The most common reason for analysing synovial fluid in the horse is for suspected synovial contamination and infection.

**Synoviocentesis**
For accurate interpretation, a synovial fluid sample without iatrogenic haemorrhage or contamination is necessary. A number of techniques should be used to minimise these risks. The area should be clipped and aseptically prepared before aspiration. The patient should be adequately restrained (appropriate bit/sedation). Minimising patient movement is important and placement of a subcutaneous bleb of local anaesthetic at the proposed site of aspiration is recommended. The site selected for aspiration should be remote from any traumatic wounds/punctures and, when possible, areas of soft tissue swelling/infecion. This reduces the risk of blood contamination and inoculation of the synovial cavity from periarticular sites of infection. Knowledge of sites for joint injection, including both dorsal and palmar/plantar pouches is essential. Use of a (relatively) large bore needle (19 gauge) minimises needle blockage by fibrin or congested synovium.

After needle insertion, if fluid flows freely this should be caught before any attempt at aspiration is made. If suction is required, this should be applied gently with a 5 ml syringe. Aspirated fluid should be collected into an EDTA blood collection tube for cytology and total protein determination and into an enrichment tube (biphasic blood culture medium) or lysing tube (for culture and sensitivity. If a sample cannot be obtained (e.g. because of a draining wound), a wash sample (obtained following injection of sterile physiological fluid) may provide some information (i.e. white cell differential). Dilution of the synovial fluid can subsequently be estimated by determination of serum and sample urea (Gough et al. 2002), although in practice this is infrequently performed.

**Normal synovial fluid**
Normal synovial fluid should be clear, straw yellow coloured and viscous. Normal parameters are: total nucleated cell count <1 x 10^9/ l; white cell differential <10% neutrophils; total protein <20 g/l.

**Contaminated and infected synovial fluid**
Diagnosis of synovial contamination and/or infection on the basis of synovial fluid analysis alone is not straightforward and results should always be interpreted in light of clinical and historical findings. No one parameter measured can provide an entirely accurate diagnosis and instead interpretation should combine visual assessment, total protein and nucleated cell count and differential.

**Visual assessment**
Synovial fluid from infected synovial cavities is frequently turbid, and may be flocculent. Colour ranges from pale yellow, to orange or red. Sanguineous fluid is not unusual. Visual assessment is extremely useful and frequently accurate (Wright et al. 2003). Viscosity is usually reduced.

**Total protein**
Total protein can easily be measured on a hand held refractometer. Levels become elevated early (<24 h) in the pathogenesis (Tulamo et al. 1989) and frequently exceed 40 g/l (a level rarely reached with noninfected causes of synovitis). However, levels vary and may be less in acutely contaminated cavities, with ranges reported from 22–98 g/l (Schneider et al. 1992; Frees et al. 2002; Wright et al. 2003).

**Nucleated cell count and cytology**
Nucleated cell count can be measured by an automated analyser, or alternatively estimated with reasonable accuracy from microscopic examination of a smear. Smears can be made directly from synovial fluid, air dried and rapidly stained with a Romanowsky stain (e.g. Diff Quik). Total nucleated cell count rises early following microbial contamination (Tulamo et al. 1989) and typically exceeds 30 x 10^9 cells/l (Wright et al. 2003). Marked variation, however, has been reported from 1.1-380 x 10^9 cells/l (LaPointe et al. 1992; Schneider et al. 1992; Frees et al. 2002; Wright et al. 2003). In cases of established infection it has been postulated that white cells may become sequestered into deposits of pannus within the infected cavity (Ian Wright, personal communication). Cytological examination of synovial fluid from contaminated and infected synovial cavities typically identifies a neutrophil differential in excess of 80% (Schneider et al. 1992; Wright et al. 2003). Degenerative changes in neutrophil morphology are uncommon. Identification of microorganisms also is uncommon, although positive identification on a gram stain provides an early guide to antimicrobial selection.

**Haemorrhagic fluid samples**
Iatrogenic blood contamination at the time of sampling can often be differentiated as the sample is aspirated, with blood occurring in streaks within the synovial fluid. Infected synovial fluid samples are often sanguineous, but the degree of haemorrhage within the sample usually does not significantly hamper interpretation. Differentiation of haemarthrosis from infection, however, may be difficult. Nucleated cell count and total protein are significantly elevated from normal synovial fluid. In addition, the nucleated cell differential may have a high neutrophil percentage. Comparison of the synovial fluid nucleated cell count and differential with peripheral blood can be useful and similar values suggest an absence of infection.

**Acute nonseptic inflammation**
One of the most difficult conditions to differentiate from synovial...
infection is post medication ‘flare’. Clinical signs are similar (severe lameness, joint distension, acute local inflammation). Flare may occur following injection of many substances, including local anaesthetics, HA, corticosteroids and PSGAGs. Clinicopathological values can be similar to values typical for synovial infection. There is no easy means of differentiation although, in the author’s experience, nucleated cell counts are often lower, but total protein high with flare. Early onset of clinical signs (<12 h) is suggestive of flare and, in the author’s experience, cases usually respond well to a single dose of NSAIDs. Clinical signs thereafter gradually resolve over 48–72 h.

Identification of synovial infection following injection of corticosteroids can also be difficult, due to suppression of the typical clinical signs of infection, synovial fluid nucleated cell count and total protein (Tulamo et al. 1989). Clinical signs may be suppressed to varying degrees for days or longer. Careful consideration of the clinical history, synovial fluid analysis and initial injury are required to best assess the presence or absence of infection.

Acute nonseptic inflammation also can occur in response to injury resulting in devitalisation of intra-synovial tendon and/or ligaments. Although uncommon, the author has seen cases with white cell counts in excess of 50 x 10⁹/l, with >90% neutrophils. Differentiation from synovial infection is difficult, although clinical signs often are not entirely consistent (e.g. lesser degrees of lameness).

**Synovial fluid culture**

Bacterial culture is the gold standard means of diagnosing synovial infection and, in addition, identifies the causative organism and allows sensitivity testing. However, there is a delay (usually 48 h) from sample submission to diagnosis and false negative cultures are common (approximately 50% when enrichment media are not used and 25% when they are) (Pille et al. 2007). Due to the urgency of the condition, treatment therefore is instituted before the results of culture are available. A degree of caution is also required in interpretation - synovial infection most commonly occurs secondary to wounds and multiple bacteria are usually involved (but may not be identified). In addition, in vitro sensitivity does not always accurately reflect in vivo sensitivity.

PCR for identification of bacterial 16s rRNA is an alternative method for positively identifying bacteria in the synovial fluid and has a high sensitivity (approximately 90%) (Pille et al. 2007). This also avoids the delay with culture, with results in <24 h. Although species identification can be performed, standard culture techniques are still required for sensitivity testing. Currently, this method of bacterial identification is limited commercially.

**References**


