UROLOGY

Papers held at Congresses 1991 - 2002
# ACCEPTED ABSTRACTS 1991 - 2002

English/German/French/Spanish

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Kidney Stones
KLINISCHE ERGEBNISSE MIT DEM MODULITH SL 10/20

Department of Urology, Klinikum Mannheim, Mannheim, Germany
* STORZ MEDICAL AG, Kreuzlingen, Switzerland

Der MODULITH SL 20 (Fa. STORZ MEDICAL AG, Kreuzlingen) wurde als Prototyp nach Labor- und tierexperimentellen Untersuchungen im August 1989 an der Urologischen Klinik des Klinikums Mannheim installiert. Die klinische Erprobung und Einführung dieses neuen elektromagnetischen Lithotripsers der dritten Generation umfasste dabei 3 Phasen: Phase 1: (August bis November 1989) mit alleiniger Ultraschallortung und reduzierter maximaler Generatorspannung (max. 18 kV); Phase 2 (Dezember 89 bis April 90) mit kombiniert integrierter Ultraschall- und Röntgenortung und reduzierter maximaler Generatorspannung (max. 18 kV) und Phase 3 (Mai 90 bis Dezember 90) mit kombinierter Ultraschall- und Röntgenortung und vollem Energiebereich (12-30 kV).

<table>
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<tr>
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<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steinverteilung Niere / Harnleiter</td>
<td>89% / 11 %</td>
<td>71 % / 29 %</td>
<td>65 % / 33 %</td>
</tr>
<tr>
<td>Auxiliärmassnahmen vor ESWL</td>
<td>18,6 %</td>
<td>21,9 %</td>
<td>32,4 %</td>
</tr>
<tr>
<td>Stosswellen-Anzahl</td>
<td>2.384</td>
<td>2.821</td>
<td>2.806</td>
</tr>
<tr>
<td>Re-ESWL</td>
<td>30,2 %</td>
<td>22,5 %</td>
<td>19,4 %</td>
</tr>
<tr>
<td>Kurative, auxiliäre Massnahmen nach ESWL</td>
<td>9,3 %</td>
<td>21,8 %</td>
<td>17,3 %</td>
</tr>
<tr>
<td>Steinfreiheit (durchschnittlich 5 Monate)</td>
<td>60 %</td>
<td>83 %</td>
<td>83 %</td>
</tr>
<tr>
<td>Effektivitätsquotient</td>
<td>0,43</td>
<td>0,58</td>
<td>0,62</td>
</tr>
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</table>
Der MODULITH SL 20 hat sich nach den Erprobungsphasen 1 und 2 an unserer Klinik als interdisziplinärer Lithotripter etabliert. Seine therapeutische Effektivität ist dem ehemaligen "goldenen Standard" Dornier HM3 vergleichbar (Effektivitätsquotient = 0,62).

Berücksichtigt man jedoch den erweiterten Indikationsbereich (durch kombinierte Ultraschall- und Röntgenortung), die bessere Handhabung (durch Lagerung auf einer impedanz-adaptierten Folie), die Durchführung der ESWL in i.v.-Analgesie, die Kompaktheit und Multifunktionalität des Gerätes (z.B. für endourologische Eingriffe), so muss ein derartiger Lithotripter als neuer Standard für zukünftige Entwicklungen angesehen werden.
Renal trauma associated with extracorporeal shock wave lithotripsy has gained in interest, particularly since the introduction of new shock wave sources with a wider range of SW energy. Obviously, renal trauma depends on both SW number and generator voltage. However, the exact correlation between these parameters has not yet been defined. Therefore we initiated an experimental study to determine the threshold for induction of different grades of renal trauma based on the calculated amount of the applied energy.

We used the canine kidney in an animal model (n = 38 renal units) and the electromagnetic lithotripter MODULITH (STORZ MEDICAL) with in-line ultrasound localization. The generator voltage ranged from 12 - 20 kV (= 30 - 100 MPa) and the number of impulses varied from 100-2500 SW. Based on the measurements of the focal area (- 6 dB: 6 x 28 mm at 15 kV), the calculated energy per impulse was 1.65, 2.4, 2.8, 4.4 and 6.5 mJ at 12, 14, 16, 18 and 20 kV respectively (PVDF needle hydrophone, imotec).

The degree of renal trauma was assessed by continuous ultrasound monitoring and controlled by acute morphological examinations. The following classification was used: Grade I: first reflex changes on ultrasound, parenchymal petechiae, minimal tubular necrosis. Grade II: hypoechoic arteriolae. Grade III: perirenal hyperreflective zone, perirenal hematoma, rupture of interlobar arteries.

The determined threshold of shock wave energy was 0.5 - 0.7 J for a grade I, 2.0 - 3.6 J for a grade II and 5.9 - 6.6 J for a grade III lesion. With varying SW number and kV, grade I lesions appeared at constant energy levels and were therefore exclusively energy dependent. In contrast to this, for induction of a grade II to III lesion, lower amounts of total energy were necessary on higher generator voltage (2 J at 20 kV) than on lower kV (3.6 J at 14 kV).
Threshold energy of shock waves initiating different grades of lesions in the canine kidney

Department of Urology, Klinikum Mannheim, Mannheim, Germany
*STORZ MEDICAL AG, Kreuzlingen, Switzerland

Petechial bleeding and limited parenchymal hematomas are considered tolerable side effects of clinical ESWL. Perirenal hematoma is a more severe complication. Up to date, the threshold energy inducing this kind of lesions has not been systematically determined for any lithotripter. We commenced our evaluation with two different electromagnetic shock wave sources: the MODULITH SL 20 and the Lithostar Plus overhead module.

Material and Method
Under observation by real-time ultrasound monitoring, SW were focused on the canine kidney until the typical lesions occurred. On autopsy, the kidney trauma was morphologically classified into 3 grades: grade I = petechial bleeding, grade II = parenchymal hematoma, grade III = perirenal hematoma. The SW number inducing the lesion was correlated with the generator voltage.

Results
1) At the highest energy level (level 9), the following SW number resulted in the corresponding lesion: MODULITH grade I 25-100 SW, grade II 300-600 SW, grade III 900-2500 Sw; Lithostar grade I 100-170 SW, grade II 100 SW. 2) The SW number inducing a distinct grade of lesion depended mainly on the generator voltage: MODULITH grade I = energy level 2-9 = SW number 400-100; Lithostar grade I = energy level 1-9 = SW number 1100-100.

Discussion
1) Ultrasound proved to be an efficient method of detection of renal trauma during SW application. 2) Threshold energy, determined by SW number and generator voltage, can be evaluated under standardized conditions for different grades of lesion. 3) This evaluation enables the comparison of various lithotripters. 4) Threshold energy must be correlated with the disintegrative capacity at the same energy level in order to assess the extent of trauma initiated by a SW source. 5) With regard to clinical ESWL, the significance of threshold energy in the canine kidney model must still be determined.
STORZ MODULITH SL 20 - THE FIRST 500 PATIENTS TREATED

T.G. Liston, M.I. Bultitude, R.C. Tiptaft
The Lithotripter Centre, St. Thomas' Hospital, London, England

The MODULITH generates shock waves from an electromagnetic source and allows anaesthesia-free lithotripsy with approximately 70% of the patients requiring mild sedoanalgesia and the treatment is usually given on an outpatient basis. Stones can be localised with an in-line ultrasound and also with intermittent X-ray control.

500 patients with renal tract calculi have been treated, of these 90% had pelvi-calyceal stones with the remainder in the ureter. 90% of stones were 11-15 mm in diameter and requiring a mean treatment rate of 1.5 treatments. Just over 90% of ureteric and renal pelvic stones were rendered stone-free or had a few insignificant fragments (<3 mm in diameter) following treatment. Clearance of calyceal calculi was slower and lower (70%).

In this paper particular reference will be made to the relationship between stone site, stone size and retreatment rate. The outcome, in terms of stone fragmentation and stone-free rates at 3 months, as well as the complications that occurred will be discussed, as will the outcome of treatment in medically compromised patients.
ESWL FOR RENAL CALCULI IN RENAL TRANSPLANTS

T.G. Liston, M.I. Bultitude, R.C. Tiptaft
The Lithotripter Centre, St. Thomas' Hospital, London, England

Two recipients of a renal transplant have been treated by ESWL for renal calculus disease; one was live related and the second a cadaveric transplant.

