

## Bone Marrow

### Aims, advantages, and limitations

The main aim of bone marrow aspiration is to assess the cell populations in the bone marrow, and particularly the haematopoietic system. Good smears of bone marrow particles are required to obtain maximum information.

Cytology of bone marrow aspirates allows a more detailed evaluation of bone marrow function than core biopsy, and an approximate assessment of cellularity. However, biopsy of the bone marrow provides a more accurate assessment of cellularity and better information as to other pathological processes occurring in the bone marrow, such as myelofibrosis or myelophthisis. Where a full blood count suggests bone marrow evaluation is indicated, an aspirate should be the first technique used. If the cellularity is particularly low, a biopsy can then provide additional information.

Conditions where a bone marrow aspirate could be useful include peripheral blood abnormalities not explained by peripheral processes, staging of neoplastic disease, some infectious diseases (e.g. *Lishmania*), persistent hypercalcaemia, or pyrexia of unknown origin.

The procedure rarely poses a risk to the patient, even where there is severe thrombocytopenia. However, the risk of sedation or anaesthesia should be considered.

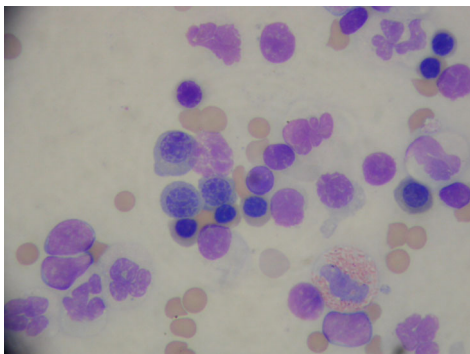


Figure 1. Myelodysplasia in feline peripheral blood.

## Preparation

Bone marrow clots very rapidly after sampling. Consequently, it is essential that all equipment is prepared prior to sampling. Several clean glass slides are prepared, placed at an angle of approximately 45° draining onto an absorbent surface. EDTA tubes should also be available. A small surgical kit is required, along with a bone marrow needle; suitable needles include the Rosenthal, Illinois sternal, Salah, or Jamshidi.

## Aspiration technique

The ideal sites for bone marrow specimens include the iliac crest, trochanteric fossa and proximal humerus (anterior side) in small animals, and the sternum or rib (dorsal end) in large animals. The patient is gently restrained with light sedation if possible (although cats may require general anaesthesia). The area over the sample site is clipped and prepared for a sterile procedure. Local anaesthesia is infiltrated into the skin and periosteum. A stab incision is made into the skin. The biopsy needle is inserted and, with firm pressure and a clockwise-counterclockwise motion, inserted through the cortical bone. The stylet is removed and a syringe applied (2-20ml depending on personal preference). Negative pressure is applied to the syringe until blood appears in the tip of the syringe. Up to 0.5ml fluid is collected.

For bone marrow biopsy, once the needle is through the cortical bone, the stylet is removed, and the needle advanced by twisting in one direction only.

For both biopsies and aspirates, the needle and syringe are withdrawn as a unit and a skin suture can be placed to close the stab incision if required. Both samples can be taken at the same time if wanted.

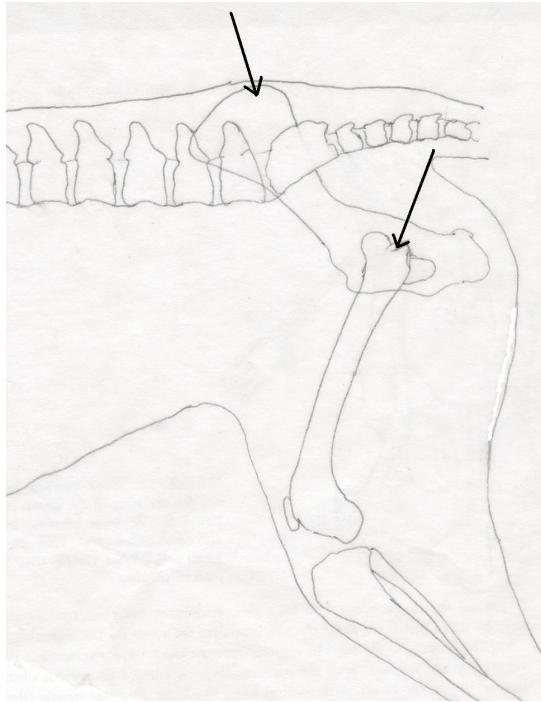


Figure 2. Sites for bone marrow aspiration

### Smear and sample preparation

Several air-dried smears are prepared within seconds of collection. Larger volumes of fluid can be preserved in EDTA, but cell preservation is not as good as with fresh air-dried smears. Even with EDTA, smears should still be prepared within 1-2 hours.

A drop of the aspirated marrow is expelled gently onto the angled slide, where the fluid is allowed to drain off, leaving the marrow particles adhering to the slide. The particles are then smeared by placing a second slide over the sample, clinging by capillary action only, with no pressure, or only slight finger pressure if particles are very thick, and pulling the slides apart gently.

If the sample has been placed into EDTA, the fluid can be emptied into a Petri dish. The particles should be visible as grey flecks that can be picked up with a capillary tube or pipette and transferred to a slide and smeared as before.

The smears should be rapidly air-dried, using a low setting on a hair dryer if necessary.

Bone marrow core biopsy samples are pushed from the needle in a retrograde direction (i.e. from the point of the needle towards the hub) with the stylet or a needle and placed directly into 10% buffered formalin.

Please keep fluids and air-dried smears well away from formalin and its fumes as this significantly affects stain uptake, leading to unreadable slides. It can be helpful to submit them in separate packages to avoid fumes affecting the smears in transit to the laboratory.

#### Sample preservation and submission to the laboratory

For submission to the laboratory, the practitioner should include a complete history with previous test results, details of any therapy, details of the technique used, and a peripheral blood sample (EDTA and air-dried smear) for haematology to be run at the time of the sample. This is essential for interpretation of the bone marrow smear examination. The smears should be labelled with the patient name and date.