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EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY or ESWL

DEFINITIONS:
Extracorporeal = Outside the body
Lithotripsy = stone crushing (Greek)

DESCRIPTION OF THE TECHNOLOGY
Research done in the late 1970s showed that shock waves generated outside the body can pulverize urinary stones inside the body. The pulverization resulted in sand-like particles which could be passed easily. Such treatment has become the standard therapy for stones of the upper urinary tract (kidney and upper ureter).

Shock waves are high energy pressure waves and may be generated in air or water. In this medical application, shock waves are generated underwater by a "spark plug" electrode. Ignition of the electrode generates a spark, which in turn, generates a shock wave that is transmitted through water and any adjacent living tissue. The shock wave may be focused with mechanical devices so that its energy can be concentrated on a urinary stone. Multiple shock waves fragment or pulverize the stone. The resilient or movable nature of nearby living tissue results in little or no tissue damage from the passing shock wave.

Shock waves are not the same as ultrasound, laser, or X-ray. Shock waves and sound waves have some similarities and differences. Shock waves are more powerful than sound waves. Laser rays are merely concentrated light beams. Lasers beams can pulverize stones when the stone can be seen visually. Laser beams will not penetrate human tissue like a shock or sound wave. X-rays will penetrate tissue but do not impart energy like a shock wave.

EXPERIMENTAL EXPERIENCE

Animals have been treated experimentally with shock waves several times more powerful than those currently used to treat humans. Careful examination of the animals revealed no significant organ or tissue damage to the urinary tract from shock waves. Shock wave treatments have now been used safely in humans for over 15 years and was approved for use on humans by the United States Food and Drug Administration in December, 1984. Many thousands of patients have now been treated and ESWL is now accepted as the treatment of choice for patients with stones of the kidneys and upper ureters.

HUMAN EXPERIENCE

Not all patients, however, are candidates for ESWL treatments (see candidates, below). Stone pulverization occurs in about 99% of the patients selected for treatment. Approximately 85-90% of patients will become stone free. Approximately 10-15% of patients have some residual stone fragments on X-rays made three months after treatment. In most cases, the residual stones caused no symptoms.

In approximately 10% of cases the complexity or size of the stones warrants staged treatment consisting of two (or rarely more) ESWL treatments. In approximately 5% of patients secondary minor surgical

procedures are utilized to facilitate passage of stone fragments. These include cystoscopy and ureteroscopy (telescopic removal though the bladder and ureter) and percutaneous nephrostomy with lithotripsy (through the side directly into the kidney with telescopes to break up stones with sonic waves or laser beams applied directly to the stone). Less than 1% of patients will need conventional open surgery to remove stone fragments that were not removed by ESWL. Some patients experience pain, fever, or intestinal upset as the stone particles pass. These symptoms, however, are usually mild, short in duration and respond well to mild pain-killing drugs. Blockage of the ureter by a shower of stone fragments (called 'steinstrasse' or 'street of stone') might require passage of a plastic tube into the ureter to relieve pressure in a small percentage of patients.

Less than 1% of patients have some bleeding within or around the kidney (a hematoma). In almost all instances, this resolves spontaneously without specific treatment. No other clinically significant problems occur with any regularity.

CANDIDATES

Any patient with a stone of the kidney or upper ureter is a candidate. But there are reasons for NOT doing ESWL. Patients may not be good candidates for ESWL treatment if:

weight exceeds 300 lbs. (140 kg)
height exceeds 6 feet, 8 inches
the stone-containing kidney has little or no function,
life-threatening cardiac (heart) problems exist,
the ureteral stone is below the hip bone (iliac crest) (depending of machine type),
bleeding disorders,
pregnancy,
some cardiac pacemakers,
in the opinion of the attending physician the risks of anesthesia and ESWL treatment outweigh the potential benefits, or
some other form of stone treatment is more appropriate.

Furthermore, the size, location and number of stones and/or the presence of unusual or abnormal structural abnormalities of the kidneys or ureters may make other forms of treatment preferable. In some instances, combination treatment using ESWL may be needed This would include surgical removal of stones from the kidney or ureter with telescopes after pretreatment with ESWL.