In the first, one year after transplantation the patient suddenly became anuric with a calculus obstructing the pelvi-ureteric junction. A percutaneous nephrostomy was inserted and further treatment delayed until creatinine had returned to normal.

In the second, the stone was in the transplanted kidney; this was recognised one week after transplantation and ESWL was administered one month after successful transplant surgery.

Both patients were treated on the STORZ MODULITH SL 20 with the patients lying in the prone position. The stones were localised employing the X-ray C-arm. A successful outcome has been achieved in both cases; each being stone-free and having a normally functioning graft.
MULTICENTER STUDY STORZ MODULITH SL 20 - A NEW LITHOTRIPTER

1 Department of Urology, Klinikum Barmen, Wuppertal, Germany
2 Department of Urology, Medizinische Hochschule, Hannover, Germany
3 Department of Urology, Klinikum Mannheim, Mannheim, Germany

The MODULITH SL 20 is a new tubless lithotripter with an electromagnetic shock wave source and both X-ray and ultrasound imaging systems. The first clinical trials were started in August 1989 in Mannheim; further lithotripters were installed in February 1990 in Hannover and in March 1990 in Wuppertal. Up to February 1991 345/345/240 patients with 521/421/312 stones were treated in Hannover, Mannheim and Wuppertal, respectively. The stone size was in 51%/64%/53% smaller than 1 cm, in 28%/31%/25% smaller than 2 cm, in 9%/3%/16% smaller than 3 cm and in 12%/2%/6% bigger than 3 cm. Distribution of stone location was 72%/71%/83% renal stones and 28%/29%/17% ureteral stones.

Mean number of shock waves was 3100/2731/2450, voltage was 17.0/17.4/17.3 KV. 57%/27%/31% of patients had preoperative ureteral catheterization and 8%/17%/9% of patients required post-treatment auxiliary instrumentation. Stone disintegration was successful in 89%/90%/92% at 1.35/1.23/1.30 treatments per patient (including patients with planned staged treatment). As complications 0%/1%/2% perirenal hematomas were encountered.

In conclusion, the STORZ MODULITH SL 20 is a multifunctional table and lithotripter with both X-ray and ultrasound imaging systems with low costs and maintenance.
DER DESINTEGRATIONS-/TRAUMA-KOEFFIZIENT - EIN STANDARDISIERTER PARAMETER ZUM VERGLEICH VON STOSSWELLENQUELLEN

Department of Urology, Klinikum Mannheim, Mannheim, Germany
* STORZ MEDICAL AG, Kreuzlingen, Switzerland


Material und Methodik
1.) Anhand eines bewährten in-vitro Steinmodells wurde die SW-Anzahl für steigende Generatorenspannungen bestimmt, die zur vollständigen Desintegration eines Standardkreidewürfels notwendig ist. 2.) Am Hundemodell wurden in-vivo die SW-Anzahl für steigende Generatorenspannung bestimmt, die an der Niere eine Grad 1 Läsion (petechiale Blutung im Parenchym) induziert. 3.) Aus in-vitro und in-vivo Versuchen erhobene SW-Anzahl wird der Desintegrations/Trauma-Koeffizient berechnet. 4.) Zwei verschiedene elektromagnetische SW-Quellen (MODULITH SL 20, Lithostar Plus Overhead Modul) wurden mittels dieser Koeffizienten verglichen.

Ergebnisse
1.) In-vitro und in-vivo Versuche ergaben für jeden Lithotriptor charakteristische Kurvenverläufe bei der Korrelation von SW-Anzahl und Generatorenspannung. 2.) Der Desintegration/Trauma-Koeffizient verläuft kurvenförmig in Abhängigkeit von der Generatorenspannung mit negativer Steigung. 3.) Der Koeffizient liegt im oberen Energiebereich (Stufe 6-9) für den MODULITH SL 20 zwischen 3 und 1,5 und für den Lithostar Plus Overhead Modul zwischen 7 und 3,5.

Diskussion
1.) Die negative Steigung des Desintegrations/Trauma-Koeffizienten zeigt an, dass mit steigender Generatorenspannung die Desintegrationskraft im Verhältnis zur traumatisierenden Wirkung verbessert wird. 2.) Verschiedene SW-Quellen lassen sich durch den typischen Kurvenverlauf charakterisieren und vergleichen. 3.) Anhand des Koeffizienten erscheint der MODULITH SL 20 dem Lithostar Overhead Modul überlegen zu sein.
THE DISINTEGRATION/TRAUMA COEFFICIENT - A STANDARDIZED PARAMETER FOR THE COMPARISON OF SHOCK WAVE SOURCES

Department of Urology, Klinikum Mannheim, Mannheim, Germany
* STORZ MEDICAL AG, Kreuzlingen, Switzerland

The development of shock wave sources aims at highly-disintegrative stone lithotripsy with minimal tissue lesion. Generator voltage and shock wave number are decisive factors with regard to both effects. The following questions were dealt with: 1) Classification of the SW-induced kidney lesion. 2) Which is the most favourable combination of generator voltage and SW number for a defined SW source? 3) Can standardized comparison be made between different lithotripters with respect to disintegrative capacity and traumatization?

Material and Method
A well-tried in-vitro stone model enabled determination of the SW number with ascending generator voltages necessary for the complete disintegration of a standard chalk cube. 2) Kidney lesions of increasing extent were induced in the dog model by variation of the SW number and generator voltage. 3) The extent of kidney lesion was classified into three groups: Grade 1: petechial parenchymal bleeding. Grade 2: intraparenchymal hematoma. Grade 3: perirenal hematoma. 4) The SW number inducing a grade 1 lesion with ascending generator voltage was determined. 5) The disintegration/trauma coefficient was calculated from the SW number evaluated in in-vitro and in-vivo trials. For two different electromagnetic SW sources (MODULITH SL 20 and Lithostar Plus Overhead Module).

Results
1) In vitro and in-vivo trials revealed characteristic curves for each lithotripter plotting SW number against generator voltage. 2) The disintegration/trauma coefficient plotted against generator voltage represents an inclining curve. 3) The coefficient is between 3 and 1.5 for the MODULITH SL 20 and between 7 and 3.5 for the Lithostar Plus Overhead Module.

Discussion
1) The typical curve progress of d/t-coefficient allows characterization and comparison of different shock wave sources. 2) A low coefficient value means optimal disintegration applying minimal SW number combined with a standard trauma induced by maximal number of impulses. 3) The coefficient reveals that the MODULITH SL 20 is evidently superior to the Lithostar Plus Overhead Module.
MODULITH SL 20 - ITS EFFICACY

Department of Urology, Klinikum Mannheim, Mannheim, Germany

During a very short period of 9 months, the newly-developed MODULITH SL 20 has become established as a third generation lithotripter in clinical ESWL. During this period, 185 patients were treated for urinary tract stones with this highly-efficient electromagnetic shock wave source:

- No. of patients: 185
- Re-ESWL: 19.4%
- Ureteral stones: 34%
- Subsequent aux. measures: adjuvant: 11%, curative: 6%
- Average stone size: 0.8 cm
- Average SW number: 2800
- Previous aux. measures: 32%
- Stone-free on follow-up: 83%

Subsequent auxiliary measures must be classified into two groups for reasonable analysis of success: Adjuvant procedures are carried out, i.e. stent, PCN, in order to avoid or clear complications caused by painful fragments. Curative auxiliary measures, i.e. URS, PCNL, loops, are employed to clear insufficiently disintegrated stones or fragments. The necessity of these measures indicates ESWL failure. The sum of these cases must be subtracted from the number of stone-free patients to enable calculation of the efficacy quotient. On the other hand, respect must be paid to adjuvant auxiliary measures before and after ESWL. Bearing this in mind, we propose a more detailed calculation of the efficacy quotient of lithotripters as compared to that of Preminger and Clayman:

\[
EQ = \frac{\% \text{ stone-free} - \% \text{ curative auxiliary measures}}{100\% - \text{Re-ESWL} - \% \text{ auxiliary measures before ESWL} - \% \text{ adjuvant measures after ESWL}}
\]

Apart from the high clinical success rate, the MODULITH itself displays the following advantages in comparison with other lithotripters:

- Parallel utilization of combined ultrasound and X-ray localization systems
- Wide energy range
- Large range of focal depth

These factors lead to the recommendation of this machine for all interdisciplinary indications.
ESWL for kidney and ureter stone treatment is well established. Lithotripters of the third generation with integrated ultrasound and X-ray imaging system are now available.

