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REDACTION



DIAGNOSIS AND RENAL LITHIASIS TREATMENT USING ULTRASOUNDS

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Key words: mechanical waves, vibrations, particle energy



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Abstract: Sound represents a vibration of matter transmitted like mechanical waves by solid, liquid or gaseous medium particles therefore sounds are mechanical waves. In order to have a mechanical wave it is necessary that one particle within the medium to start vibrating by ceasing energy to the surrounding particles. The energy is transmitted with the wave and each particle from the medium is taking energy from the particle right next to it accompanied with by an oscillation movement around balanced position then is ceasing the energy to the next particle and comes back to balanced position.

The waves consist in condensing (compression) areas which are alternating with thin air areas (decompression) of particle transmitting medium that is why sound propagation is related to the presence of a material medium (sound does not travel through vacuum). [3, 10]

Sound waves are characterized by following physical measures: amplitude, period, wave length, frequency, velocity, acoustic energy, acoustic power and acoustic intensity.

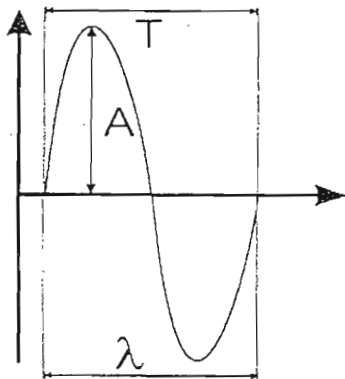


Fig.1 Wave diagram A – amplitude; T – period; λ – wave length.

Accordingly to the frequency, sound waves are divided into: infra-sounds (0-16 Hz), audible sounds (16 Hz-18 KHz), ultrasounds (18 KHz-150 MHz) and hyper-sounds (over 150 MHz). Ultrasounds are used in medicine for diagnosis and have frequencies between 1 and 10 Hz (occasionally even higher 15 to 20 MHz). [10]

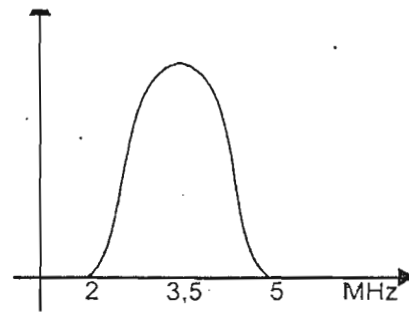


Fig.2 Wave length for signal sound.

Inside the human body the ultrasounds are similar with a light beam and are subject to transmission phenomena, reflection, refraction and diffraction; specific phenomena such as attenuation, absorption and diffusion, all these been part in forming the echo graphic image, the 'final product' of each ultrasonic examination. [3, 10]

Ultrasonic exploration, similar to other imagistic examination, is characterized by semiology and specific terminology connected to ultrasound propagation particularities through human body.

Ultrasound propagation within biological mediums is related to their consistency, thus, a medium that is denser than water is returning the ultrasounds like echoes, the intensity of the echoes being directly proportional with the consistency or the hardness of penetrated tissue. Once returned the ultrasounds are decoded by a device and represented on the display like a range of grey shades. [10]

There is a direct relation between the grey shade which can encode the echo and the density of the medium crossed by ultrasounds, thereby, higher the intensity of the echoes closer to white the color onto the device screen and backward.

A solid biological structure which can return echoes represented onto the display by light grey shades is named reflector proof (is reflecting the ultrasounds). Reflector proof structures are numerous and within this category there are: parenchyma, body fat, bones, air. [2, 3, 10]

When ultrasounds reflection is very intense on the display grey shades will be almost white and semiological expression will correspond to a reflector proof or hyper reflector proof structure. On the contrary a structure less reflector proof than surrounding area is expressed by comparing it with a hypo reflector proof structure (as an example the kidney is less reflector proof than the liver).

