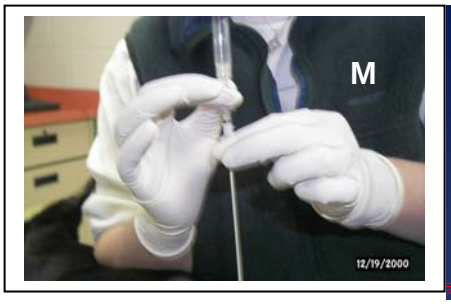
The #11 blade is used to make a skin incision at the site of the lidocaine block. The skin is 'tented' well away from the body wall and the incision is made at the skin base (Figure I). Be sure to make this stab incision completely through the dermis.

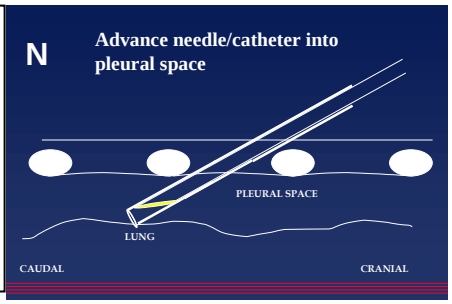


The 3-ml syringe is attached to the needle/catheter assembly, and the device is advanced into the wound. If wearing sterile gloves (Figure J), the dominant hand should rest on the body wall and the wrist and fingers are used to advance the catheter into the pleural space. If using clean exam gloves (Figure K), the elbow of the dominant arm should rest on the dog or table, and the catheter assembly is advanced from that position. *Be sure your elbow or forearm is stabilized on the dog or table to allow the fine motor control of your hand to do the work – don't advance this catheter with your triceps!* As soon as the needle has reached the subcutaneous tissue, 1-2 ml of vacuum is applied to the plunger, and *is not released until the needle has entered the pleural cavity.* Do *not* apply vacuum, release, advance and test again – you want the vacuum continuously applied. As soon as the needle penetrates the pleural space, the vacuum will be lost as air or fluid enters the needle. This finding should stop you from advancing the needle any farther into the pleural space (Figure L).



Once the needle penetrates the pleural space, focus all of your attention on the needle hub and hold it absolutely stationary relative to the body wall until the catheter is partially advanced off of it to cover the needle tip. This is accomplished by keeping your wrist or elbow stabilized on the chest wall or table, holding the needle hub stationary, and advancing the catheter 1 cm into the chest (Figures M & N). Your primary focus during this step is on holding the needle stationary. Avoid the common mistake of pulling the needle back as you advance the catheter in.

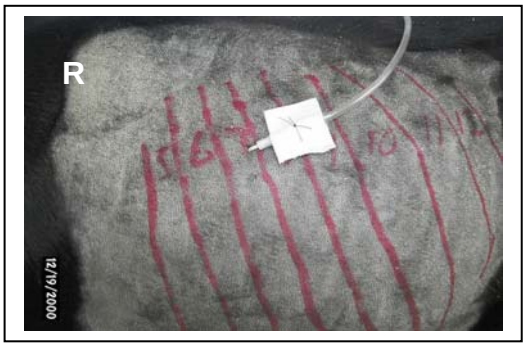




Once the plastic catheter has covered the needle tip, the hub of the needle/catheter assembly is brought closer to the body wall, to make it as parallel to the body wall as practical (Figure O). If you are treating pneumothorax, the catheter should be oriented parallel to the spine. If treating effusion, it should be aimed at the cranioventral thorax. The device is laid as parallel to the rib cage as possible without bending it excessively across the rib behind it. During this step, take care to not accidentally retract the needle out of

the pleural space. The needle tip must remain within the pleural space to serve as a stylet until the catheter is advanced completely into the chest (Figure P). To accomplish this, hold the needle hub stationary and advance the catheter cranially, high for air and low for fluid.