The newly developed MODULITH incorporates a cylindrical acoustic source based on electromagnetic principles combined with a parabolic reflector of 83 in which the ultrasound imaging is integrated. The focal dimensions are 6 mm lateral, 30 mm axial combined with a pressure wave of up to 900 MPa. For the X-ray localization of upper and mid-ureter stones it is necessary to move the patient with the floating table away from the shock wave source; after visualizing the stone, the patient is replaced to the focal point.

At the Department of Urology the MODULITH was installed in October 1989. We started with the ultrasound guided localisation system. Then the machine was upgraded with a free adapted C-arm for prefocusing and therapy control. Now the MODULITH incorporates ultrasound and X-ray imaging for stone localisation and therapy control.

Since October 1989 we have treated 263 patients with kidney and 34 patients with ureter stones. After a learning phase for the ultrasound guided focusing system the retreatment rate depending on the stone localisation is between 19% and 28%. The mean number of shock waves is 1870 with 16 kV. Except for two severe hematomas, one of them requiring open surgery, we had only few minor complications.
En 1990, 1150 lithotriteurs extra-corporels étaient installés dans le monde. La majorité d'entre-eux ont soit un système de repérage radiologique, soit un système échographique; 12 % seulement ont un double repérage.

Le MODULITH SL 20 est un lithotriteur à énergie électromagnétique avec double système de repérage: transducteur coaxial ultrasonique et arc en C pour amplificateur de brillance.

Dans une série consécutive de 158 calculs traités de août 90 à janvier 91, 109 calculs furent repérés par échographie contre 49 radiologiquement (dans les calculs non visibles en échographie).

<table>
<thead>
<tr>
<th>Localisation</th>
<th>C. Renal</th>
<th>Urétéral haut</th>
<th>Urétéral bas</th>
<th>Absence de calculs -7 j.</th>
<th>Absence de calculs -90 j.</th>
</tr>
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<tbody>
<tr>
<td>RX</td>
<td>--</td>
<td>30</td>
<td>19</td>
<td>54,3 %</td>
<td>82,6 %</td>
</tr>
<tr>
<td>Ultrasonique</td>
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<td>--</td>
<td>32,98 %</td>
<td>82,08 %</td>
</tr>
</tbody>
</table>

Le double système de repérage est donc évident puisque sans système radiologique, 31,01% des calculs de notre série n'auraient pu être traités sans flush préalable. Les systèmes de localisation radiographique et échographique du MODULITH SL 20 sont également précis, puisque le succès final est le même dans les deux méthodes.

A 7 jours, les meilleurs résultats sont obtenus par le repérage radiologique, mais il s'agissait de calculs de l'uretere qui avaient donc commencé leur migration.
A DIFFERENTIATED CLASSIFICATION OF EXPERIMENTALLY - INDUCED ENERGY - DEPENDENT RENAL TRAUMA AFTER SHOCK WAVE APPLICATION

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Petechial bleeding and limited parenchymal hematomas are considered tolerable side effects of clinical ESWL. Perirenal hematoma is a more severe complication. Up to date, the threshold energy inducing these types of lesion has not been systematically determined for any lithotripter. We commenced our evaluation with two different electromagnetic shock wave sources: the MODULITH SL 20 and the Lithostar Plus overhead module.

Material and Method
Under observation by real-time ultrasound monitoring, SW were focused on the canine kidney until the typical lesions occurred. On autopsy, the kidney trauma was morphologically classified into 3 grades: grade I = petechial bleeding; grade II = parenchymal hematoma, grade III = perirenal hematoma. The SW number inducing the lesion was correlated with the generator voltage.

Results
1.) At the highest energy level (level 9), the following SW number resulted in the corresponding lesion: MODULITH grade I 25-100 SW, grade II 300-600 SW, grade III 900-2500 SW; Lithostar gr I 100-170 SW, grade II 100 SW. 2.) The SW number inducing a distinct grade of lesion depended mainly on the generator voltage: MODULITH grade I = energy level 2-9 = ca. SW number 400-100; Lithostar grade I = energy level 1-9 = ca. SW number 1100-100.

Discussion
1.) Ultrasound proved to be an efficient method of detection of renal trauma during SW application. 2.) Threshold energy, determined by SW number and generator voltage, can be evaluated under standardized conditions for different grades of lesion. 3.) This evaluation enables the comparison of various lithotripters. 4.) Threshold energy must be correlated with the disintegrative capacity at the same energy level in order to assess the extent of trauma initiated by a SW source. 5.) With regard to clinical ESWL, the significance of threshold energy in the canine kidney model must still be determined.
THE FIRST 500 PATIENTS TREATED WITH THE STORZ MODULITH IN THE UNITED KINGDOM

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The Lithotripter Centre, St. Thomas' Hospital, London, England

There can be no doubt that in the last decade extracorporeal shock wave lithotripsy (ESWL) has revolutionised treatment of upper urinary tract calculi. Since the emergence of the concept of lithotripsy, there have been steady and progressive technological developments in the clinically available lithotripters. This paper will present our experience with the STORZ MODULITH SL 20, the most recent addition to the field of lithotripsy, together with the results of the first 500 patients treated by it at St. Thomas' Hospital, London.

Five hundred (500) patients with 551 and 120 ureteric stones, mean diameter 11.9 mm, underwent 746 treatments. 62 % of patients required a single treatment. The mean treatment rate for ureteric calculi was 1.4; for renal calculi, this was 1.5 rising to 4.2 for staghorns. 62.2 % of treatments were performed on an outpatient basis.

Analgesia (iv Fentanyl) was required in 60.9 % of treatments for renal calculi but only 38.2 % for ureteric calculi. The overall stone free rate at 3 months was 77.6 % of patients with a further 14.7 % having fragments < 3 mm in diameter, not requiring further treatment. The stone free rate was dependent on the site of the stone with the majority of fragments in a lower pole calyx. There were few complications overall. The MODULITH is an efficient and safe lithotripter capable of treating stones at all sites in the urinary tract.
SHOCK WAVE INDUCED VASCULAR LESION OF THE KIDNEY: IN-VIVO AND IN-VITRO FINDINGS

Department of Urology, Klinikum Mannheim, Mannheim, Germany

Intrarenal bleeding is the predominant side effect of shock wave application to the kidney. Type and dose-dependency of vessel lesion must be classified in order to minimize bleeding complications caused by ESWL.

Material and Methods

Two different animal models were utilized:

a) 30 minutes after SW application to the canine kidney in-vivo, barium containing contrast dye was injected into the renal artery under physiological pressure.

b) SW were applied to the isolated perfused pig kidney in-vitro. Barium dye was injected immediately after SW application.

Subsequent to fixation of the kidney in both models, extravasation was documented by X-ray.

Results

In the in-vivo model with varying SW number and generator voltage, a dose-dependent dye extravasation was determined. Distinct deviation with respect to amount and localization was observed. The in-vitro model revealed a constant extravasation at the target area.

Discussion

Vessel lesion in the kidney is a dose-dependent effect of SW application. This can be evaluated by both in-vivo and in-vitro studies. The isolated kidney model proved advantageous because of high reproducibility and exclusion of in-vivo animal trials.
10th World Congress on Endourology and ESWL
03.-06.09.1992, Singapore

HOW TO SAVE SHOCK WAVES IN ESWL

L.F. Coz, R. Lyng, M. Bustos, C. Stein
Military Hospital, Santiago, Chile

The number of shock waves needed to appropriately fragment a stone depends on its constitution, the energy or pressure level reached in the focal area, the size of the focal area and the number of shock waves that actually impact the stone.

Since August 1990, one million six hundred thousand shock waves have been released from a MODULITH SL 20 STORZ MEDICAL lithotripter in our Lithotripsy Center. 295 kidney stones, 87 upper ureter stones and 125 lower ureteral stones have been treated. The global stone-free patient index achieved was 89.22 %.

50 % of the patients were treated in ambulatory regime.

