early November of last year, it was felt that general agreement was reached on the following points:

Conclusions

• Surgical lasers are not the only devices that can produce a plume that could potentially contain material harmful to the patient or operating room nursing and medical staff;

• In most cases, no matter what the debris source, the precautions one would take to increase patient and operating room personnel are the same:

• Further research is necessary to better characterize either the specific nature of the by-products or the potential reinfectivity/carcinogenicity of these laser plume by-products.

• Additional research is especially important for better characterization of the interactions of pulsed lasers with tissue since pulsed lasers tend to produce larger particle sizes and presumably could more easily transfer viable material. However, following the recommended safeguards on evacuation, appropriate covering should also protect from these larger tissue particles.

• If the users of surgical lasers employ the safeguards recommended, i.e., confirmation that the laser is an advantage over other conventional surgical instrumentation, a proper smoke evacuation system, gloves, gowns and the wearing of appropriate masks and eyewear, then there is probably little or no significant risk to the patient or surgical team.

Exerpted from the *Journal of Laser Applications,* Volume 1, Number 2, March, 1989; pp. 4.

Laser surgery submissions...

Canadian Operating Room Nursing Journal

1. An Introduction to Surgical Lasers (Wright, Riopelle), Vol. 2, No. 5, Oct./Nov., 1984.
2. Controlling the Hazards of Laser Surgery (Wright, Riopelle), Vol. 2, No. 5, Oct./Nov., 1984.
3. Laser Surgery in Gynecology (Wright, Riopelle), Vol. 2, No. 5, Oct./Nov., 1984.
4. Outpatient Gynecological Laser Surgery: Patient Concerns and How to Deal With Them (Gervaize, Beresford), Vol. 2, No. 5, Oct./Nov., 1984.
5. Guidelines for Establishing an Institutional Laser Program (Gauntlett, Wright, Riopelle), Vol. 3, No. 2, April, 1985.
6. Laser Safety for CO_2, Argon and Nd:YAG Lasers (Ball), Vol. 4, No. 2, April, 1986.
7. Health Care Industry to Feel Impact of Laser Technology (Fagan), Vol. 4, No. 4, Sept., 1986.

Laser program for nurses to be held in Toronto in July

A series of post-graduate programs in laser surgery is to be offered this July in Toronto. Several of these programs are of special interest to operating room nurses/laser nurses and out-patient/day surgery nurses. All programs will be held at the King Edward Hotel on King Street in downtown Toronto.

The program most pertinent to nurses is "Lasers in Nursing," which will be held July 14 and 15. However, depending on the laser procedures performed at your institution, any of the others may be of interest. Other laser programs include:

Basic Colposcopy - July 12 - 13
Update in HPV/Genital Neoplasia - July 12 - 13
Gynecologic Laser Surgery - July 14 - 15
Lasers in General Surgery - July 14 - 15
Lasers in Nursing - July 14 - 15
Laser Assisted Angioplasty - July 16

This series of laser programs are sponsored by:

- The Department of Surgery, St. Joseph's Hospital, London, Ontario
- Biomedical Communications, Komoka, Ontario
- The Department of Obstetrics and Gynecology, Divison of Gynecologic Oncology, The University of Toronto.

For more information, course brochures, registration and related forms, contact:

Mary Ann Riopelle
Program Co-ordinator
Biomedical Communications
P.O. Box 224, Komoka, Ontario
N0L 1R0 (519) 471-0300

Extracorporeal shockwave lithotripsy (ESWL)

A treatment synopsis

By Darcy R. Kasprick, R.N.

One of the newest forms of treatment for the formation of urinary calculi (urolithiasis) is extracorporeal shockwave lithotripsy (ESWL). A Siemans' Lithostar lithotriptor was installed at the Health Sciences Centre in Winnipeg, Manitoba in March 1988 **(Photo A).** Since then, over 500 treatments have been performed.