Liquid structures are entirely crossed by ultrasounds without any reflections from them echoed image being the expression of 'lack of echoes', black color onto the display and semiological term being trans-sonic. [2, 3, 10]

The acoustic shade (cone shade) is the expression of attenuation and a maximum ultrasounds reflection. The acoustic shade is present in all situations where the ultrasounds meet a very dense structure such as a bone or renal calculi. Besides these structures there are no more ultrasounds, final aspect being as 'non image' and having imagistic expression of a black line named 'back cone shade'.

Ultrasound investigation realizes a deep morphological evaluation of the kidney and renal area being a performing method non invasive and not ionized with an affordable cost and repetitive. [3]

Renal lithiasis has a variable incidence within the population and is related to geographical location, food habits, climate, etc.

Along with non contrast urethral radiography and intravenous urogram the ultrasound investigation is decisively in renal lithiasis diagnosis.

Renal calculi are echo diagnosed by highlighting a less reflecting oval or arc shape area with various dimension and accompanied by an acoustic cone shade. [3]

Unlike classic radiology ultrasound investigation is highlighting equally the calculi disregarding their chemical composition; so calculi's nature does not influence the echo graphic image.

The concretions, radio opaque or transparent ones have the same echo graphic aspect, less reflecting 'back cone shade' image. [2, 3]

Normally renal calculi are localized on the renal sinus or at contact area with the parenchyma respectively within projection area of pyelo-calyceal system (fig.3).



Fig.3 Renal lithiasis, calyceal calculi.

In order to evaluate renal lithiasis ultrasound examination has to specify the presence of calculi, location

and number together with obstructive or non obstructive character of lithiasis.

Calculi number from a kidney can be hardly appreciated (fig.4) because a large reflecting proof image can be produced by renal pelvis localized calculi or by a cluster of small calculi which on subsequent examination can appear dispersed in calyceal shape or calyceal bars.

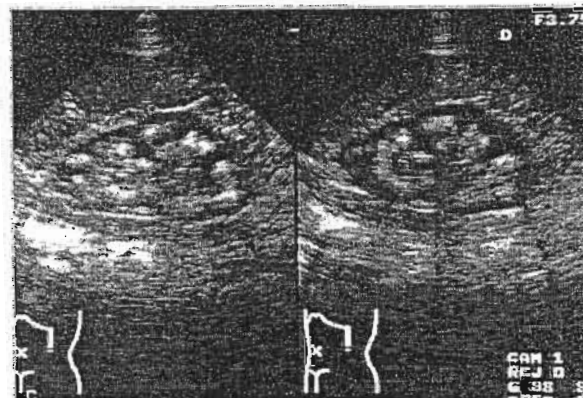


Fig.4 Renal lithiasis, multiple calculi.



Fig.5 Renal lithiasis associated with hydronephrosis

The sound of obstruction produced by renal calculi together with other secondary modifications is usually highlighted extremely precise by ultrasounds. Already localized calculi within calyceal bar can produce internal hydronephrosis which can be associated with an isolated hydrocalyce; a basin calculi localized at pyelo-calyceal junction can produce an external hydronephrosis if renal pelvis is outside the sinus.

Accordingly to the severity of hydronephrosis parenchyma indicator can modify itself. These are situations which require immediately therapeutically intervention.

RENAL LITHIASIS TREATMENT WITH SHOCK WAVES

Any physical mechanism which can convert energy within its acoustic form can be used for ESWL (Extracorporeal Shock Wave Lithotripsy).

This method is using ultrasounds which easily penetrate the body with a sufficient intensity to fragment renal calculi.

Extracorporeal Shock Wave Lithotripsy (ESWL) was described and used for the first time in 1980 being the result of researches made by a company specialized in manufacturing components for supersonic airplanes. Under

the action of shock waves, generated outside the body, renal calculi are disintegrated within tiny fragments which can be natural eliminated lately.

