1. **ACCURACY OF LABORATORY INVESTIGATIONS ON JOINT FLUID FOR INFECTION**

   For at least two years I have been hearing growing rumours of new technology using joint fluid to diagnose infection with enhanced accuracy. It hasn’t arrived in South Africa, but I thought it would be useful to evaluate the parameters we currently use so that we can have a base line for comparison.

2. My study reflects the findings on 360 patients with a wide variety of pathology. Most had infection, some had gout, rheumatoid arthritis and other inflammatory diseases, or sympathetic effusion associated with adjoining infections like osteitis and cellulitis. In some inflammation was due to trauma. Some samples were taken at the second of a two stage exchange of an arthroplasty after the infection had apparently been dealt with.

3. These are the parameters I normally consider. Appearance, total and differential white cell count, synovial sugar, microscopic examination for crystals and bacteria and finally bacterial culture and sensitivity.

4. One cannot look at synovial fluid alone for diagnosis. We have to consider local and systemic signs of infection as well as the radiological appearances of the joint.

5. I arranged the clinical, laboratory and radiological parameters as they reflect the severity of infection. Points are awarded in each parameter and toted up.

6. If the total number of points is 2 or less we regard this patient as definitely without infection. 3 or 4 points probably means no infection. 5 to 7 is an equivalent diagnosis of infection, 8 to 9 points means there is probably infection, 10 to 12 points indicates definite infection.

7. There were 13 patients in this equivocal group. These were paraplegics or Charcot arthropathy or chronic trauma, or they were in transition having had surgery to cure their infections and they were coming up for definitive joint arthroplasty.

   These patients in the grey area will be included when analysing all patients but excluded when we separate probably clean from probably infected.

8. Here is a reminder of the formulae used to analyse clinical statistics. In summary sensitivity reflects the percentage of those who should be positive who are truly positive. Specificity reflects the number of those who should be negative who are truly negative.
Accuracy is the percentage of the whole cohort who have correctly true results. The predictive value of a positive result is the percentage of all the positive results that are truly positive while predictive value of a negative result in the percentage of all the negative results which are truly negative.

9. Now for the analyses. Turbidity is a subjective impression of the clarity and colour of the fluid.

10. Appearance is a sensitive test for infection but it lacks specificity. The predictive value of a positive result and the predictive value of a negative result seems to have relevance.

11. Clear fluid fairly reliably indicates no infection. There is a high number of false positives for many reasons. The predictive value of a positive result in those who are probably septic and the predictive value of a negative result in those who are probably not infected is significant.

12. Viscosity is measured by observing how a drop falls from a pipette. Mucin clot is observed when joint fluid is dropped into acetic acid.

13. The only good you can derive from these tests is the predictive value of a positive and a negative result in Group 4 & 5 and 1 & 2 respectively.

14. Again the test is easy, cheap and inaccurate. Mainly because the true and false results are nearly equal.

15. The traditional total white cell count, is moderately sensitive specific and accurate.

16. Its main value is the predictive value of a positive result in Groups 4 & 5 and a negative result in Groups 1 & 2.

17. There are false positives in Groups 1 & 2 for many reasons. Acute and chronic trauma, infection in adjacent tissues, foreign bodies, AVN, inflammatory diseases, overlying trophic ulcers. False negatives in Groups 4 & 5 are mainly due to the inactivity of bacteria in biofilm and to a lesser extent due to non-virulent bacteria failing to stimulate the white cells. If you categorise patients according to the overall systemic evidence of infection, the predictive value of the white cell count generally corroborates the categories.
18. We took 60% as the critical percentage of polymorphs in the differential count. This is sensitive but not specific. Once again the number of false positive results spoils the accuracy as it does for the total white cell count. The high number of false positives spoils the specificity?

19. About one third of the results are false negative or false positive but you can still bank on the predictive value of a positive result in Group 4 & 5 or a negative result in Group 1 & 2.

20. It would be wonderful if we could reliably see bacteria on microscopy. Unfortunately this is far from the case. Once again the predictive value of a positive result when it happens is valuable and equally the predictive value of a negative result in Groups 1 & 2.

21. There are many false negatives and a few false positives due to contamination.

22. Bacteria on culture is disappointingly insensitive but the specificity is more reliable.

23. Bacteria on culture is the gold standard. It is crucial to not only identify bacteria but to know their sensitivity to antibiotics. Unfortunately there are 40% false negatives due to the indolence of bacteria and biofilm. The capture of bacteria from tissue is slightly better but still 30% are false negative. False positives can be recognised by the lack of corroborating inflammatory cells.

24. We regarded synovial fluid with a sugar content less than 40% of the blood sugar as a positive result. This turns out to be an insensitive test but very specific.

25. High incidence of false negatives in Group 4 & 5 is due to the indolence of bacteria in biofilm. Metabolism and turnover of bacteria is low. One should remember that we are sampling synovial fluid whereas bacteria are mainly trapped in biofilm catered in tissue planes far from the fluid. On the other hand negative results in Group 4 & 5 may signify a genuinely clean joint where the seat of infection is elsewhere in the body, even in adjacent tissue. False positives in Group 1 & 2 may arise with AVN, loose prosthesis, polythene granuloma, trauma and rarely leukemia. Finally the predictive value of a negative result in 1 & 2 and a positive result in 4 & 5 is very high.

26. The use of Alpha Defensin has recently been discovered and launched two years ago. So far the sensitivity is 97% and the specificity 96%.