SYNOVIAL FLUID BIOCHEMISTRY TO DIAGNOSE INFECTED TOTAL KNEE REPLACEMENTS

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Introduction: Infection is a major cause of prosthetic loosening. Distinguishing between aseptic and septic loosening is important in deciding the management of a patient and remains a diagnostic challenge. Numerous tests such Erythrocyte Sedimentation Rate (ESR), C-Reactive Protein (CRP), white cell counts, serial radiographs, scintography have been used to diagnose loosening and distinguish between infected and non-infective cases. In practice assessment involves a review of patient symptoms, clinical examination and any combination of these tests.

Synovial fluid biochemistry may be altered in diseased joints. In rheumatoid arthritic and infected joints hypoxic changes are found whereas osteoarthritus and trauma show increased oxygenation in the synovial fluid. These findings suggest that fluid biochemistry may be used as an indicator of disease in a joint. The synovial fluid from prosthetic joints has not been investigated for these relationships. It is possible that the biochemistry of prosthetic joints differs from normal or osteoarthritic joints. Evidence exists that both bacteria and the hosts response can cause a lowering of pH. (1-3). There have not been any studies examining the respiratory gas biochemistry of synovial fluid from prosthetic joints. Our aim is to investigate the biochemical composition of synovial fluid obtained from prosthetic joints, and to establish whether there is a difference between, infected, aseptically loose and normal prosthetic joints. The biochemistry of preoperative osteoarthritic joints and normal joints will also be assessed.

Methods: 20 patients undergoing either synovial biopsy or revision knee replacement with signs of radiological loosening were randomly selected. All patients had a FBC, ESR, CRP, synovial fluid aspiration for biochemistry and synovial or interface biopsy for microbiology culture and histology. Patients were consented for aspiration of synovial fluid. Using an aseptic technique, under general anesthetic a heparinised syringe was used to aspirate a few milliliters of joint fluid. Full saturation of blood oxygenation was ensured prior to aspiration of joint fluid. The samples were taken before applying a tourniquet. The respiratory gases were measured within a few minutes of aspiration of the fluid using the automated gas analysis machine. The results were compared using the student t-test.

Essential results: Clinical and microbiological tests both showed 6 infected knee joints. Histopathology showed 5 and laboratory tests showed 7 infected joints. The mean pH for infected and non-infected joints with the various tests is shown in Figure 1. The pH for infected joints was significantly lower than for non-infected joints in all the test groups (p<0.05). Infected knees also had a significantly higher pCO2/pO2 ratio compared to non-infected knees (Figure 2). Synovial fluid glucose levels were significantly lower in the infected joints (p<0.05). No difference in lactate levels was found between infected and non-infected joints. Using lab results as a gold standard to compare pH measures to, pH measures are 86% sensitive and 77% specific for infected cases diagnosed by lab measures. Using clinical results, as a gold standard pH measures were 100% sensitive and 79% specific for infected cases.

Discussion: The use of synovial fluid biochemistry offers a new approach for investigating infected knees. pH levels below 7.15, pCO2/pO2 ratio above 2.5 and Glucose levels below 2.5 mmol are strong indicators of an infected TKR. Synovial pH assessment may prove to be a quick, cheap and effective method of diagnosing an infected total knee replacement.

The small patient numbers limited this study; a larger patient series is required. Further studies on normal non-problematic total knee replacements are also needed.

References:

Figure 1: Shows differences in pH in the infected and non-infected groups.

Figure 2: Shows differences in the pCO2/pO2 ratio in the synovial fluid in infected and non-infected groups.

Figure 3: Shows differences in glucose concentration in the synovial fluid in the infected and non-infected groups.