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CORR Insights

CORR Insights®: Do Serologic and Synovial Tests Help Diagnose Infection in Revision Hip Arthroplasty With Metal-on-metal Bearings or Corrosion?

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Where Are We Now?

The generation of metal debris and corrosion products by hip arthroplasties can lead to an adverse local tissue reaction (ALTR), which often presents similarly to periprosthetic joint infection (PJI). Although an ALTR to metal is most commonly thought of to occur in the context of a metal-on-metal (MoM) arthroplasty, there is increasing awareness that metal debris and corrosion products can also be generated at the head-neck junction of any bearing combination [1].

Distinguishing between ALTR and PJI has proven especially difficult due to the frequency of purulent-appearing synovial fluid associated with both conditions. Furthermore, the synovial fluid from a hip with an ALTR is likely to contain metal debris, clumped cells, and other foreign materials, with consequently inaccurate automated fluid cell counts. These problems have led to great controversy in the field. Some believe that the sometimes-misleading appearance of the joint fluid in patients with ALTR can result in the frequent false positive diagnosis of PJI in these patients. Others believe that the local immunosuppression [5, 6] in the setting of metal and corrosion debris results in the failure to diagnose PJI in this setting. It is still not clear which point of view is correct.

Although the literature has provided some early direction in diagnosing infection in the setting of metal debris, there remains considerable controversy regarding the utility of traditional serologic and synovial fluid testing in patients with these problems.

Where Do We Need To Go?

In the current study, Yi and colleagues have made a great contribution to our understanding of common laboratory tests in the setting of a hip arthroplasty with metal debris or corrosion products. They have provided us both with bad news and good news.

The bad news is that the tests that we usually use to diagnose infection do

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not work well in the setting of an ALTR. The ESR and CRP demonstrated a positive predictive value of only 43% and 39%, with overall accuracies of 82% and 80%, respectively. Similarly, when the white blood cell count reported by the laboratory was utilized, the positive predictive value for infection was only 50%, with an overall accuracy of 87%. Although negative test results are reasonably good at ruling out infection, positive results can be highly misleading, causing a surgeon to make a false diagnosis of infection. Positive laboratory values must be interpreted with great care and suspicion in the setting of possible metal debris.

The good news is that the authors have described a way to identify those white blood cell counts that are inaccurate. They found that the majority of falsely elevated white blood cell counts were due to cellular and foreign debris perturbing the automated cell count. Therefore, white blood cell counts were judged to be inaccurate if the laboratory technician noted metal debris, amorphous material, fragmented or degenerating cells, the presence of clots or excessive viscosity. When about one-third of their samples were excluded due to these conditions, they found that the white blood cell count positive predictive value increased to 69%, with an overall accuracy of 95%.

Even with this paper's contribution to the diagnosis of infection in the setting of metal debris, there is still much work to be done. It is unclear how many laboratories around the country report or accurately report the presence of debris or material in a fluid sample. And when inaccurate samples are removed, one-third of patients are left without a white blood cell count to be interpreted. Therefore, work can be done in standardizing and generalizing the methods by which inaccurate cell count reports can be identified. Developing other tools also will be important, since the test parameters of our traditional analyses are not perfect even when we exclude the compromised samples.

How Do We Get There?

We need to develop methods to diagnose both ALTR and PJI that rely on technologies that already are in common use in other fields of medicine. Protein-based technologies such as immunoassay for biomarkers, can be optimized and standardized for use in synovial fluid, providing for results that are independent of a laboratory's techniques and reporting practices. There has already been great progress made in identifying biomarkers for infection [2, 3], and it is only a matter of time before these methods are extended to the detection of ALTR.

Finally, we need a more-aggressive effort aimed at developing bacterial identification tests. The sensitivity of synovial fluid culture in the setting of infection is only about 45% [4]. Technologies, including those that are protein- and nucleic-acid-based, currently are being developed to provide a faster and potentially more sensitive method for identifying bacteria in a synovial fluid sample. Given the importance of differentiating between ALTR and infection to determine treatment, it is of utmost importance to identify and develop tests that can aid the surgeon.

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