STONE TREATMENTS: CURRENT TRENDS AND FUTURE POSSIBILITIES

With the widespread distribution of shock wave lithotripsy (SWL) by the late 1980s, this noninvasive technology became the preferred approach to most patients with symptomatic urolithiasis. The extraordinary success of the original Dornier HM3 lithotriptor had tremendous appeal to patients and physicians alike. SWL was established as the preferred initial treatment approach for 80% to 90% of calculi in the upper ureter or kidney. Percutaneous stone removal techniques were reserved for the small number of calculi deemed too large for treatment with SWL, unusual anatomical circumstances such as caliceal diverticula or SWL failures. Ureteroscopy was accepted as a suitable alternative to SWL only for lower ureteral stones for which its increased invasiveness and requirement for ureteral stenting were offset by its high level of efficiency and efficacy.1 Given this broad outline of the current approach to urolithiasis therapy, what are some of the important trends that could alter our treatment strategies for urolithiasis?

An area of growing concern for the last decade has been the reduced effectiveness of shock wave lithotripsy machines. In this issue of The Journal Ng et al (page 1887) report on the newest version of the Wolf Piezolith (Richard Wolf GmbH, Knittlingen, Germany) and find in a matched pairs analysis that the device works no better than the previous generation Piezolith and that it appears to produce more patient discomfort. Indeed, the stone-free rate at 3 months for the Piezolith 3000 was only 36% which is half of the stone-free rate reported for the unmodified Dornier HM3 (Dornier Medical Systems, Inc., Marietta, Georgia) during its United States trials.2 Data distressingly similar to that of Ng et al have been reported from a variety of different institutions using various “newer” lithotripter designs.3,4

This disturbing trend in shock wave lithotripsy devices raises some interesting and important questions. The interesting question is whether lithotripsy would have been as widely accepted if the initial lithotriptor had produced a stone-free result in only approximately a third of patients. The important question here is, of course, why technology has not marched inexorably forward in the field of lithotripsy, as we so accustomed to in other areas of medical technology. Some of the answers to this question may be found in the important article in this issue by Zhou et al (page 1892) from Duke University. These authors detail the advances in our knowledge and understanding of the basic science of SWL, in particular, the important contribution of compressive (positive pressure) and tensile (negative pressure) forces for effective stone fragmentation. Much of the information presented may be novel to urologists (and alas to many lithotripter manufacturers, as well) but is critical to the evolution of shock wave lithotripsy towards more effective (and safer) devices.

Why is this new information so important? The answer begins with the now well-known problems associated with so-called second generation lithotriptors which are defined as anything introduced in the decade following the unmodified Dornier HM3. It was quickly realized that these newer designs did not break stones as effectively as the original lithotriptor, perhaps due to the elimination of the water bath which was the ideal coupling mechanism for transmission of shock wave energy into the body. Furthermore, concerns were expressed in many quarters about the potential deleterious effects of shock waves on renal tissue, a problem only recognized after Food and Drug Administration approval of the original Dornier lithotriptor.5 The industry solution? To pack more and more compressive energy into a smaller and smaller focal zone (F2). In theory, this would hit the stone harder and expose less tissue to the potential deleterious effects of shock waves. Little or no attention was devoted to the contribution of the tensile components of the shock wave. The result? Third generation lithotriptors with lower efficacy than the original HM3 but with an increased rate of side effects (perinephric hematomas).6

Zhou et al have taken a fundamentally different approach with their lithotriptor concept, attempting to manipulate the tensile component of the shock wave (which is responsible for cavitation effects) to maintain or enhance stone fragmentation while simultaneously reducing the risk of tissue trauma (much of which is now believed to be due to cavitational effects). They report an elegant set of experiments studying in detail in vitro the effects of their modifications of the shock waveform. If their efforts translate into comparable in vivo and clinical effects, their work will represent a seminal contribution to shock wave lithotripsy therapy.

Another important trend in stone therapy is the increasing use of ureteroscopy for stones other than those in the distal ureter, for which there are 2 explanations. First is the problem with newer generation lithotriptors as reviewed previously. Second, as technology has improved with the addition of newer ureteroscopes and better intracorporeal lithotripsy devices such as the holmium laser, the efficacy of ureteroscopy of the upper ureter has improved dramatically during the last decade as emphasized in this issue by Wu et al (page 1899). Furthermore, with the increasing use of high quality flexible ureteroscopes, it is not out of question to consider flexible ureteroscopy as a competitive alternative to current SWL devices for the treatment of the majority of intrarenal calculi. Indeed, if one had to choose an indispensable tool for urolithiasis management in 2004, the ureteroscope and a holmium laser might be a better choice than a shock wave lithotriptor, a circumstance that would have been unimaginable a decade ago.

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REFERENCES