

Cerebrospinal Fluid (CSF) Collection and Epidural Administration in Swine

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Retrieval of CSF from the spinal cord and epidural administration of pharmacologic agents may be necessary for some experimental procedures. Epidural administration of analgesics, such as morphine, may be desirable for pre-emptive analgesia for surgical procedures caudal to the thorax.

Anatomy

The vertebral bone structure in the pig is massive compared to other large animal species used in research. In addition, the intervertebral spaces are narrow and the dorsal processes of the vertebra tend to interfere with access to the vertebral spaces because of their size and caudal orientation. The pig does not normally have the ability to flex the spine as much as other species, giving them a more stiff posture. The vertebral formula is C 7, T 14-15, L 6-7, S 4, Cy 20-23. The sacral vertebrae are partially fused. The spinal cord terminates with the conus medullaris at S2-3 and follows down the remaining vertebra with the cauda equina and the filum terminale. This is unlike the human in which the conus medullaris is located at L1-2. The epidural space tends to contain fatty deposits. The cross section of the vertebral canal from outside to inside is: dorsal longitudinal ligament, epidural cavity, dura mater, subdural cavity, arachnoid membrane, subarachnoid cavity, pia mater, spinal cord.^{1,2}

The epidural cavity or space is the site of injection of substances such as analgesics. The subarachnoid cavity is the site of interest for obtaining CSF.

Epidural Injection

Swine must be anesthetized for these procedures. Complete aseptic technique should be utilized when invading the spinal canal. This includes shaving, surgical skin preparation and wearing sterile gloves. Most porcine spinal canals can be accessed using 20-22 g, 1.5-3.0" (3.8-7.6 cm) spinal needles. (Figure 1)

Epidural administration of analgesics for preemptive analgesia is the most common procedure for which this technique is used. However, administration of test substances or radiopaque solutions may require this technique. Epidural administration is usually performed in the lumbar region because the regional analgesia is only effective for procedures caudal to the thorax. It is necessary to flex the spine in order to separate the intervertebral spaces. This is performed either by hanging the pigs rear legs off the end of a table while it is in sternal recumbency or by bending the rear legs forward under the abdomen in the same position.

An imaginary line is drawn between the most cranial aspects of the bilateral tuber coxae (wings of ileum), which are readily palpable. The intervertebral space cranial to this line will be L 5-6 or L6-7. The needle is placed between the palpable dorsal spinous processes and advanced slowly through the intervertebral space until a popping sensation is felt and there is a lack of resistance. If the vertebral body is hit, the needle will not advance and it should be withdrawn to try again. After entry into the site, the stylet is removed from the needle to ensure that blood or other fluid does not appear in the needle hub. The syringe is then attached and the injection is given. There should not be any resistance to the injection if it is in the epidural space. Catheters can be passed into the epidural space using the same technique. See the anesthesia section at www.sinclairresearch.com for drug dosages.

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CSF Collection

The area is prepped as per the directions above. CSF can be obtained from the lumbar region using the same technique and landmarks as described above. A greater volume can be obtained from the cisterna magna accessed through the foramen magnum. If this area is used, the pig's head is leaned off the end of a table to flex the neck. Alternatively the pig may be placed in lateral recumbency and the neck flexed by an assistant. The caudal end of the occipital bone and the nuchal tubercles are palpated. The needle is passed slightly caudal to this area at an angle (approximately 60°) towards the oral cavity to enter the foramen magnum cranial to the body of the axis.

For CSF collection the subarachnoid cavity is the site of interest. The spinal needle is passed into the epidural space as described above. Then a slight resistance is felt as the arachnoid membrane is penetrated. The stylet is removed from the needle and clear CSF fluid will drip from the needle if the location is correct. Passing the needle too deep will penetrate the spinal cord and a reflex jerk will be observed. If blood comes from the needle then either the venous plexus or a small artery has been hit. These problems should not occur if the needle is passed on the midline in the fashion described above.

Discussion

This fact sheet provides a stepwise methodology of collecting CSF fluid and performing epidural injections in swine. An exact calculation is not available but generally administration of <5 ml of solution or collection of 5-10 ml of CSF twice a week is not harmful to 25-50 kg swine. More comprehensive descriptions of these techniques and related experimental methodologies have been published.²

References

1. Sack WO. 1982. *Essentials of Pig Anatomy and Harowitz/Kramer Atlas of Musculoskeletal Anatomy of the Pig*. Ithaca, NY: Veterinary Textbooks.
2. Swindle MM. 1988. *Surgery, Anesthesia and Experimental Techniques in Swine*, Ames, IA: Iowa State University Press.