Prior to the installation of this unit, a lithotriptor was being used which required the patient to be emerged in a water bath with a general or spinal anaesthetic. With our new generation lithitriptor, the treatment is performed without water emersion, without anaesthesia, and usually on an out-patient basis.

The following is a synopsis of the activities in our centre for treating a condition previously requiring up to ten days hospitalization.

Preparation & procedure

Special preparation prior to treatment is not required for a patient undergoing ESWL. However, nausea and vomiting may be associated with the treatment, possibly from the pain experienced from the shockwaves, or as a side effect of the analgesia being administered. Thus, the patient is advised to have a light meal on the day of treatment.

A kidney, ureter, bladder X-ray (KUB) is taken on the day of treatment to determine the position of the calculus. This is important as the calculus may have migrated from its original position, thereby affecting the outcome of the procedure. For example, a calculus may originally be in the upper ureter, and migrate down to the mid ureter overlying the sacroiliac joint by the time of treatment.

If a urinary tract infection is suspected, a urine culture is obtained. If positive, the patient should be placed on antibiotics prophylactically to prevent bacteremia during treatment (Cochran et al, 1988).

A ureteric stent is inserted for the treatment of large calculi (15-20mm) as the stent will cause some dilation of the ureter. This will facilitate the passage of fragments, and will also minimize ureteric obstruction after treatment as the stent will facilitate continous urine drainage. With the preparations complete, the patient is ready to be positioned on the table **(See photo B).** The shockwave heads, or the

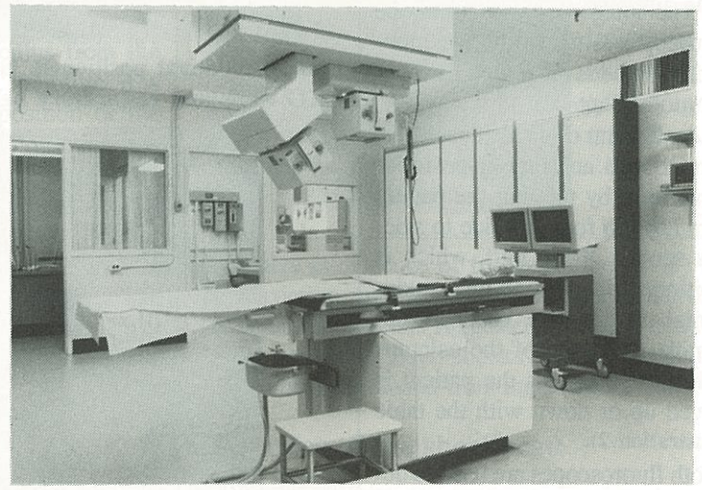


Photo A: ESWL treatment centre with control room in background. Fluoroscope monitors are attached overhead.

