

## Bone Marrow Access in Swine

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It may be necessary to perform bone marrow collection as part of an experimental protocol. For example the isolation of hematopoietic stem cells may require this methodology. It is also possible to administer therapeutic agents, such as fluids, and test substances into the bone marrow. Absorption from the bone marrow is essentially equivalent to performing iv administration.<sup>1</sup>

### Anatomy & Normal Values

The iliac crest (tuber coxae) is a common site for collection of bone marrow from humans. However, the bone structure of swine is massive and the cortical thicknesses are generally much greater than humans and other laboratory species. Similar problems are encountered with collection of bone marrow from the sternum, except in neonatal swine. Consequently, the tibia is the easiest site from which to obtain bone marrow samples. (Figure 1)

Some normal hematologic and myeloid values of swine may be useful as guides for bone marrow collection and injection procedures and are summarized in this section. There are 16 blood groups in swine, but the blood group antigens are weak and transfusion reactions are rare unless they are repeated sequentially with incompatible blood. The Myeloid/Erythroid Ratio is 1.2-2.2:1. The hematocrit (PCV) varies considerably with age and nursing swine are subject to an anemia which must be prophylactically treated with iron dextran injections. The PCV range is generally considered to be 26-35 in neonates and 35-45 in adults. The circulating blood volume of the pig ranges from 65-75 ml/kg and comprises approximately 5.5% of the body weight. It is generally safe to sample 7.5% of the blood volume weekly, 10% every two weeks or 15% monthly in swine. A maintenance fluid rate for swine is 5-15 ml/kg/hr. Bone marrow surgically harvested from 15-30 kg minipigs from both humeri and tibiae ranged from  $2 \times 10^9$  to  $8 \times 10^3$  cells/pig. Bone marrow collection volumes guidelines have not been determined. In our experience it is possible to obtain 10-20 ml samples from 20-30 kg swine several times a week without harm. Adult human collections generally average 1000ml. Consequently, a guideline of 10-15 ml/kg for swine as a total monthly collection should be acceptable. More in depth discussions and reference tables have been published.<sup>1-3</sup>

### Technique

Swine must be anesthetized to perform this technique. Complete aseptic technique, including shaving, surgical prepping and sterile gloves, is essential. The technique is performed with a standard bone marrow collection needle which has a cutting edge and a stylet. The usual needle size is 16-20 g, 1.0-1.5" (2.5-3.8 cm).

The medial aspect of the proximal tibia is the best location to obtain bone marrow in swine. The pig is placed in lateral recumbency. The area of interest is approximately at the level of the distal portion of the tibial tuberosity in the middle of the bone. The region is distal to the attachments of the tensor fascia latae and the insertions of the quadriceps muscle. When the area is palpated there is a slight depression not covered by muscle, providing direct access to the bone through the skin. This area has relatively thin bone cortex.

Alternatively, with the pig in sternal recumbency, the tuber coxae can be palpated on the dorsum at the most cranial aspect of the wing of the ileum. This area is also relatively free of muscle tissue. In neonates the ventrolateral aspects of the 2<sup>nd</sup> sternal body may be used after placing the pig in dorsal recumbency. Once the sternum ossifies significantly with age the marrow cavity decreases in size and this technique becomes unrewarding.

Regardless of the site the technique is the same. After prepping the animal as described above, the bone marrow needle with the stylet in place is passed through the skin. When the bone is felt, the needle is rotated back and forth with a forward pressure. A popping sensation is felt when the needle penetrates the cortex of the bone. The

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stylet is removed and bone marrow can be readily withdrawn in a syringe if the placement is correct. Alternately, administration of substances may be performed at this point. Once the sample is removed, the needle is rotated out of the bone and skin. Usually a suture is not required and digital pressure with a sterile gauze pad is all that is necessary to close the wound. An antiseptic ointment may be applied to the wound if the skin penetration hole is large.

### References

1. Swindle MM: *Surgery, Anesthesia and Experimental Techniques in Swine*, Ames, IA: Iowa State University Press, 1998.
2. Fraser CM, Bergeron JA, Mays A, Aiello SE (eds), *Merck Veterinary Manual*, 7<sup>th</sup> ed, Rahway: NJ, 1991.
3. Pennington LR, Opitz F, Sakamoto K, Pescovitz MD, Sachs DH: Bone marrow transplantation in miniature swine in Tumbleson ME (ed), *Swine in Biomedical Research*, Vol 1, NY: Plenum Publishers, 1986, pp 377-385.