Lithotripsy devices can generate shock waves using electro-hydraulic, crystal unit or electro-magnetic systems and localization of calculi can be done by echo graphic or radio guidance. Both systems have advantages and disadvantages: echo graphic guidance is non irradiating and can be used to visualize radio opaque and radio transparent renal calculi while radio guidance (fluorescent) is irradiating and can visualize renal radio opaque and urethral calculi. Latest lithotripsy devices have double localizing systems having a wide range of imagistic guidance possibilities. [4, 5, 6]

From the very moment of emission shock waves travel through the tissues with a negligible energy loss but at renal calculi level are present various phenomena such as: cavitation (cavitation bubbles), erosion or direct elements due to shock waves. These phenomena lead to calculi disintegration at liquid-solid interface (high density difference). Phenomena produced by cavitation bubbles present at solid-liquid medium interface are, probably, the most important aspects of all researches in order to improve lithotripsy devices efficiency. [4, 5, 6, 8, 11]

ESWL represents a modern way of non invasive treatment for calculi under 15-20 mm which cover approximately 90% of treatment indications for urethral lithiasis affections. [1, 4, 5, 7]

There are several types of shock wave generators:

1. Dot like sources which can emit shock waves by sudden liquid evaporation;
2. Multiple sources which can produce a flat acoustic wave within the fluid;

- a. Crystal unit sources;
- b. Electro-magnetic sources.

During our research an echo graphic crystal unit source (Litotriptor Piezolith 2300 Richard Wolf) has been used.

Focusing shock waves is a must in order to obtain a maximum amount of energy within the calculi and to have a minimum impact to surrounding area. Focusing is different accordingly to generator type:

- For dot like sources are used semi ellipsoidal reflectors;
- For crystal unit sources is used spherical source alignment;
- For electro-magnetic sources are used spherical slots. [9]

In order to explain even better ESWL results, renal-bladder radiography has been used because is more accurate in following the results after ESWL sessions (for radio opaque calculi). For radio transparent calculi is used echo graphic method.



Fig.6 Radio opaque image with 1, 5 cm diameter located within right kidney projection area

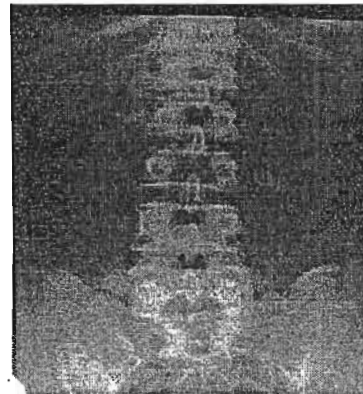


Fig.7 After first ESWL session; right renal calculi partially fragmented



Fig.8 After second ESWL session; two small fragments located within right kidney projection area and multiple fragments migrated to right pelvic urethra

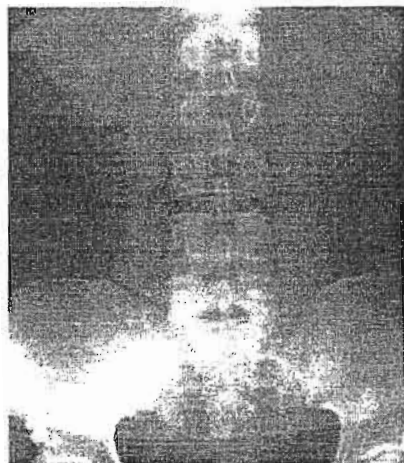


Fig.9 'Stone free' image

The number of input impulse is between 1000 to 3000 with an average of 2500 for each session and a frequency of 60 to 120 per minute.

The success of this method depends on size and chemical composition of the calculi being necessary 1 to 7 sessions. For the case presented above it is a calcium oxalate calculi (a very tough one) which required 2 sessions of ESWL.