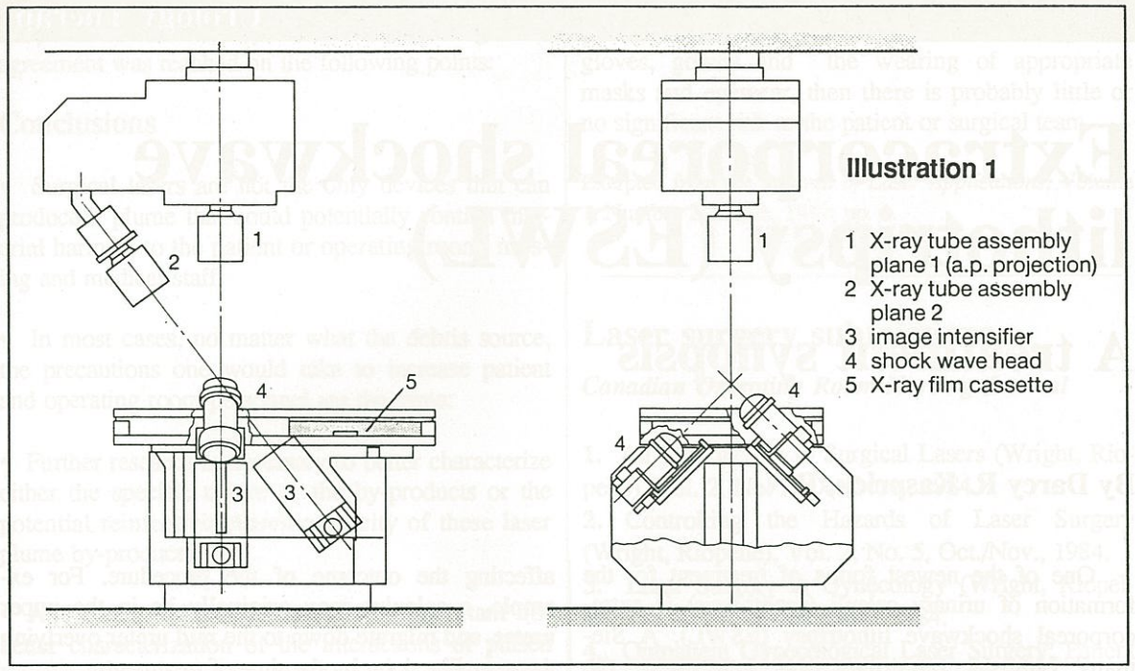


Illustration 1

1 X-ray tube assembly plane 1 (a.p. projection)
2 X-ray tube assembly plane 2
3 image intensifier
4 shock wave head
5 X-ray film cassette

shockheads, are located within the unit on either side **(Illustration 1 above)**. For the calculus to be fragmented the patient must be appropriately positioned within the path of the shockwaves.

Treatment

Two fluoroscopy monitors (anterior-posterior, and oblique) located on a ceiling mount, are used to locate the calculus **(See photo A)**. The image depicted from the fluroscopes is transmitted to monitoring screens in a nearby control room **(Photo C)**.

Localization of a calculus is performed with an anterior-posterior X-ray unit, by moving the patient from head to foot and side to side.

A second X-ray unit, which is positioned in an oblique caudocranial fashion, is used to determine the depth of the calculus within the body, as the patient is moved up or down with the table **(Illustration 2)**.

Both fluoroscopes are used to determine the exact position of a calculus. The anterior-posterior fluoroscope may also be used to obtain

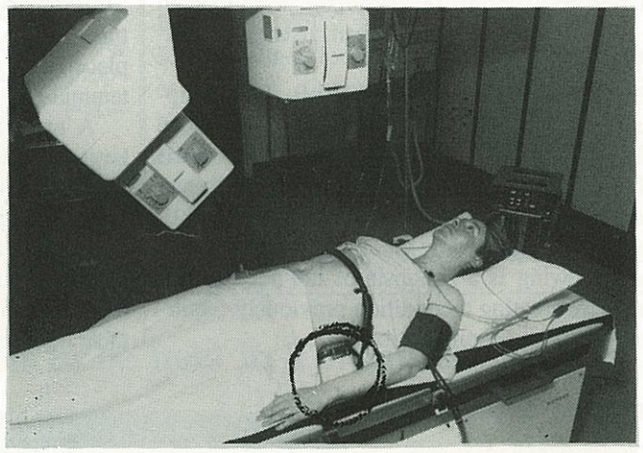


Photo B: Patient positioned. Note shock head against flank, EKG leads and respiratory belt

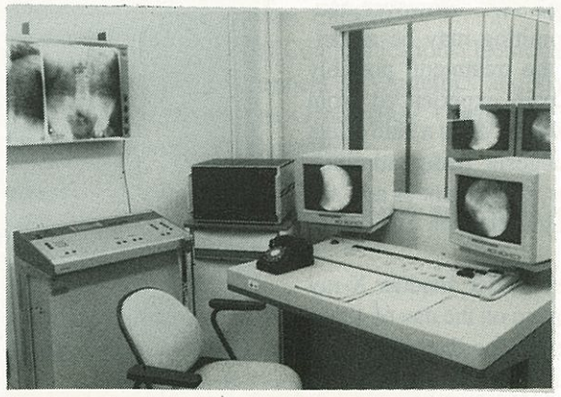


Photo C: Control room showing control panel, fluoroscopy monitors and EKG monitor