20 % of the patients did not need analgesia, 67.87 % received analgosedation and 12.13 % epidural anesthesia.

88.28 % of the kidney stones and 90.5 % of the ureteral stones were successfully treated with complete absence of residual fragments before 90 days. An average of 2212 shock waves was necessary for kidney stones and 2326 for ureteral stones.

We describe the strategy that has allowed us to considerably reduce the number of shock waves necessary to fragment the stones. The patients have been asked to fire themselves the shock waves only when they visualize the stone perfectly located on the echograph screen.

Even though this strategy lengthens the time of treatment, it decreases the number of shock waves needed to fragment the stones because only shock waves that are precisely delivered on the stone are released.

This can only be performed with lithotripters with in line ultrasonography.
Ziel dieser Arbeit war es, ein standardisierbares Modell zur Evaluierung von Pathomechanismen und Dosisabhängigkeit des Stosswellen-induzierten Nierentraumas zu entwickeln.


Die Mikroangiographie zeigte unterschiedliche, für die verschiedenen Fokuslokalisationen typische Muster der Kontrastmittelparavasate. Die Dosisabhängigkeit des Läsionsausmasses wurde durch die Ausdehnung der Läsion sowie der Häufigkeit, zusammengefasst in einem Score, nachgewiesen. Die Art des Perfusates hatte deutlichen Einfluss auf die Ausdehnung der Gefässläsion. Histologisch war das Trauma zu kategorisieren: Einzelzellnekrosen mit Verlust der Zellgrenzen, Parenchymdefekt mit erhaltenen Stroma oder kompletter Gewebedefekt.

The aim of this investigation was an easily reproducible model to evaluate shock wave induced renal tissue damage avoiding unpredictable artefacts.

Kidneys (n=45) from slaughtered pigs were perfused under physiological conditions. We applied shock waves at different doses (2-100 SW, 12-20 kV, MODULITH SL 20, STORZ MEDICAL AG). The perfusion-fixed kidneys were sliced, focal areas and control areas were dissected and processed for conventional and electron microscopy.

The dose-dependent alterations in conventional histology were characterized by disintegration of tubular cells leading to circumscribed gap-like defects. Even after low shock wave doses electron microscopy showed vacuolar degeneration.

Our findings on this ex-vivo model verify the strongly localized, dose-dependent but considerable shock wave induced damage of renal parenchyma. The primary tubular cell destruction and disruption of peritubular capillaries resulting in capillo-tubular connections can explain even severe macrohematuria without renal hematoma.
ESWL OF URINARY CALCULI: EXPERIENCE WITH THE MODULITH SL 20 (STORZ MEDICAL AG)

F. Coz, R. Lyng, M. Bustos, C. Stein
Military Hospital, Santiago, Chile

The authors present results obtained with a MODULITH SL 20 lithotripter. This instrument has a large aperture electromagnetic generator and a double localization system (X-ray and in line echography).

Material and Method

467 patients with 529 urinary stones were treated. Staghorn calculi have been excluded of this series.

Stone localization: kidney 55.03 %; lumbar ureter 16.32 %; pelvic ureter 24.86 % and bladder 3.79 %.

Results

Three months after treatment the stone-free rate was: 90.4 % in renal calculi, 89.53 % in lumbar ureter stones, 92.5 % in pelvic ureter calculi and 100 % in bladder stones.

Conclusion

These results confirm the MODULITH SL 20 as an instrument that can achieve very good fragmentation rate of diversely located stones.
THE RESULTS OF THE TREATMENT BY THE STORZ MODULITH SL 20 FOR THE FIRST THOUSAND PATIENTS WITH URINARY STONES

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From February 1992 to March 1993 1000 patients underwent treatment of ESWL. The MODULITH SL 20 was used in all cases on an outpatient basis. Hydroacoustic waves generated peak pressure from 400 to 1000 bar. 2750 impulses fell on one treatment. 528 males, 461 females and 11 minors received the treatment; only 16 stones were larger than 20 mm. The average stone size was 13.2 mm in diameter; 683 patients had kidney stones and 317 ureteric stones. In all 1374 cases lithotripsy was carried out. The results were evaluated for ureteric stones after 3 weeks and for kidney stones after 12 weeks. Good stone clearance results or negligible residues were achieved in 96 % kidney stones and 92 % ureteric stones. 5.2 % patients needed auxiliary endourological procedures. The number of good results was growing with staff experience.

Conclusions:
1. The MODULITH SL 20 is a highly effective device
2. The treatment has to be repeated more frequently for ureteric stones

From June to December 1992 276 lithotripsy treatments were carried out in 222 patients with ureterolithiasis. By changing the voltage in the electromagnetic convertor within the range of 16.5 to 21 kV the shock wave pressure was generated within the range of 600 to 100 bar; 2780 impulses were applied during the treatment. The efficacy of the therapy was evaluated 2 weeks after the first lithotripsy. What we considered a good therapeutic result was a removal of the concrement or clinically negligible residues (neither pain nor infection nor ureterohydronephrosis). 150 patients had stones whose diameter did not exceed 10 mm. 72 patients had bigger calculi. The chart below presents the interdependence of the treatment's efficacy, the localization of the concrement and the numer of lithotripsy treatments.
Conclusions:

1. The best results falling on the lower part of the ureter, the poorest results falling on the middle section

2. If there is no positive result after the first lithotripsy the treatment should be repeated
Les auteurs présentent les résultats obtenus dans le lithotripteur MODULITH SL 20. Cet appareil possède un générateur de grande ouverture et un double système de repérage radioscopique et échographique en liaison.

Matériel et Méthode

467 patients porteurs de 527 calculs urinaires ont été traités. Localisation des calculs: rein 55,03 %, uretère lombaire 16,32 %, uretère pelvien 24,86, vésicaux 3,79 %.

Résultats

Le contrôle à 3 mois de cette série de patients démontre qu'ils sont radiologiquement libre de tout fragment résiduel. 90,4 % des calculs rénaux, 89,53 % des calculs de l'uretère lombaire, 92,5 % des calculs de l'uretère pelvien et 100 % des calculs vésicaux.

Conclusion

Ces résultats nous confirment que le MODULITH SL 20 est un appareil d'une excellente performance, permettant de traiter des calculs dans toutes les localisations avec une très bonne fragmentation, que ces calculs soient repérables ou pas par échographie.
87e Congrès Français d'Urologie
17.-20.11.1993, Paris, France

LE LITHOTRITEUR STORZ MODULITH SL 20
RESULTATS PRELIMINAIRES

Service d'Urologie, Hôpital St. Louis, Paris

Le STORZ MODULITH SL 20 est un lithotriteur à générateur électromagnétique qui utilise un système de repérage échographique et radioscopique.

100 patients (137 calculs) ont été traités de janvier 1993 à avril 1993 et 123 séances ont été nécessaires dont 18 retraitements (13%).

La localisation des calculs a été: le rein 86 (63 %), le bassinet 18 (13 %), l'uretère lombaire 9 (6,5 %), l'uretère iliaque 4 (3 %) et l'uretère pelvien 20 (14,5 %).

Une diazanalgésie est le plus souvent nécessaire pour les calculs rénaux, alors qu'une prémédication est suffisante pour les calculs de l'uretère.

Les résultats préliminaires à 1 mois, pour nos 81 premiers patients, sont un succès complet 63 %, un succès partiel 25 %, un échec 12 %.

Le STORZ MODULITH SL 20 permet donc une très bonne fragmentation, aidé par un double repérage échographique et radioscopique, avec une assistance anestésique limitée.
EXPERIMENTAL BASICS FOR THE "LOW ENERGY PRINCIPLE" FOR ESWL OF KIDNEY STONES

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Department of Urology, Klinikum Mannheim, Mannheim, Germany

The dose of applied shock waves (SW dose) for ESWL is defined by the energy level (generator voltage, kV) and the number of impulses (SW number). Stone disintegration and kidney trauma correlate with both factors. However, the optimal combination of both parameters, for achievement of a high fragmentation rate with minimal renal trauma is unknown.

Disintegration was performed using an artificial stone (dental cement, glass microsphere, 1.0 ± 0.01 g) in a wire net. Shock waves were applied until all fragments had passed through the mesh. The shock wave number necessary for disintegration was evaluated for low (12 kV), medium (16 kV) and maximal (20 kV) energy levels using the electromagnetic lithotripter MODULITH SLX.