CANDIDATE EVALUATION

Patients who on preliminary review seem to be candidates for ESWL treatment will undergo tests consisting of blood and urine tests, studies to determine the presence of urinary infection, X-rays, and, if necessary, an electrocardiogram and isotope studies of kidney function.

Alternative methods for stone removal (i.e. the traditional open surgical techniques and percutaneous lithotripsy (telescopic removal from the kidney through a small incision) will also be considered and explained.

ESWL TREATMENT

Most candidates are admitted to the hospital the morning of treatment. An anesthetic will be administered. Selection of the anesthetic is up to the patient and anesthesiologist. Most common are

'epidural' or 'spinal' anesthetics in which a small tube is placed in or near the spinal canal to give anesthetic directly to the nerves going to the kidney and surrounding tissue. General anesthesia is also available, but rarely used. Sedatives are routinely given intravenously during the procedure to make the patient relaxed and comfortable.

The anesthetized patient is placed on a support platform, which is suspended overhead. The patient is secured with straps to prevent movement. A catheter is sometimes placed into the patient's urinary bladder after the patient has been anesthetized.

The patient is then precisely positioned in the water bath with the head and shoulders out of the water, so that the kidney stones are positioned at the highest energy point of the shock waves. Positioning is assisted with two x-ray monitors. When positioning is complete, shock wave treatment will be initiated. Approximately 300-2500 shock waves from the electrode will be utilized. The treatment procedure will last approximately one hour. The urologist conducting the treatment monitors stone fragmentation using the fluoroscopes. Every few minutes the patient will be repositioned using fluoroscopes and the hydraulic suspension system.

The radiation received from the X-ray monitors is about the same as that from an intravenous urogram (IVP) and well below minimum toleration limits. (Female patients are routinely checked for pregnancy).

Upon completion of treatment, the patient will be removed from the water bath and sent to the recovery room until the anesthetic has worn off. On occasion, additional procedures might be done before or after the treatment, such as cystoscopy (telescopic examination of the bladder) and passage of stents (plastic tubes into the ureter and kidney to facilitate observation of the stone and subsequent passage).

FOLLOW-UP

Typically patients will usually be discharged on the day of treatment.

Blood-tinged urine is to be expected for a few days. Stone particles typically begin to pass during treatment and may continue to pass intermittently for several weeks. Most patients have remarkably little discomfort. Pain will be treated with appropriate painkilling drugs.

Patients will be discharged from the hospital when their symptoms and medical condition warrant. Laboratory and radiographic studies similar to those made before ESWL treatment will be made at periodic intervals after treatment to assess the patient's response. Follow-up after treatment is usually done within a few weeks in the office.

LIMITATIONS

1. Visualization of Stones: In most cases only stones that are visible on radiographs and the fluoroscope may be treated. Some stones may be too small and/or too faint to be reliably treated with ESWL.

2. Non-fragmentable Stones: The location and/or crystalline type of stone may affect its pulverization. For example, cystine stones are more resistant to ESWL than other crystalline types. Stones located in the ureter pulverize to a lesser extent than if they were located in the kidney.

3. Very Large Stones: Patients with very large stones may not be good candidates for ESWL because the volume of particles may be too much for the urinary system to pass conveniently. In such cases tubes

placed through the flank into the kidney or from the bladder into the kidney (stents) may be of assistance in facilitating passage of stone debris.

4. Patient Size: The Lithotripter is designed for average size adults. Children and/or persons of exceptionally large or small statures may not fit into the apparatus.

BENEFITS

ESWL is intended to pulverize stones noninvasively so that all stone material may pass spontaneously. Such treatment is expected to obviate the need for invasive surgical procedures in a high percentage of patients.

Recovery time following ESWL is expected to be minimal. Experience shows many patients have been able to resume full activities within a few days after treatment.

ADDITIONAL INFORMATION

Additional information regarding patient candidacy and patient evaluation may be obtained by consultation by either writing or calling us.