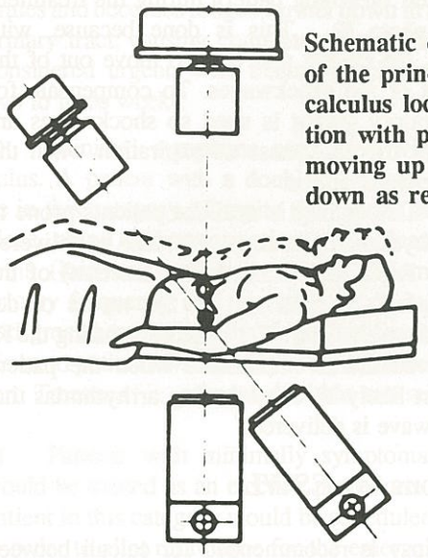


Illustration 2.

Schematic diagram of the principle of calculus localization with patient moving up and down as required

plain hard-copy X-rays. Ideally, the calculus should be as central as possible on both fluoroscopy monitors, as the average width and length of the focal point of the shockwave is 8mm and 20mm respectively. Therefore, if the calculus is central on the fluoroscopes, this will allow for the maximum amount of energy from the shockwaves to "pulverize" or fragment the calculus.

Once localization is satisfactory, the shockwave head is raised from within the table and positioned or "coupled" firmly against the patients skin **(See photo B, circled area)**. An ultrasound gel is used to improve contact with the skin allowing for transmission of the shockwaves. The shockwave head in the raised position tends to move the patient laterally, thereby displacing the calculus from the centre of the fluoroscopy monitors. Therefore, it is very important to redetermine the position of the calculus with fluoroscopy prior to initiating the treatment. If the calculus has been displaced from its original position, fine table adjustments are made to reposition the calculus.

The energy for the shockwave is measured in kilovolts (KV) ranging from 10. 0 - 19.0 KV. The shocks are delivered beginning at low energy level which is gradually increased depending on how the patient tolerates the energy changes.

The lithotripsy treatment continues until the calculus is "fuzzy" or difficult to visualize with the fluoroscopes. At this time, a plain abdominal X-ray is taken and compared with the pre-treatment film **(Photo D1-D2)**. This will help determine **(1)** the amount fragmented, **(2)** if treatment is to continue

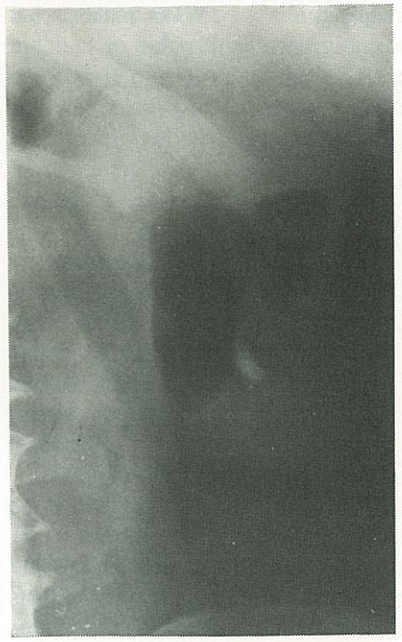


Photo D1:

A plain x-ray of a calculus in left renal pelvis before treatment

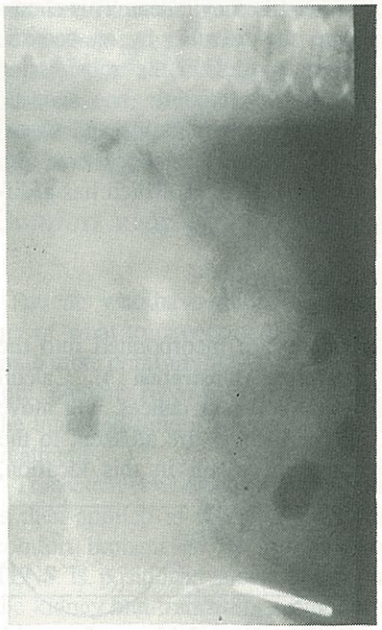


Photo D2:

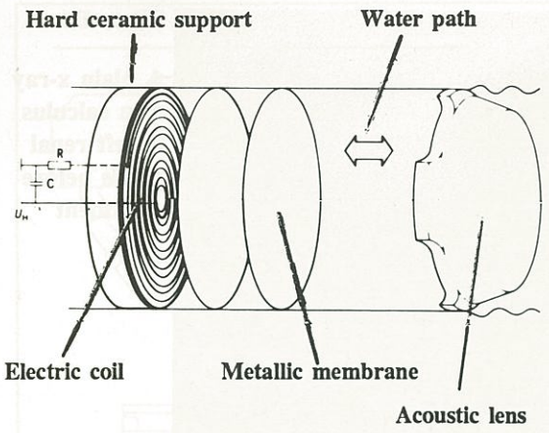
After receiving 4700 shocks

Note moth-eaten appearance of the calculus after treatment indicating good fragmentation

until there is evidence of fragmentation, or **(3)** until the maximum number of 6000 shocks is delivered. The manufacturer has suggested that each treatment should not exceed 6000 shocks in order to minimize the risk of renal trauma from the shockwaves.

Principles of the shockhead

The shockwave head or shock head is depicted in **(Illustration 3)**. An electrical current produces an electromagnetic field when it passes through a



Ilustration 3: Cross section of the shock head illustrating the principles of its mechanics

coil. In turn, this electromagnetic field causes the metal membrane to become instantaneously attracted and then pushed away from the coil. The movement of the membrane produces a shockwave which propagates up the water-filled cylinder. This shockwave is focused onto the calculus by an acoustic lens. A water medium is used for the transmission of the shockwaves, as this medium has acoustic densities similar to that of body fluids and tissue. Fragmentation results when the shockwave encounters a foreign body (calculus) which has a different acoustic density.

Features of the Machine

Some special features are incorporated into the Lithostar lithotriptor unit **(Illustration 4)**. Calculi located within the renal pelvis or calices, will move with respiration, as the kidneys are adjacent to the diaphram. Patients with calculi in this location, have a respiratory belt placed across their chest to monitor their breathing pattern during the treatment **(Refer to photo B).** This is done because, with respiration, the calculi will tend to move out of the focal point of the shockwaves. To compensate for this, respiratory gating is used so shockwaves are delivered at the end phase of expiration when the kidneys are montionless.

As well, EKG gating is used for patients prone to cardiac arrhythmias. Shockwaves would be delivered during the R-phase (ventricular contraction) of the QRS complex (as indicated by the waves or deflections of the electrocardiagram). It is during the R-phase of ventricular contraction when the patient would least likely be experiencing arrhythmias that the shock wave is delivered.

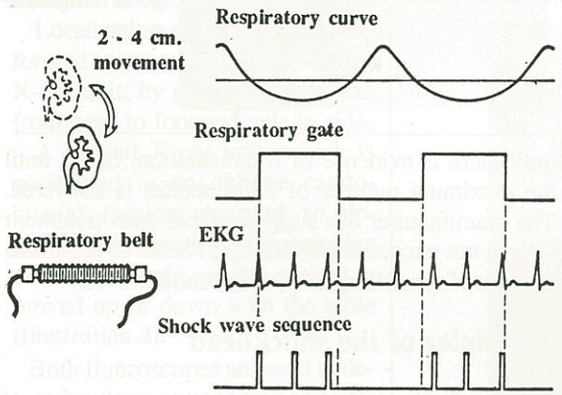


Illustration 4: Diagram showing the principles of respiratory and/or EKG (cardiac) gating

Indications for ESWL

Lithotripsy is recommended for calculi between 2mm and 20mm (Wilbert et al, 1987). This is the arbitrary size, allowing adequate visualization on fluoroscopy as well as gravel particles small enough for spontaneous passage. If calculi are larger than 20mm, alternative procedures such as open or percutaneous extractions should be considered.