Renal trauma was investigated using the isolated, perfused kidney model. Kidney from slaughtered pigs were flushed by Tyrode solution. During shock wave application BaSO4 suspension was perfused. The roundish area of petechial dye paravasation, representing the extent of vascular lesion, was quantified after documentation on mammographic film. Furthermore the lesion was evaluated by histomorphology. Kidneys (n = 24) were exposed to the identical SW number and kV as in the stone model.

The following are the SW numbers necessary for stone disintegration as well as angiographic kidney trauma:

<table>
<thead>
<tr>
<th>Energy level</th>
<th>SW number for complete stone disintegration</th>
<th>Size of renal trauma</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 kV</td>
<td>870 SW</td>
<td>ø 4.1 mm</td>
</tr>
<tr>
<td>16 kV</td>
<td>179 SW</td>
<td>ø 10.6 mm</td>
</tr>
<tr>
<td>20 kV</td>
<td>85 SW</td>
<td>ø 12.0 mm</td>
</tr>
</tbody>
</table>

Histological findings showed gap-like defects that worsened with increase of the applied energy level.

The model of the isolated, perfused kidney using slaughtered pig kidney has proved to be ideal to evaluate the dose dependency of the shock wave induced renal lesion. This study shows that a low energy level combined with a high number of shock waves leads to a sufficient stone disintegration with the lowest risk of renal trauma. This finding should be respected in the clinical ESWL although high energy levels will be necessary in special situations like cystine, ureteral or diverticular stones.
FIRST RESULTS WITH THE NEW MODULITH SLX LITHOTRIPTOR

A. Wolf, P. May
Department of Urology, Klinikum Bamberg, Germany

The MODULITH SLX (STORZ MEDICAL AG) is a further development of the third generation SL 20 with an electromagnetically energy source, in-line flouroscopy and optionally ultrasound.

From 6/94 to 12/94 106 consecutive patients were treated. On 6 patients several stones were treated in one session. Intravenous sedation and analgesia was performed in all patients. Energy level 6 was used for the kidney and level 8 for the ureter (max. 9). A shock wave (SW) frequency of 120/minute could be used in all except for 3 patients. Follow-up was conducted for up to 3 months to determine stone free rate and success rate (≤ 3 mm).

<table>
<thead>
<tr>
<th>pat. no.</th>
<th>pelvis</th>
<th>calices</th>
<th>ureter</th>
</tr>
</thead>
<tbody>
<tr>
<td>size (mm)</td>
<td>12.5</td>
<td>8.9</td>
<td>7.2</td>
</tr>
<tr>
<td>SW</td>
<td>2892</td>
<td>3032</td>
<td>3600</td>
</tr>
<tr>
<td>success 1. day %</td>
<td>84.6</td>
<td>75</td>
<td>83.8</td>
</tr>
<tr>
<td>success 3 months %</td>
<td>92.3</td>
<td>94.4</td>
<td>87</td>
</tr>
</tbody>
</table>

7 patients needed further treatment (6 ESWL, 1 perc. Nethrolitholapaxie). One hematoma was treated conservatively.

Conclusion:
The MODULITH SLX is an effective uncomplicated machine with an above average success rate.
With the first electrohydraulic lithotripters (ESWL) had to be applied under general anaesthesia. Intravenous (i.V.) analgosedation was required using later modifications, accompanied by an impairment of efficacy. Piezoelectric lithotripters can be run without anaesthesia, but are burdened with a high retreatment rate. The electromagnetic lithotripter MODULITH SL20 (STORZ MEDICAL AG) should be evaluated concerning the mode and need of anaesthesia.

The MODULITH SL20 provides the high disintegrative efficacy due to its combination of electromagnetic coil and paraboloid reflector (energy range 12 - 20 kV). In clinical practice the highest energy level was routinely applied giving i.v.-analgosedation (combination of opioid and benzodiazepin). The treatments of 313 patients were analyzed retrospectively concerning analgesia and efficacy. Data of a clinical prospective study (n = 26) evaluated the mode of anaesthesia in 3 treatment branches: 1. no analgesia; 2. minimal analgesia (prilocain-lidocain-creme/EMLA-creme/Astra GmbH and diclofenac supp. p.r.); 3. i.v. analgosedation (midazolam/piritramid).

313 patients were treated with i.v. analgosedation in 99 % of the cases. An average of 17,6 kV was applied to achieve a stone free rate of 93 % (follow up of 3 months). 19 patients could not tolerate an energy level more than 14 kV, nevertheless their urinary calculi were sufficiently disintegrated. The prospective study revealed that in 4 of 9 patients ESWL could be performed without any analgesia, in 8 of 8 and 9 of 9 the procedure was carried out under minimal and i.v.-analgosedation respectively.

I.v.-analgosedation is feasible for tolerable ESWL in nearly all patients. Its routine use seems to be an overtreatment, even with high energy lithotripters for two reasons:
1. Low energy levels inducing less pain are sufficient in a lot of patients.
2. High energy levels are tolerated by many patients without analgosedation, obviously depending on other parameters than generator voltage.

Future studies should find out predictive parameters to choose energy level and anaesthesia individually required.
Ureter Stones
86th Annual Meeting of the American Urological Association, Inc.
02.-05.06.1991, Toronto, Canada

THE INFLUENCE OF A COMBINED ULTRASOUND AND X-RAY TARGETING SYSTEM ON URETERAL ESWL

T.O. Henkel, K.U. Köhrmann, J. Rassweiler, P. Alken
Department of Urology, Klinikum Mannheim, Mannheim, Germany

The sole use of ultrasound targeting has revealed various drawbacks in the successful ESWL treatment of ureteral stones. Since August 89 a MODULITH lithotripter is available in our department. In Phase 1 it was used with in-line ultrasound targeting only. In Phase 2 external C-arm fluoroscopic targeting was added and in Phase 3 generator voltage was increased. A total of 95 patients have been presently treated with the following ureteral stone location: upper 51%, mid 14%, lower 35%. Treatment results are listed below:

<table>
<thead>
<tr>
<th></th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>12</td>
<td>37</td>
<td>50</td>
</tr>
<tr>
<td>Number of treatments</td>
<td>13</td>
<td>42</td>
<td>71</td>
</tr>
<tr>
<td>Retreatment rate (%)</td>
<td>8</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Shock wave number</td>
<td>2.423</td>
<td>2.875</td>
<td>2.936</td>
</tr>
<tr>
<td>Generator voltage (kV)</td>
<td>17,7</td>
<td>17,7</td>
<td>18,9</td>
</tr>
<tr>
<td>Desintegration rate (%)</td>
<td>64</td>
<td>74</td>
<td>85</td>
</tr>
<tr>
<td>Auxiliary measures (%)</td>
<td>8</td>
<td>40</td>
<td>30</td>
</tr>
</tbody>
</table>

The small number of treatments in Phase 1 is attributed to the restrictive patient selection limited by ultrasound targeting. The introduction of a combined ultrasound and X-ray targeting system (Phase 2) creates a wider indication range. Together with the increased generator voltage (Phase 3) the number of auxiliary measures could be reduced. This reduction of invasive techniques was coupled with an increased retreatment rate based on the concept of in situ disintegration. In conclusion the combined targeting system coupled with the wide shock wave energy range is necessary to achieve good ureteral ESWL results.
ESWL for ureteric calculi is dependent on stone localisation and the ability to deliver the shock wave to the stone. The STORZ MODULITH SL 20, employing an electromagnetic energy source with a unique X-ray system for stone localisation permits the treatment of calculi at all sites in the ureter.

Since April 1990, 100 patients with ureteric calculi have been treated. The stones ranged in size from 4-20 mm. ESWL was administered in the supine position for stones in the upper third of the ureter. The majority of the patients received 3,500 shocks at power levels 8-9 (18-20kv). The mean number of treatments was two.

90% of the patients have been rendered stone-free by ESWL alone. 5% required endoscopic retrieval of stone fragments and two patients subsequently had a ureterolithotomy.