CONCLUSIONS

Renal lithiasis treatment which can not be eliminated spontaneously until ESWL appeared was only one: surgical intervention. After ESWL has been discovered a virtual revolution within therapeutic conduct emerged because this method is by far less invasive (but not entirely risk free) and used for 80-90% lithiasis cases. European Association of Urology recommends active ESWL treatment for every renal or urethral calculi bigger than 6-7 mm. [1, 4, 5, 6, 11]

Since first lithotripsy devices appeared their dimensions have reduced becoming cheaper and very adaptable. With all these the old versions (such as Litotripter Piezolith 2300 Richard Wolf used in our clinic) are proven to be very efficient though require a better patient-device relation (difficult position onto lithotripsy table quite uncomfortable). Within this context there were several articles regarding latest lithotripsy devices much more comfortable for the patient but less efficient and reliable. [1, 6]

Therefore ESWL represent at this moment first choice treatment for most of the renal and urethral calculi being associated with a low rate of complications.

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THE EFFICIENCY AND TOLERABILITY OF POLYPROPYLENE SUBURETHRAL STRIPS IN THE TREATMENT OF STRESS URINARY INCONTINENCE OF WOMEN

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Key words: polypropylene, suburethral strips, incontinence.



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Abstract: *In this paper is presented the efficiency and tolerability of polypropylene suburethral strips in the treatment of stress urinary incontinence of women, in the „tension free” manner (TOT), in the Urology Clinic experience in Brasov. In the medical field, polypropylene is used widely, the biggest success of the material is the appearance of the synthetic nonresorbable thread.*

Polypropylene, one of the most known and versatile polymer, is a thermoplastic polymer. In terms of structure, it is similar to polyethylene, being a vinyl polymer, but with a more resistant structure than polyethylene.

The melting point of polypropylene is high and therefore can be successfully used in laboratories for medical purposes, being resistant to sterilization in autoclaves.

Polypropylene is used in many fields: textile industry, furniture, stationary, automotive components, pipe systems etc.

In the medical field, polypropylene is used widely, the biggest success of the material is the appearance of the synthetic nonresorbable thread (Prolene). The appearance of polypropylene prosthesis was a very important step in the parietal surgery, because they have been successfully used in hernias cures and abdominal eventrations. The use of polypropylene in the parietal plastic produces an inflammatory local response, that makes a matrix with the secondary induction of collagen synthesis.

Another use becoming more common of these polypropylene materials is in urogynecology. Thus, for the surgical treatment of cystocele or stress urinary incontinence, prosthetic devices made from this material are used. The results are very good because polypropylene filaments are made in a special way, with a porous structure, which means that after being mounted, they produce a minimum inflammatory local response and the fibrous tissue to actually load the strip structure.

Polypropylene strips used in the minimally invasive surgical treatment of stress urinary incontinence can be monofilament or multifilament, with or without resorbable threads included that help tensioning the strips. There are many manufacturing companies, with little differences between strip types, but all of them having the same biomechanical properties. Lately, it emphasizes on biocompatibility, because not all the strips have the same properties regarding this aspect. A good biocompatibility means a decreased inflammatory infiltrate, a decreased

fibrosis, a decreased muscle infiltration and dense collagen filler.

Stress urinary incontinence (IUE) means the loss of urine through the urethra, that occurs when performing a physical activity that leads to the increase of the intraabdominal pressure (coughing, sneezing, laughing etc). Incontinence can be mild (the loss of only a few drops of urine or in high-intensity efforts) or severe (the loss of urine may be in the form of a jet or can occur in low-intensity efforts). The psychological and social impact of this pathology on women is obvious, many patients consider themselves to be disabled in terms of human social relations.

The mechanisms through that the stress urinary incontinence may occur are not yet understood. It is considered as very important in the development of this disease the dysfunction of neuro-muscular mechanisms of the pelvic floor, to this it can also be added injuries or other damages to the supporting tissues of the urethra or bladder neck. In the appearance of IUE, some risk factors are highlighted: the pregnancy itself (especially the natural birth), menopause (due to secondary hypoestrogen), obesity, chronic pulmonary diseases, chronic constipation, prolonged physical efforts or those that overwhelm the body, pelvic irradiation, surgery in the pelvic area and others [2,4,5].