(See Canadian Operating Room Nursing Journal, Vol. 4, No. 6, Dec., 1986, "Retrograde Nephrostomy," and Vol. 3, No. 1, Feb., 1985, "Ultrasonic Percutaneous Lithotripsy.")

Generally, symptomatic calculi are treated with a lithotriptor. Struvite calculi or calculi associated with infections are also treated with a lithotriptor, provided the patient is adequately covered with antibiotics to prevent bacteremia.

Booking System

A booking category system has been devised to priorize the urgency of the treatment. The categories range from 1-4, with 1 being the most emergent. The following are criteria for each of the categories:

1) The presence of severe renal colic which is usually associated with nausea and vomiting. If an acute obstruction to the path of urine is present, a ureteric catheter or stent is preferred prior to treatment for decompression. This is considered an emergent treatment, as prolonged obstruction may lead to severe renal damage. Treatment should be scheduled within seven days if immediate obstruction is not relieved with the above procedures.

2) Less severe colic with some associated nausea and vomiting. A partial obstruction may be present and further problems may occur if the calculus migrates and becomes lodged further down in the genitourinary tract, causing complete obstruction. This is considered urgent, with treatment scheduled within two to three weeks.

3) Minimal symptoms associated with the calculus. A patient with a double-J ureteral stent may be in this category. Despite the benefit of a stent in place, many patients experience troublesome symptoms (loin or flank pain, lower abdominal pain, urinary frequency and nocturia, debris in the urine, and gross hematuria). Consideration for treatment is given to patients with stents to alleviate this discomfort. Treatment is scheduled within one month.

4) Patients with minimally symptomatic calculi would be treated as an elective procedure. Only one patient in this category would be scheduled per week in order to allot more time for the emergent patients to be treated.

Contra-indications

General: Lithotripsy does cause some trauma to the kidney, such as damage to blood vessels, bruising, hematomas, and interstitia bleeding (Kaude, 1985). Therefore, patients with uncontrolled bleeding disorders are not treated. A patient with an aortic aneurysm would not be treated with ESWL as there is a risk that shockwaves may cause the aneurysm to rupture. Pregnant women may experience some damage to the fetus from the shock waves, or as a result of the radiation used. In this case, other forms of therapy should be considered. In addition, children are not suited for ESWL treatment. A child's thorax is proportionately larger than the abdomen, thereby increasing the risk of pulmonary contusions.

Technical: Lithotripsy may not be possible for some patients. Some obese patients make localization of a caluclus very difficult, and sometimes impossible. The calculus must be within the path of the shockwaves for fragmentation to occur, and this path is very difficult to establish or position in obese patients.

Some calculi are located in an area of the genitourinary tract where fluoroscopic visualization is very difficult without any adjunctive procedures. For example, a calculus overlying the sacroiliac joint may not be visualized with fluoroscopy as the sacrum interferes with the view of the ureter. Therefore, a cystoscopy and insertion of retrograde catheter is performed attempting to manipulate the calculus back into the renal pelvis. If this is not successful, the catheter is left in situ to administer contrast medium to aid with visualization, or the tip of the catheter is moved to the base of the calculus. The catheter itself will facilitate visualization and the shockwaves will be focused on this. However, if these attempts are not successful, the patient cannot undergo shockwave treatment.

Urological: For lithotripsy to be performed, calculi should be of an appropriate size so the treatment can be performed safely with minimal complications. Calculi 30mm and larger are not recommended for lithotripsy, as there is an over-abundance of gravel particles that usually do not pass spontaneously.

