Sonication

Sonication is the act of applying sound energy to agitate particles in a sample, for various purposes such as the extraction of multiple compounds from plants, microalgae and seaweeds.

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The enhancement in the extraction of bioactive compounds achieved using sonication is attributed to cavitation in the solvent, a process that involves nucleation, growth, and collapse of bubbles in a liquid, driven by the passage of the ultrasonic waves.

Ultrasonic frequencies (>20 kHz) are usually used, leading to the process also being known as ultrasonication or ultra-sonication.

Prinz et al. evaluated the value of sonication of explanted shunt-devices to improve the microbiological detection rate.

All consecutive patients undergoing revision surgery due to suspected ventriculoperitoneal shunt infection from January 2015 to February 2017 were evaluated. Intraoperative tissue samples wound swabs, and cerebrospinal fluid (CSF) were collected for microbiological examination. In a subgroup of patients, the removed implants were additionally sent for sonication.

A total of 35 patients were included with a mean age of 57.5 ± 18 yr, 21 were female (60%). In 13 patient's tissue samples, CSF and wound swabs were analyzed. In 22 patients, the explanted device was additionally sent for sonication. All 22 sonication cultures showed a positive microbiological result (100%), whereas with conventional microbiological methods, the causative microorganism was identified in 8 of 13 (61%; P = .018). Analyzed by method, all 22 sonication cultures (100%) were positive and 21 of 35 conventional microbiological analysis results (60%) detected the causative agent (P < .001.) In 18 patients (51%), antimicrobial treatment was started preoperatively. In those patients, the pathogen was detected in all 12 sonication cultures (100%), whereas conventional methods grew a pathogen in 3 of 6 patients (P = .005).

Sonication significantly increases the microbiological yield in VP-shunt infections, especially in patients receiving antibiotics prior to diagnostics and in infections caused by low-virulent organisms. The implementation of sonication into the clinical routine can substantially increase the rate of pathogen detection allowing targeted treatment ¹⁾.

Loosening of pedicle screws is a frequent complication after spinal surgery. Implant colonization with low-virulent microorganisms forming biofilms may cause implant loosening. However, the clinical evidence of this mechanism is lacking.

Prinz et al., evaluated the potential role of microbial colonization using sonication in patients with clinical pedicle screw loosening but without signs of infection.

All consecutive patients undergoing hardware removal between January 2015 and December 2017, including patients with screw loosening but without clinical signs of infection, were evaluated. The removed hardware was investigated using sonication.

A total of 82 patients with a mean (\pm SD) patient age of 65 \pm 13 years were eligible for evaluation. Of the 54 patients with screw loosening, 22 patients (40.7%) had a positive sonication result. None of the 28 patients without screw loosening who served as a control cohort showed a positive sonication result (p < 0.01). In total, 24 microorganisms were detected in those 22 patients. The most common isolated microorganisms were coagulase-negative staphylococci (62.5%) and Cutibacterium acnes (formerly known as Propionibacterium acnes) (25%). When comparing only the patients with screw loosening, the duration of the previous spine surgery was significantly longer in patients with a positive microbiological result (288 \pm 147 minutes) than in those with a negative result (201 \pm 103 minutes) (p = 0.02).

The low-virulent microorganisms frequently detected on pedicle screws by using sonication may be an important cause of implant loosening and failure. Longer surgical duration increases the likelihood of implant colonization with subsequent screw loosening. Sonication is a highly sensitive approach to detect biofilm-producing bacteria, and it needs to be integrated into the clinical routine for optimized treatment strategies².

References

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