We conclude this lithotripter is effective at treating ureteric calculi as a monotherapy.
ULTRASOUND GUIDED LITHOTRIPSY OF LOWER URETER STONES

Department of Urology, University Frankfurt/Main, Germany

The lithotripsy of lower ureter stones is now a common therapy in lithotriptors with fluoroscopy. With the new STORZ MODULITH SL 10 we started a treatment series of patients with lower ureter stones. The treatment was performed in prone position with a filled bladder (volume more than 150 cc). The stone is visualized by the in-line ultrasound (3.5 MHz). For the disintegration we use electroacoustic shock waves generated in a special coil and reflected by a paraboloid.

We treated 19 patients (12 male/7 female) with an average age of 49 years. For complete stone disintegration, there were 23 EL sessions in analgosedation necessary. Under the treatment we have not seen any complications nor was nephrostomy necessary.

The ultrasound guided lithotripsy of lower ureter stones in analgosedation is an effective, non-invasive therapy with a low complication rate.
IN SITU ESWL TREATMENT OF URETERAL CALCULI WITH MODULITH SL 20

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ESWL Center I.F.C.A., Department of Urology I.N.R.C.A., USL 10/D, Florence, Italy

MODULITH SL 20, a third generation electromagnetic lithotripter, is characterized by a wide energy range of the shock wave source, a large aperture focusing system, a matched focal zone, a coaxial ultrasound probe for real time scanning and integrated C-arm with pulsed fluoroscopy using a virtual focus for stone localization. Those features make effective disintegration of difficult stones possible (both for density and position), anesthesia-free treatment and low side effects. The video presents our initial experiences with the MODULITH SL 20 in the treatment of 18 patients with ureteral calculi, 12 in the upper and 6 in the lower ureter. No attempts were made to manipulate the stone back into the pelvis and no ureteral catheter or double J stent was used. Successful disintegration was achieved in 95% of the patients using an average number of impulses of 2130 (range 1100-3000) and a mean voltage of 16.7 kV (range 15-19), with a mean energy delivered of 34,000. No patient required anesthesia; only i.m. sedation was used. One patient was submitted to nephrostomy before ESWL for severe hydronephrosis. Only two patients required 3 sessions and received a total shock wave number of 6,000 and 5,500 respectively, for impacted stone. No serious complications were observed. Complete removal of stone was obtained in 83% in the patients at discharge from the hospital. All patients were followed up three months, and the results were assessed by pain film and ultrasound examination.

In situ extracorporeal lithotripsy with the MODULITH SL 20 lithotripter is an effective method for the treatment of ureteral stones, due to the capability of the machine either to enable optimal fragmentation with wide energy levels or to change the acoustic window, rotating the shock wave source and focusing system with the integrated ultrasound probe providing a continuous real time monitoring of the localization and fragmentation process.
Presently in situ ESWL is the treatment of choice in the management of ureteric calculi. Ultrasound targeting of urinary stones has proven effective in most areas of the urinary tract eg. kidney, PUJ and distal ureter. However sole ultrasound use has revealed drawbacks in localisation of calculi in the mid-ureter. The addition of an X-ray targeting system complements the overall treatment spectrum of ultrasound focusing.

The Department of Urology, Klinikum Mannheim, Germany, and STORZ MEDICAL AG (Kreuzlingen, Switzerland) together have developed the STORZ MODULITH SL 20, a third generation interdisciplinary lithotripter equipped with an ultrasound and an X-ray imaging system. During the first two months, 12 patients (phase 1) were treated the following five months utilizing dual imaging modalities. During the final seven months 89 patients (phase 3) were treated with ultrasonic and fluoroscopic localisation combined with an increased maximal shock wave pressure (20 kV= 1000 bar).

The introduction of fluoroscopic targeting (phases 2 and 3) resulted in satisfactory localisation of calculi in the mid-ureteric portion, previously limited by sole coaxial ultrasound use. The extension of stone localisation to the whole ureteric length was linked to a marked decrease in treatment time, reflecting the easy handling of the dual localisation system. The rise in generator voltage (phase 3) improved the disintegration rate from 69% (phase 2) to 96%, whereas the number of impulses and extent of curative measures remained unchanged. However, the rate of adjuvant procedures post ESWL was distinctly reduced from 25% (phase 2) to 9%.
TREATMENT OF URETERIC STONES BY IN SITU SHOCK WAVE LITHOTRIPSY WITH THE STORZ MODULITH LITHOTRIPTER

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Department of Urology, Singapore General Hospital, Singapore

We started using the third generation STORZ Lithotripter in April 1991. One of the distinguished features of the STORZ MODULITH SL 20 is that it is capable of treating stones along the whole length of the ureter including those located at the sacral-iliac joint which was considered as the no-men’s land for shock wave treatment. In the first 3 months we treated a total of 149 patients with 51 patients having ureteric stones. One of them had bilateral ureteric stones.

Treatment sessions were 1.5 for the 27 upper third stones, 1.4 for the 13 middle third and 1.3 sessions for the 12 lower third stones. The success rate, as defined by stone clearance or insignificant fragments, for upper, middle and lower third stones were 78%, 100% and 83%, respectively. Of the 8 failures, 3 had ureteroscopic lasertripsy, 4 had ureterolithotomy and one was lost to follow up. The overall success was 85% which suggests that in situ shock wave is a good first choice alternative treatment for ureteric stones.
ESWL OF PELVIC URETERAL STONES TREATED IN VENTRAL AND DORSAL POSITION: COMPARISON OF RESULTS

L.F. Coz, R. Lyng, M. Bustos, C. Stein
Military Hospital, Santiago, Chile

Iliac ureter stones can be treated with shock waves transmitted through the anterior abdominal wall (ventral position) or through the gluteal muscles (dorsal position).

We present a comparison of the efficacy and tolerance of ESWL of iliac ureter stones in two series of patients: one treated in ventral position and the other in dorsal position.

From August 1990 to April 1992 a total of 126 stones located in the inferior ureter were treated. Of these, 46 were treated in ventral position and 69 in dorsal position. All stones treated through the gluteal muscles were radiologically localized. In the case of stones treated through the anterior abdominal wall, only 6.5 % were localized through X-ray. The rest, ie, 93.5 %, being close to the bladder, were easily identified by echography.

Complete fragmentation of stones was achieved in 95.65 % of the cases treated in ventral position and in all (100 %) the cases treated in dorsal position.

Tolerance of both procedures differed: 52.17 % of stones treated in ventral position did not need analgesia, while 86.96 % of those treated in dorsal position did require analgesedation.

Stones located in the inferior ureter and visible to echography must be treated in ventral position. All stones that cannot be localized by echography can be treated in dorsal position with the same efficacy but will require more analgesia.
Siendo en la actualidad la litotricia extracorporea por ondas de choque (ESWL), la modalidad de tratamiento preferida para la resolución de la litiasis renal, el escaso éxito alcanzado en la litofragmentación de los cálculos ureterales, a lo largo de la evolución del método, ha hecho que este tipo de pacientes no hayan sido nunca considerados candidatos óptimos.

Las nuevas generaciones de litotritores, mejorando la arquitectura mecánica, los sistemas de localización, y los niveles de energía, comienzan a resolver de este modo este tipo de patología.

Análisis de nuestra experiencia ambulante e „in situ“ (MODULITH SL20)

<table>
<thead>
<tr>
<th>No. pacientes</th>
<th>104</th>
</tr>
</thead>
<tbody>
<tr>
<td>período de seguimiento</td>
<td>6 meses</td>
</tr>
<tr>
<td>exitos totales</td>
<td>82,69 %</td>
</tr>
<tr>
<td>exitos una sesión</td>
<td>51,92 %</td>
</tr>
</tbody>
</table>

El MODULITH SL20 perteneciente a la tercera generación, permite la desintegración electiva de los cálculos ureterales en cualquier situación del TUS, práctica que se realiza de forma ambulatoria en nuestra Unidad de Litotricia, al no precisar ningún tipo de anestesia ni hospitalización.

Nuestros resultados y nuestra estrategia supone un nuevo cambio de orientación en el manejo de esta litiasis frente a las establecidas e históricas dóctrinas existentes respecto al cálculo de localización ureteral.
IMPACTED URETERAL STONE: IN SITU ESWL AS PRIMARY METHOD OF CHOICE

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The lack of fluid interface and the presence of oedema of mucoa around the stone seem to reduce the success rate in treatment of ureteral stone by ESWL as reported by many authors. Our experience shows that ESWL in situ treatment is the method of choice even in impacted ureteral stones.