Calculi, once fragmented, must be able to pass down the genitourinary tract to reach the bladder. Thus, calculi are not treated in a nonfunctioning kidney, nor if an obstruction is present distal to the calculus impeding the passage of particles. For example, a calculus in the mid ureter, with distal obstruction to the lower ureter due to either another calculus or ureteric stenosis, would not be treated.

Cystine calculi may be considered a relative contraindication, as this type of calculus is resistant to shockwaves. However, if the calculus is in a good location, and is of an appropriate size, treatment may be considered.

Comfort measures

Patients who have gained an adequate understanding of what to expect of this treatment seem to remain more comfortable during the procedure. Therefore, patients receive written instructions, a tour of the unit, and time for learning with a nurse prior to treatment.

Transcutaneous electronic nerve stimultor (TENS) is then applied to the patient to alleviate skin discomfort brought on by the shockwave. **(Photo E).** TENS is positioned along the dermatome route of the kidney and tramsmits a tingling sensation to the skin surface which may assist in blocking nerve sensation.

Establishing an intravenous will allow analgesia to be administered for relief of discomfort. Fentanyl Citrate (Sublimase) is a narcotic analgesic with actions qualitatively similar to those of morphine and meperidine. Its principle actions are analgesia and sedation. This is an ideal analgesic to use on out-patients since this drug peaks approximately 1-2 minutes after administration, and has an analgesic effect of short duration, with the patient experiencing minimal effects upon discharge. On treatment

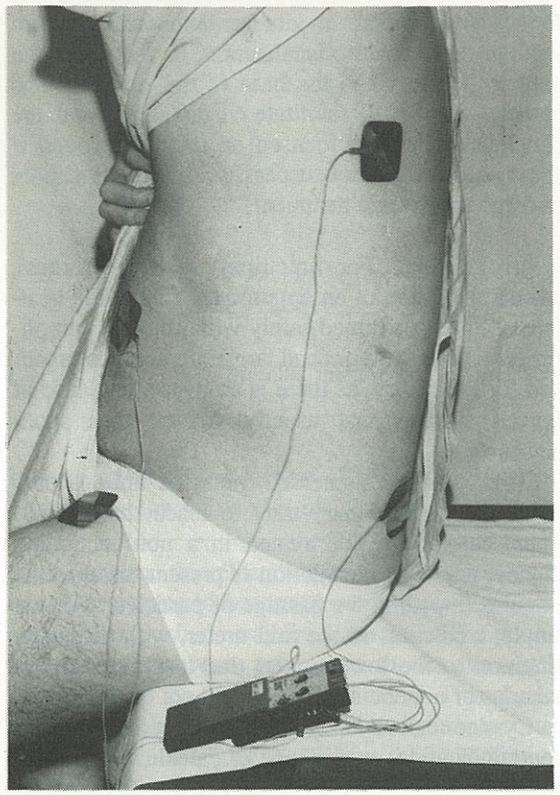


Photo E: Transcutaneous electronic nerve stimulator (TENS) is shown positioned on the patient

day, the nurse reviews the patient's expectations and preparations, and updates information as indicated. The nurse assesses the patient's comfort level and vital signs as the treatment progresses, and works in collaboration with the physician regarding pain control, positioning, and evaluating treatment progress.

The patient must remain in the optimum position for the duration of treatment. Therefore, the patient is positioned as comfortably as possible to facilitate the effectiveness of the shockwaves being focused on the calculus.

Post-shockwave treatment

The patient is given a strainer to strain all the urine. Gravel fragments may be passed in the urine for several weeks. The patient is instructed to strain the urine until there has been no gravel fragments for several days. Gravel fragments may not be visible in the urine. In some patients, gravel fragments are very fine and may go unnoticed. If fragments are noticed in the urine, they should be saved and sent for analysis to determine the composition.

Hematuria is usually present with the first void post treatment, and pinkish or discoloured urine may be present for 1-2 weeks. However, if a patient has a stent in situ, the hematuria may continue until the stent is removed.