IUE treatment involve firstly to resort to some hygienic-dietary measures that consist of lifestyle changes (quitting smocking, losing weight, avoid sedentary lifestyle and sustained efforts). Minimal invasive surgery is little used and consists of injection of resorbable or nonresorbable agents or mounting of paraurethral bubble.

The main method to cure this disease is surgery. This consists mainly of interventions for the recovery of the contention mechanisms. Lately, as a worldwide way of surgical treatment, it is used the suburethral strip mounted in the „tension free” manner (TVT –tension free vaginal tape or TOT –tension free transobturator tape). Thus, TOT and TVT are the reference procedures in the IUE treatment at this point.

Both surgical techniques are based on supporting the urethra during the efforts made by a patient, a goal achieved by mounting nonresorbable suburethral strips. Mounting of transshutter suburethral strips in the „tension free” manner (TOT) was first described in Holland in 1998. This technique involves the insertion of a polypropylene strip through the shutter hole, through „outside-in” or „inside-out” procedures. TVT is distinguished by the retropubic strip passage and its removal to skin, suprapubic [2,4,5].

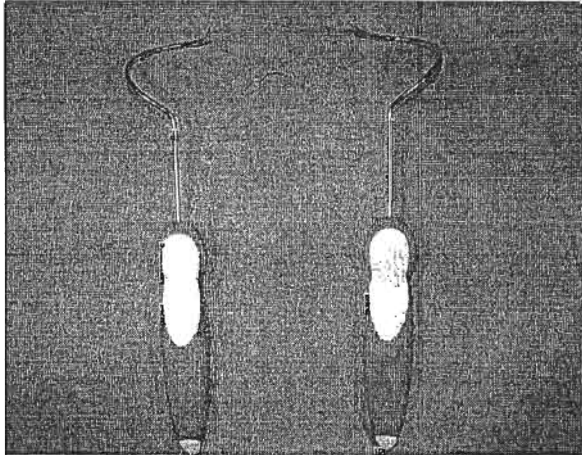


Fig.1 The kit for mounting the polypropylene suburethral strip

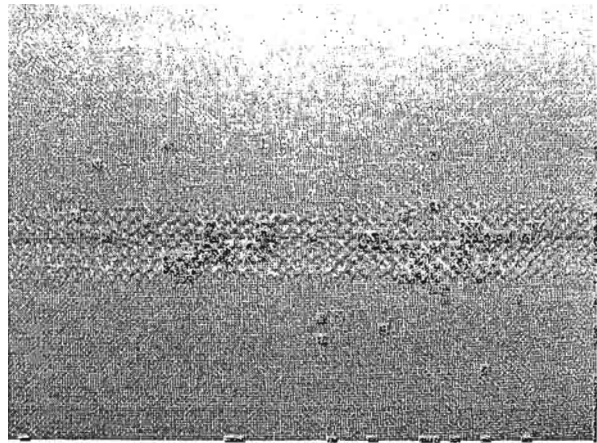


Fig.2 Polypropylene strip (detailed)

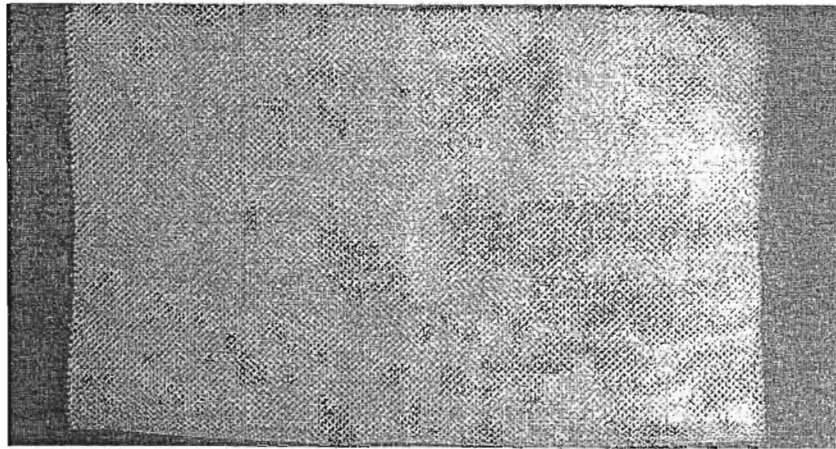


Fig.3 Polypropylene prosthesis for parietal plastic surgery

GOAL

The purpose of this study was to evaluate the efficiency, tolerability and complications of the surgery for mounting the polypropylene transshutter suburethral strips in the „tension free” manner (TOT), in the Urology Clinic experience in Brasov.