224 ureteral stones treated with ESWL between July 1990 and March 1993 were evaluated. Out of these 104 (46.4 %) presented an obstruction from mild to severe, and nevertheless they were scheduled for in situ treatment, without any previous manipulation on the stone. Comparison between the two groups of stones, impacted 104 (46.4 %) and non impacted 120 (53.5 %), showed no significant differences in results at 3-month follow up (94.2 % vs 100 % P = 0.829). Retreatment rate in impacted stone was significantly higher: 40.3 % vs 24.9 % (P = 0.049). The mean number of shocks was 3420 vs 2656, without difference in mean energy level used (17.1 vs 17.5 Kv). Better results were achieved in calculi located in the mid and lower ureter (100 % free at 3 months) when compared with stones in the upper ureter (impacted 94.2 % vs non impacted 100 %). Ureterolithotomy was performed in 6 non-fragmented stones (5.6).

Our experience suggests that impacted stones can be treated and fragmented with in situ ESWL with repeated treatments. This is possible using an effective and anaesthesia-free lithotripter like the STORZ MODULITH SL 20. Impacted stones needed a higher number of shocks, a higher number of treatment (P = 0.02 for more than two sessions) to obtain the success rate like non impacted calculi and, finally, a higher number of pre and post-ESWL, ancillary procedures (JJ stent and nephrostomy) (11.5 % vs 0%) to reduce hydronephrosis. Our data suggest that push and bang ureteroscopy or any stone manipulation should be performed only when repeated ESWL failed, i. e. no clinical improvement or radiological findings of fragmentation occurred.
Dual imaging and precision focusing with careful patient positioning have allowed the treatment of all ureteric calculi in situ. Stone clearance was reduced in stented ureters; this clinical observation has been verified by an experimental study.

122 consecutive patients presented with ureteric stones (43 upper, 29 middle, 50 lower). All these were treated on the STORZ MODULITH lithotripter. 36 were treated with J stents and the remaining 86 without any prior instrumentation. In the stented ureters the treatment rate was 2.26 which compared with 1.19 in non stented ureters.

The experimental study confirmed less fragmentation of a phantom stone in the presence of a stent. Acoustic energy output was recorded and structural changes in stent morphology was assessed by scanning electron microscopy.

Our clinical observations, supported by experimental study, confirm that prior manipulation and stenting reduces the efficacy of ureteric stone disintegration and clearance.
LITHOTRIPSIE EXTRA-CORPORELLE DE CALCULS DE L'URETÈRE PELVIEN: COMPARAISON DE DEUX OPTIONS DU MODULITH SL 20

L.F. Coz
CMC, Porte de Choisy, France

Les ondes de choc pour fragmenter des calculs de l'uretère pelvien peuvent être transmises à travers la paroi abdominale antérieure (position ventrale) ou transmises à travers les muscles fessiers (position dorsale).

Les auteurs comparent deux séries de patients ayant des calculs logés dans l'uretère pelvien, traités par LEC en position dorsale ou ventrale.

Matériel et Méthode
Tous les patients ont été traités dans un lithotripteur MODULITH SL 20 STORZ MEDICAL possédant un générateur électromagnétique et double système de localisation radioscopique et échographique.
89 calculs traités en position dorsale. 42 calculs traités en position ventrale.

Résultats
Calculs traités en position dorsale succès complet 94,87 %. Calculs traités en position ventrale succès complet 88,9 %.
Seulement 35,7 % des calculs traités en position ventrale ont requis analgésie. En revanche 83,33 % des calculs traités en position dorsale ont requis analgésie.

Conclusion
Les auteurs concluent que la fragmentation de calculs de l'uretère pelvien est aussi efficace lorsque les ondes de choc sont transmises que ce soit à travers la paroi abdominale antérieure ou par les muscles fessiers. Cependant les besoins d'analgésie sont différents; ils sont considérablement augmentés en position dorsale par la stimulation fréquente du nerf sciatique, ce qui ne se produit pas en position ventrale.
RESULTS OF THE IN SITU MANAGEMENT OF URETEROLITHIASIS WITH LITHOTRIPTER MODULITH SL 20

W. Jamrozy, M. Olkiewicz, J. Lorenz,
Centre of Lithotripsy, Polish National Insurance Company Ltd., Polanica Zdrój, Poland

Introduction
Extracorporeal shock wave lithotripsy /ESWL/ is now the first choice in the treatment of urinary tract stones. The lithotriptor MODULITH SL 20 for its combination of ultrasound and X-ray locating system allows to disintegrate urinary stones in all urinary tract. We report our experience in treatment of the ureteral stones for its difficulty in localisation and disintegration.

Material and Methods
From February 1992 to December 1993 554 procedures were performed on 445 patients with ureteral stones. The pressures of shock wave in the range of 600 to 1000 bars were generated by changing the voltage on the electromagnetic transducer from 16.5 to 21 kV. The total number of shock waves varied from a minimum of 1500 to a maximum of 3500 for one session/average 2560/. The average stone size was 13.5 mm across. The effectiveness was evaluated by the X-ray examination at the every latest 2 weeks ESWL procedure. The effect of ESWL was assumed to be good when there was no evidence of stone in the ureter/stone was eliminated spontaneously/ or the stone was crushed into small fragments of no clinical significance / stasis, pain, infection/.
(continued)

**Results**
The relationship between stone location and number of procedures is set out in the table

<table>
<thead>
<tr>
<th>Portion of ureter</th>
<th>No. of patients</th>
<th>Efficiency in %</th>
<th>after 1 proc.</th>
<th>after 2 proc.</th>
<th>after foll. proc.</th>
<th>without success</th>
</tr>
</thead>
<tbody>
<tr>
<td>upper</td>
<td>193</td>
<td>92</td>
<td>96</td>
<td>97</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>middle</td>
<td>74</td>
<td>68</td>
<td>80</td>
<td>81</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>terminal</td>
<td>178</td>
<td>90</td>
<td>96</td>
<td>98</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>445</td>
<td>87</td>
<td>92</td>
<td>94</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

**Conclusions**
1. The success rate of ESWL depends on the position of the calculus in the ureter being highest in the terminal and lowest in the midureteric stones.
2. In cases of failure of first attempt the lithotripsy should be repeated the second procedure significantly raises the efficiency.
3. MODULITH SL 20 allows to disintegrate the ureteral calculi with 92% success rate.
EXPERIENCE WITH MODULITH SL 20 FOR RENAL AND URETERIC STONES

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Department of Urology, Al-Azhar University, Cairo, Egypt

We have been using the STORZ lithotripter SL 20 at the stone lithotripsy centre, in Al-Azhar University in Cairo, since September 1992. This third generation lithotripter has an in-line ultrasonography, real-time co-axial U/S image and an integrated isocentric C-arm X-ray system with pulse progressive fluorscopy for positioning and monitoring of fragmentation.

We have treated 550 patients including 412 with renal stones. The stone size was less than 2 cm in 77% of cases and over 4 cm in 10% of cases. Auxiliary measures in the form of ureteric stents or catheters were needed in only 3% of cases. The overall stone disintegration rate was 96%, while the stone clearance (3 months after treatment) was 87%. 38% of our patients received more than one session with an average of 1.7. Impacted pelvicalyceal stones, small sized; stones in a dependent lower calyx are among factors causing treatment failure with ESWL.

We have also treated 118 ureteric stones during the same period with an overall success or stone clearance of 77%. Ureteric catheters or stents were inserted in 18% of cases. Failure fragmentation was encountered in 13.5% of cases. These residual stones were treated by URS using laser or ultrasound fragmentation.

Our experience in treating the renal and ureteric stones indicates that the MODULITH SL 20 represents future standard with respect to efficacy operation and painfree treatment of urinary stones.
Internationales Symposium für Urologie
14.-15.10.1994, St. Pölten, Österreich

PRIMÄRE IN-SITU ESWL DES DISTALEN HARNLEITERSTEINS THERAPIE DER 1. WAHL?

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Ausgangsdaten
Zwischen August 91 und Juli 94 fielen an unserer Abteilung 361 interventionsbedürftige distale Ureterkonkremente an. Bei 215 war der grösste Durchmesser kleiner als 7 mm, bei 146 grösser oder gleich. Nur 10x wurde eine primäre ureteroskopische Extraktion durchgeführt, die restlichen 351 Steine machten 492 extrakorporale Stosswellentherapien erforderlich.

