The effect of antibacterial acting extracorporeal shockwaves on bacterial cell integrity.

BACKGROUND: Antibacterial effects of extracorporeal shockwaves (ESWs) have been demonstrated in vitro against bacteria under static and dynamic growth conditions. This study assessed the effects of ESWs on the cell wall integrity of bacteria.

MATERIAL/METHODS: Standardized suspensions of Staphylococcus aureus were exposed to various shockwave impulses (2000-12,000) of different energy flux densities (EFD, 0.38-0.96 mJ/mm²). Bacterial suspensions of equal concentration that had been permeabilized (to>99%) with isopropanol were used as positive controls. The bacteria of all groups were stained with Sytox Green nucleic acid stain. The fluorescence of the shockwave-treated, permeabilized, and untreated suspensions was measured and compared for bacterial survival, quantified by colony-forming units after plating. RESULTS: Although ESWs showed a significant energy-dependent antibacterial effect that reduced CFUs in the treated suspensions by between 56% and 99%, only maximum energies (4000 impulses at 0.96 mJ/mm² and 12,000 impulses at 0.59 mJ/mm²) were followed by a significant increase in fluorescence compared with the untreated control (p<0.05).

CONCLUSIONS: This is the first study to assess bacterial cell wall permeability after ESW treatment. It was found that the permeabilization of bacterial cells after ESW treatment was far less than expected due to the corresponding antibacterial effect.
Other mechanisms, such as intracellular effects, might be involved in bacterial killing after ESWs and still must be elucidated.