

Chronic Intravascular Catheterization in Swine: Peripheral Vessels

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This fact sheet details the techniques of inserting intravascular catheters for chronic blood sampling and administration of test substances into the major peripheral blood vessels. The general principles of surgery, catheter design and maintenance are covered in a previous fact sheet on this website (Chronic Intravascular Catheterization in Swine: General Principles) and should be reviewed as a complement to this publication. There are also detailed reviews of the techniques, which have been published.^{1,2}

Manipulation of Blood Vessels

Gentle dissection of blood vessels is the best means to prevent the vasospasm, to which swine are predisposed, and is preferable to the use of topical lidocaine or papaverine. Elastic vessel loops are available to provide retraction and occlusion of blood vessels and are less traumatic than the use of suture material such as silk (Figure 1). After occlusion of the vessel proximal and distal to the site of catheter insertion, the vascular incision may be made with iris scissors, a #11 surgical blade or a hypodermic needle, and care should be taken to perform the procedure gently $\frac{1}{2}$ way through the vessel. A vascular pick may be useful to keep the lumen exposed for catheter insertion. After catheter insertion, it is secured in place as per the instructions in the manuscript on general principles.

External and Internal Jugular Veins/ Carotid Artery

These blood vessels are located deep in the neck musculature at the level of the ventral surface of the cervical vertebrae (Figure 2). The external jugular vein is very large and accessible even in immature pigs.³ It is surgically approached by an incision along the jugular furrow. The jugular furrow may be visualized by retracting a foreleg caudally while the pig is in dorsal recumbency. This anatomic reference is along a line drawn from the medial aspect of the mandible to the point of the shoulder. The dissection is made between the sternocephalic and brachio-cephalic muscles and this approach will be relatively bloodless after incising the superficial cutaneous muscles. Alternatively, the two mandibular branches of this vein may be cannulated. Several branches of this lateral and dorsal branches of this vein may have to be ligated during the dissection.

The internal jugular vein is located within a sheath with the vagus nerve and carotid artery on the lateral aspects of the ventral surface of the cervical vertebrae. The vein may be surgically approached either via a direct cutdown or a midline incision, however, there is a simpler approach if the external jugular vein is already exposed. A blunt dissection over the dorsal surface of the sternocephalic muscle will expose the sheath containing this vein and it may be retracted into the surgical site of the external jugular vein for catheterization. Experience has shown that the jugular veins can be ligated bilaterally without complications due to collateral circulation, however, it is preferable to leave one vessel on either side to assist with venous drainage.

The carotid artery may be exposed using the surgical approaches described above for the internal jugular vein. This vessel may be ligated unilaterally on either side without circulatory complications.

The placement of the tip of the catheter should be at the base of the heart in the precava. This area has the turbulence and velocity to help prevent thrombosis. Catheter tips inside the heart may stimulate arrhythmias. Premeasurement, blood pressure tracings or radiography may determine location and proper length of the catheter.

Chronic Intravascular Catheterization in Swine: Peripheral Vessels (cont'd)

Femoral Artery and Vein

The femoral vessels may be surgically approached by making an incision over the fascial division between the sartorius and gracilis muscles with the pig in dorsal recumbency and the leg retracted gently caudally. The location may be confirmed by feeling the pulse in the medial saphenous artery and following it to this location, where it disappears. A longitudinal incision will expose the vessels better than a transverse incision. Lateral and deep branches of the artery and vein have to be cauterized or ligated while dissecting the vessels. Both vessels can be ligated without any circulatory problems.

Other Peripheral Blood Vessels

The cephalic vein may be used for chronic cannulation by locating the vein as it crosses the neck superficially from the point of the shoulder to the thoracic inlet. With the pig in dorsal recumbency, digital pressure is applied in the thoracic inlet and the dilated vessel will become apparent. It has the advantage of being more superficial in its location than the jugular veins, however, it has a much smaller diameter.

The external mammary vein is located along the lateral aspect of the mammary glands on the abdomen. This vein may be located by putting digital pressure at either side of the sternum with the pig in dorsal recumbency. This vein is best utilized for short term catheterization procedures because of its superficial location in an area which is easily traumatized by the pig. It is relatively small in immature pigs.

The medial saphenous artery is located over the medial aspect of the stifle (knee or femoral/tibial joint). Its pulse can be located superficially in all ages of animals. The artery is best utilized for short term catheterization because of its location. Smaller catheters can be advanced into the femoral artery from this location. The vein is usually a plexus and is unreliable for cannulation.

Discussion

These are the most common peripheral vessels that are surgically cannulated. All catheters should be exited out the dorsum of the back after tunneling, unless they are for very short term procedures. Catheters exiting out the ventral or medial surface are prone to trauma and infection. If they are cannulated for only a short time a circumferential bandage may be used to protect them.

References

1. Swindle MM: Surgery, Anesthesia and Experimental Techniques in Swine, Ames, IA: Iowa State University Press, 1988.
2. Swindle MM, Smith AC, Goodrich JA: Chronic cannulation and fistulization procedures in swine: A review and recommendations. J Invest Surg 11: 7-20, 1998.
3. Purohit DM, Swindle MM, Smith CD, et al: Hanford miniature swine model of extracorporeal membrane oxygenation (ECMO). J Invest Surg 6: 503-508, 1993.