Dysuria is also common with the passage of fragments, as gravel may irritate the bladder and urethra.

Severe renal colic may be experienced when the fragments are eliminated. The fragmented particles may or may not obstruct the ureter. Patients are instructed to report to an emergency department promptly if severe renal colic is experienced, or if the patient is unable to urinate.

Erythema, petechiae, and cutaneous bruising are usually present on the skin surface at the shock wave entrance site.

After treatment, a normal diet should be resumed. An increased fluid intake is advised to aid with gravel passage, and to keep the urine well diluted, with the hopes of preventing further calculus formation. The patient may resume all the activities of daily living, and continue taking prescribed medications, unless told otherwise by the urologist.

Complications

Complications of ESWL can be related to the actual shockwaves, or to the degree of fragmentation and the passage of the gravel particles. The major complication associated with the passage of gravel fragments are ureteric colic and ureteric obstruction with or without associated urosepsis.

With fragmentation of calculi with ESWL, bacteria may be released from a calculus. The shockwaves administered may create a great deal of tissue trauma which may in turn allow bacteria to enter the bloodstream, causing urosepsis (Roth et al, 1983; Coptcoat et al, 1986).

Ureteric obstruction occurs when one fragment or a group of fragments are lodged in the distal ureter. This is known as "steinstrasse," meaning "street of stones." Ureteric obstruction may be asymptomatic so the patient must be observed on a regular basis.

The shockwaves may cause some renal trauma with damage to some blood vessels, resulting in hematuria after the treatment. This may also be secondary to the passage of fragmented particles.

At present, long term complications of treatment are speculative. Hypertension and renal failure have been implicated (Williams et al, 1988; Kaude et al, 1985). The mechanisms are yet to be elucidated.

Post lithotripsy follow-up

The examination of patients post lithotripsy should continue on a regular basis, to evaluate the passage of gravel particles, and to document any complications. It is very important to determine that the gravel particles are being passed without causing obstruction. As already mentioned, ureteral obstruction may be asymptomatic, and only be detected with an intravenous pyelogram (IVP). Generally, patients are seen in follow-up one week after the treatment. A KUB is done to determine the amount of gravel remaining in the genitourinary tract. If good fragmentation and passage of particles has occurred, a stent, if in situ, would be removed at this time. If ureteric obstruction is suspected, or the patient has radiolucent calculi, an IVP is performed.

A 3-6 month follow-up visit is recommended. The patient may be seen on a more regular basis, depending on whether the patient has active calculus progression, or any residual calculi in the genitourinary tract.

Conclusion

ESWL is a new technology allowing calculi in the genitourinary tract to be fragmented and passed spontaneously. With this procedure possible on an out-patient basis, the positive impact on patient morbidity and lost time from work can be extremely beneficial. However, the impact on health care costs has yet to be determined. With further experience and newer technology, many operative procedures may well become obsolete. ■

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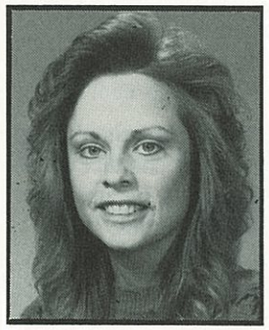

PAR nursing conference scheduled for Toronto

The Ontario Post Anaesthetic Nurses Association (OPANA) will be holding its 4th Annual Conference in Toronto this September. The annual gathering will be held at the Chestnut Park Hotel September 29 and 30.

Agenda highlights include:

- a panel discussion on current issues affecting the post anaesthetic nursing specialty
- a debate on "solo staffing"
- the legalities of being a PAR nurse: "Keeping Yourself out of Court"
- Fluid balance
- PCA (patient controlled analgesia)
- other topics impacting on PAR nursing

For more details, contact: Gail Skene:
(Wk) - 1- 416-633-9420 Ext. 6615
(Home) - 416-884-5697