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EDITORIAL

Contact-Free Renal Stone Fragmentation with Shock Waves

F. Eisenberger and Ch. Chaussy

Department of Urology, University of Munich, Munich, FRG

The treatment of nephrolithiasis requires the operative removal of those stones which will not pass spontaneously. Successful chemical dissolution is limited to uric acid calculi and recent attempts with physical methods are applicable only in the lower urinary tract. In order to guarantee fragmentation of a stone and to avoid lesions of the mucosa, direct contact of the ultrasonic or electric probes with the stone, under visual control has been necessary. Difficulties in the transfer of energy to the tip of the probe have limited the range of application.

The introduction of new technology in the production and transmission of shock-waves has now made contact-free stone destruction possible. This new device emits focussed high energy shock-waves and was initially shown to destroy stones in vitro without direct contact. Experiments in various animal models have indicated that these high energy waves could become an alternative to lithotomy.

The shock-waves were produced at one focus of a water filled ellipsoid by the discharging of high voltage (25 kV) sparks. Samples to be studied were exposed to the shock-waves at the second focus of the ellipsoid. As the effect of shock-waves depends on undisturbed energy transfer to the stone, the experiments were carried out in a water-bath. Little absorption of shock-waves occurs at the body surface as the acoustic density of water and tissue are almost identical. At the same time this linkage medium prevents the development of tissue lesions on the contralateral side of exposure. Shock-waves hitting air-filled alveolar tissue result in tissue destruction because of the differences in the sound wave resistance. It has become evident that trauma of pulmonary tissue can be avoided by precise localisation of the stone and by protection of the tissues at risk. Observing these precautions it was possible to crush human calculi of different varieties which had been implanted into the renal pelvis of dogs. During these experiments it became evident that exact localisation of the stones was essential. Satisfactory methods of localisation have not yet been developed although two-dimensional X-ray localisation appears to be most promising.

The problem of the spontaneous passage of the crushed fragments is closely related to that of exact localisation as a stone can only be converted into gravel when it is placed right in the focus. A stone hit tangentially, at the present time requires separate localisation and individual ultrasound treatment of each single fragment, thus decreasing the efficiency of the method. Preliminary studies of a series of shocks in these tests a salvo-like burst lasting one micro-second are encouraging. The later shock-waves impinge on a stone which is already in decay but due to inertia the fragments are still lying within the focus.

The future for the clinical application of focussed shock-waves is promising. The localisation of stones and the problem of dealing with fragments require further study. If the problems can be solved then the method may become applicable to large staghorn calculi.

Priv.-Doz. Dr. F. Eisenberger
Urologische Klinik
Katharinenhospital
Kriegsbergstrasse 60
D-7000 Stuttgart 1

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