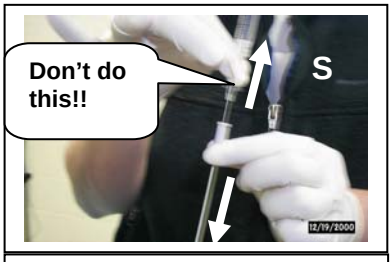
After removal of the needle the extension set is connected to the catheter and the air or fluid is aspirated (Figure Q). If the catheter is to remain in place, the catheter/tubing connection is bridged with a 'butterfly' of 1" waterproof white tape and this is sutured to the skin (Figure R).



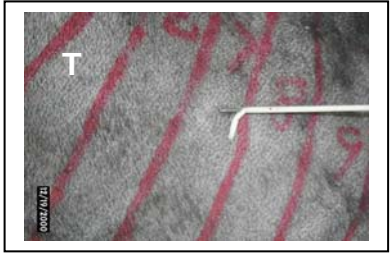
The catheter may work well for several hours before it kinks too much, giving you time to stabilize the patient. If you plan to radiograph an animal with pneumothorax, be sure to position him so the catheter is at the highest aspect of the pleural space and completely empty it just before obtaining the film. For effusion, lay the animal catheter-side down and drain all the fluid out just before making the shot.

What can go wrong?

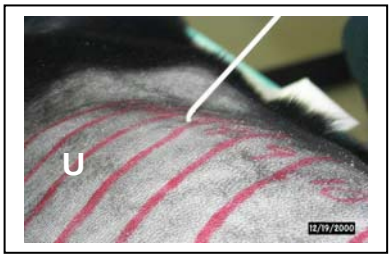
The most common difficulty experienced occurs during the process of advancing the catheter off the needle after penetration of the pleural space. Instead of holding the needle stationary and advancing the catheter off of it, the natural tendency for most people is **to pull the two apart** (Figure S). The result is that the needle will be withdrawn



from the pleural space. If the catheter tip is also accidentally withdrawn from the pleural space, when you try to advance it the catheter tip will curl into the tissues of the body wall. If you encounter substantial resistance to advancement of the catheter, remove the needle and catheter *together as a unit.* Do not try to advance the needle back into the catheter – it will puncture through the wall of the bent catheter tip (Figure T) and may shear it off.

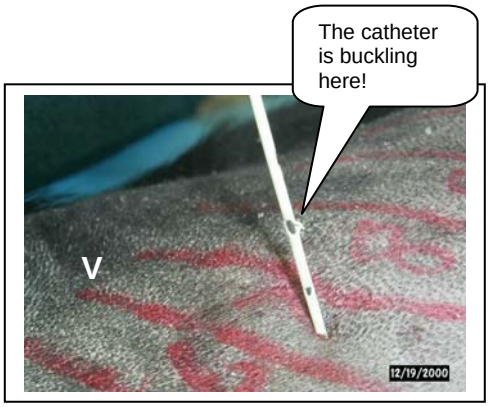


If the catheter advances into the pleural space **but the needle is accidentally withdrawn**, the stylet function of



the needle is lost, and the catheter bends at up to a 90^{o} angle as it passes between the ribs. When you try to advance it, the shaft of the catheter may coil subcutaneously or into the air if the needle is backed all the way to the skin (Figure U).

Another common problem is **to forget to make the facilitation incision** (or make it too shallow) in the skin prior to advancing the needle/catheter assembly. When that happens, you will encounter high resistance as you try to advance the catheter tip, and then the side fenestrations, through the dermis. If you see the skin 'drag ' inward with the catheter, remove it and make the hole deeper.



Finally, another problem occurs **when the side holes are too large or have rough edges**. During insertion, the catheter may collapse at the fenestration site (Figure V) or snag on the dermis as you try to advance it into the chest. When you attempt to withdraw this catheter, it will snag on the intercostal muscles or the dermis (Figure W). If this happens, hold the catheter perpendicular to the skin at that location and apply steady, gentle traction. You will have to estimate how hard you can pull on it without tearing the catheter in half! If in your judgment the catheter is at risk of tearing, you should be able to salvage it by enlarging the incision in the body wall with a #11 BP blade. While holding the catheter perpendicular to the body wall and applying gentle traction, slide the blade with the *back side* against the catheter into the wound, until the blade cuts enough tissue to enlarge the hole sufficiently to eliminate the snag (Figure X).