MATERIALS AND METHODS

In January 2008 – May 2011 time period, in the Urology Clinic of the Emergency Hospital of Brasov, 176 patients diagnosed with stress urinary incontinence were

treated through TOT. The average age of these patients was 59 years old.

The investigation protocol included a detailed history, complete physical examination (including vaginal examination), the usual laboratory tests (including urinalysis, uroanalysis, coagulation tests), uretro-cystocopye, abdominal ultrasound and, in some cases, intravenous urography. The devices and strips used were supplied by different companies, but with minimal differences in terms of biomechanical properties and biocompatibility.

RESULTS

All the investigations were performed under spinal anesthesia. The average duration of the surgery itself was 22

minutes. After surgery, all the patients received analgesics, anti-inflammatory, antibiotics and low molecular weight heparin. The urethro-bladder probe was removed 24 - 48 hours after the surgery.

The results from the use of polypropylene suburethral strips were favorable, in all 176 cases the complications after intervention were minor.

Thus, the imperative urination „de novo” was detected for 24 patients (13.63%) and required the administration for 7-10 days of an anticholinergic drug, with a complete disappearance of the symptoms. After the surgery, dysuria was present in 29 patients (16.47%) and did not require specific treatment.

Full retention of urine after the removal of the urethro-bladder probe was detected in 2 patients (1.13%). One of the patients showed complete retention after the urethro-bladder probe removal. In this case, the probe was restored and maintained for 4 days, after that the patient presented easy urination and continence.

The second patient presented incomplete retention of urine and 7 days after the probe removal, came in complete urine retention. The second surgery was performed for the strip relaxation. The patient presents continence and without bladder residue.

We recorded no cases of bladder perforation, bleeding during surgery, the development of urethro-vaginal fistula or dyspareunia.

Vaginal wall erosion, a complication possible with the presence of a nonresorbable material at a sensitive and highly vascularized tissue, was present to one patient (0.56%). The complication was resolved by a secondary suture after 3 weeks.

The patients were released after an average of 3 days after surgery and reexamined after 14 days from the day of release, concerning the vaginal wound and the urinary comfort.

DISCUSSION

Urinary incontinence is a common condition in woman's pathology and still avoided during the discussion between a patient and a doctor. Repercussions can be devastating on various aspects of a woman's life, affecting normal daily activities, interpersonal relationships, weakening the patient socially.

Generally, choose one of the types of interventions (TOT or TVT) it belongs urologist, depending on experience. Are however studies that show differences between TOT and TVT, not in terms of success rate of intervention (in many comparable studies), but also on postoperative complications, supporting that TOT is a procedure more secure and right

faster execution. The only concern in TOT technique is related to the possible involvement of the shutter vessels, although pelvic arteriography demonstrated that, by following steps technique, the insertion of a needle guide is a relatively safe area, at least 3 cm from the shutter vessels.[6] It also argues that the TOT provides an anatomical position compared to TVT. In the case of patients who are obese or which have postoperative abdominal wounds, use of TVT technique is quite risky, so that TOT is manner to choose especially in these cases. [1,2,3,7,8].

Our study shows that treatment of stress urinary incontinence TOT technique is an effective treatment with minimal complications and well tolerated by patients.

Using the polypropylene suburethral strips provide a very good stability and a reduced local inflammatory response.

Although it is a synthetic material, it is integrated very well in suburethral structures, creating a mechanism for content with excellent results.

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