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THE EFFECT OF THE EXTRACORPOREAL SHOCK WAVE THERAPY ON BACTERIUM CELLS, BACTERIA-SUSPENSIONS AND THE EFFECTIVENESS OF INTRACELLULAR ACTING ANTIBIOTICS

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Introduction: The extracorporeal shock wave therapy (ESWT) has a wide spectrum of indication in orthopaedics. However, infection in the application area is regarded as a contraindication. Therefore, in this study, the effect of ESW on bacteria and their interaction with antibiotics is tested.

Methods: Standardized suspensions of *S. aureus* (ATCC25923) were exposed to different energy flux densities (EFD 0,38–0,96 mJ/mm²) and different impulse quantities (1000–12000 impulses) of a focussed ESWT. The surviving bacteria were quantified and compared to an untreated control group. The permeability of the cell wall of treated bacteria was analysed with a fluorescence assay and the DNA examined qualitatively for defects.

The influence of ESW on the effectiveness of antibiotics was examined using Gentamicin whose stability under influence of ESW was proven infrared-spectrometrically earlier.

S. aureus in specific broth (CAMHB) was treated with 4000 impulses at 0.59 mJ/mm². Then the MIC against Gentamicin was compared with the MIC of an untreated control group.

For the examination of synergistic effects between antibiotics and ESW, bacteria were treated with ESW (4000 impulses, 0.59 mJ/mm²) in a solution of CAMHB and varying Gentamicin concentrations (0.25 – 4 µg/ml).

The vital bacteria were quantified and compared to the control group which was exposed to either ESW or Gentamicin. Bacterium colonies were quantified according to the guidelines of the NCCLS, the statistical evaluation was done with the Man-Whitney-U- test.

Results: The ESW showed a significant germicidal effect ($P < 0.01$) after application of either a high EFD (>0.60 mJ/mm², 4000 impulses) or a high impulse quantity at low EFD (up to 12,000 impulses, < 0.60 mJ/mm²). The amount of CFU could be reduced by up to 99.9%.

Despite the germicidal effect of the ESWT neither a change of the bacterium cell permeability nor a damage to the DNA could be proved. Synergistic effects between Gentamicin and ESW were not found. No loss of effectivity of the Gentamicins at a simultaneous application of the ESW ($P > 0.05$) could be seen either.

Conclusion: The ESWT has a significant germicidal effect on bacteria after exceeding a certain threshold energy.

It could be shown that the applied total energy is responsible for the germicidal effect rather than single parameters as EFD and impulse quantity. A synergistic effect of antibiotics applied in addition to the ESW could not be proved. When ESW was carried out in presence of Gentamicin, the antibacterial effect of Gentamicin was influenced neither positively nor negatively.

The simultaneous application of ESW and systemically or locally applied antibiotics could represent a new therapy approach against tissue and bone infections. To prove this, further in-vivo studies are needed.

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