Abstract

Background

Fracture related infection (FRI) is a serious complication after fracture fixation. Accurate identification of the causative pathogen(s) is essential for diagnosis. Conventional methods are often inconclusive due to biofilm on osteosynthesis material. Sonication of osteosynthesis material may be a valuable adjunct tool to dislodge bacteria from biofilms. This study aims to evaluate the clinical benefit of adding sonication as a diagnostic tool.

Methods

We included patients undergoing hardware removal after previous osteosynthesis in a large university hospital between 2012 and 2021. Based on preoperative findings, we categorized patients using AO Foundation and EBJIS FRI consensus criteria: suspected FRI or confirmed FRI. We differentiated between early, delayed, and late FRI. Sensitivity and specificity of tissue and sonication fluid cultures were assessed. Microbiological cultures were analyzed to assess the impact on FRI diagnosis. Criteria for confirming FRI include identifying two identical pathogens from different culture samples. The added value of sonication was determined as the number of cases where sonication was essential for confirming FRI.

Results

We included 337 patients. Based on preoperative findings (without microbiology), we found: 61 aseptic, 160 suggestive FRI, and 116 confirmed FRI cases. Following microbiology results, this changed to 34 aseptic, 161 suggestive FRI, and 142 confirmed FRI. Sonication was essential in 52 confirmed FRI (37%), consisting of two aseptic, 11 suggestive FRI, and 39 (preoperative) confirmed FRI. These 52 FRI consisted of 11 delayed and 41 late FRI.

Sonication had less additive value in FRI cases with 3 or more tissue cultures compared to cases with 1 or 2 tissue cultures (30% vs. 61%, $p < 0.001$).

The individual sensitivity of tissue and sonication fluid cultures were both 83%. The difference in individual specificity between tissue and sonication fluid cultures was not significant (73% vs. 71%, respectively). Combining tissue with sonication fluid cultures significantly increased sensitivity and specificity to 92% and 87%, respectively ($p <0.001$). In 30 confirmed FRI (preoperative; 26 confirmed, 4 suggestive FRI), sonication was essential for confirming FRI in 11 FRI (37%). In two of these 11 FRI, sonication led to change from suggestive FRI to confirmed FRI. In polymicrobial cases, sonication detected additional pathogens in 18/50 polymicrobial FRI cases (36%).

Conclusions

Sonication fluid cultures play a significant role in diagnosing FRI by enhancing pathogen detection. Sonication is essential in delayed and late FRI, as well as patients who preoperatively received antibiotics. Sonication significantly improves sensitivity and specificity of FRI diagnostics. In every FRI patient (suspected or confirmed), at least 3 deep tissue cultures should be obtained, and sonication should also be performed.