Therapieplanung und Behandlungsstrategien
Wir verfolgen ein maximal forciertes, minimal invasives Konzept: - bis zu 3male in situ-ESWL bei allen spontan nicht abgangsfähigen distalen Harnleitersteinen in einem Intervall von nur 1-2 Tagen. Eine endoskopische Intervention erfolgt nur bei mangelndem Erfolg.

Ergebnisse
Erfolg ESWL in situ 91,5 %
Erfolg ESWL + aux. Massn. (UK, DJ) 4,6 %
URS secundär nötig 3,9 %

Bei einem Auswertungsgrad von 94,2 % konnte Steinfreiheit im Ureter im Mittel nach 5,6 Tagen erreicht werden. Steingrössen- und Lokalisation standen nicht im wesentlichen Zusammenhang mit der Dauer bis zur Steinfreiheit oder der Rate endoskopischer Interventionen.

Zusammenfassung
COLICO NEFRITICO: CONGROL FARMACOLOGICO VERSUS LITOTRICIA URETERAL „IN SITU“ DE URGENCIA

C. Gonzáles Enguita, F.J. Calahorra Fernández, J.L. Miñon Cifuentes, E. García de la Peña, R. Vela Navarrete
Fundación Jiménez Díaz, Madrid, Spain

Las limitaciones técnicas que impedían la visualización, focalización y fragmentación de los cálculos ureterales se han superado con las nuevas generaciones de litotritores, como es el caso de nuestra experiencia con el MODULITH SL20. Cada día, más enfermos con cálculos ureterales impactados en fase de cólicos nefrítico han sido incluidos en nuestra serie, a petición de sus urologos o del propio enfermo. El axioma de que un calculo de dimensiones inferiores a 5 x 5 mm debe ser tratado con medicamentos y esperar expulsión espontanea es una circunstancia que el paciente solo asume cuando asintomático; cuando en situación de cólico lo que reclama es una solución inmediata por la vía farmacológica o mediante litotricia ‘in situ’.

Una observación común en nuestra serie de cálculos ureterales es que a pesar de que un 23 % requirieron dos sesiones y un 12 % tres sesiones para resolver el problema del calcu ureteral, el cólico se alivió inmediatamente aunque el objetivo de la fragmentación y eliminación no se hubiera conseguido. La visión quirúrgica ocasional de ureteres tratados muestra notable edema, engrosamiento de la luz, reducción de la obstrucción y verosimilmente efecto bloqueante de receptores sensitivos y mecánicos. Aunque no está claro el motivo de la respuesta analgésica a le L.E. in situ, en esta circunstancia, es una observación clínica incontestable que los pacientes expulsan, a veces sin fragmentación, con más facilidad y sin dolor.

En definitiva, desde una experiencia de 768 cálculos ureterales tratados (40 % lumbares, 5 % sacroiliacos y 55 % pelvicos), todos mayores de 5 mm, con un resultado global próximo al 97,5 %, se constata que casi un cuarto de los pacientes alcanzaron la unidad sufriendo cólico renal siendo el tratamiento, aplicado en condiciones ambulatorias, con sedación, resolutivo del dolor en todos los casos aunque la litofragmentación primaria no fue resolutiva en el 35 % de los pacientes.
IN SITU ESWL FOR URETERIC STONES; THE ADVERSE EFFECTS OF JJ STENTING

A.C. Thompson, A.B. Shamsuddin, S.F. Mishriki, P. Crocker, J.W.A. Ramsay
Charing Cross Hospital, London, England

Introduction
Dual imaging, precision focusing and careful positioning of the patient have allowed the treatment of most ureteric calculi in situ. It is generally observed, however, that the treatment of stones in stented tracts is protracted when compared to those in non-stented tracts. A clinical and experimental study was undertaken to examine the dissipation of energy in stented urinary tracts.

Patients and methods
The clinical arm of the study involved 122 consecutive patients presenting with symptomatic ureteric stones. All patients were treated on the STORZ MODULITH SL20 lithotripter; 36 patients had stented ureters while the remaining 84 were treated with no prior instrumentation. The mean treatment rate was 2.26 sessions in patients with stented ureters and 1.19 sessions in those without stents. The experimental arm of the study was composed of two parts. Firstly, the acoustic energy output was measured at the focal point of the shock wave using a needle hydrophone in the presence and absence of ureteric stents. Secondly, stone ‘phantom’ model balls (N=30) were suspended in a 1.5 mm mesh at the focal point and treated in the presence and absence of ureteric stents. The dry weights of the stone retained in the mesh were compared.

Results
Both arms of the study revealed a significant reduction in the efficiency and strength of the shock wave in the presence of a ureteric stent.

Conclusion
Our observations question the routine manipulation and stenting of patients with ureteric stones, when lithotripsy is readily available, and confirm that stenting reduces efficacy of the disintegration and clearance of ureteric stones.
XXIII. gemeinsame Tagung der österreichischen Gesellschaft für Urologie und der bayrischen Urologenvereinigung
01.-03.05.1997, Baden bei Wien, Austria

ESWL EINES HARNLEITERSTEINES IN DER 3. SCHWANGERSCHAFTSWOCHE

A. Wolf, P. May
Department of Urology, Klinikum Bamberg, Bamberg, Germany


Nach der überraschenden Feststellung einer Schwangerschaft wurde die Patientin in der 12. SSW genetisch beraten und zu der Fortführung der Schwangerschaft ermuntert. Die verabreichten Medikamente stehen nicht im Verdacht, bei kurzfristiger Anwendung in der Frühschwangerschaft teratogen oder embryotoxisch zu wirken. Die gesamte Strahlenbelastung des Embryos wurde auf max. 8 mSv berechnet. Ab 100 mSv ist ein Beratungsgespräch mit der Patientin indiziert. Zudem sind die ersten 20 Tage als relativ unempfindlich gegen äussere Einflüsse anzusehen. Der Focus-Embryo-Abstand von mind. 15 cm liess eine Schädigung des entstehenden Kindes als sehr unwahrscheinlich erscheinen. Ausserdem besteht vor der Zeit der Organdifferenzierung das „Alles-oder-Nichts-Gesetz“.

EFFICIENCY OF EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY IN PATIENTS WITH URAT’S STONES OF THE URETER

M. Alchinbaev, I. Baizhumanov, E. Sarsebekov, A. Malikh
Scientific Center of Urology, Almaty, Kazakhstan

Introduction
ESWL has become a wide employment for treatment of patients with urolithiasis last time. But the group of patients with urat’s (X-ray negative) stones of the ureter (RNSU) had to expose to operative treatment. Extensive studies were performed to investigate the ability of ESWL for treatment of the last group of patients.

Material and method
In the last 2 years 39 patients with RNSU have been treated by that way in our department. The dimensions of stones determined by computer tomography were in interval from 0.6 to 3.5 sm, its maximal density was before 730 H (from 350 to 730 H). For ESWL were used the lithotripters Lithostar 2 Plus and MODULITH SL 20. Preliminary the patients were made percutaneous nephrostomy for antegrade pyeloureteroscopy.

Results
ESWL was conducted with X-ray control by means of the stone’s location by antegrade pyeloureteroscopy with R-contrast substance. Total fragmentation and moving away the fragments were reached for 66% of the patients after 1 medical treatment, for 23% patients 2 procedures were needed anf last for 11% of the patients (with large dimensions of stones) 3 procedures were necessary. Nobody had any complication, but in one case ureterolithoextraction was conducted additionally. Nephrostomae were removed after control the passagement of ureter.

Conclusion
That method is effective for treatment of the patients with RNSU and its role raises particularly in cases of patients with serious intercurrent diseases, when surgery treatment has high anesthesiological risks.
GENERAL RESULTS AND FACTORS THAT INFLUENCE FAILURE IN THE ESWL TREATMENT OF THE URETERAL CALCULI

A. Valentin, Ch. Ionut, B. Bogdan, N. Niculae
Prof. Dr. Th. Burghele-Hospital, Clinic of Urology, Bucharest, Romania

Objectives
1. Evaluation of general results obtained through ESWL treatment of a large number of patients with ureteral lithiasis; 2. Identification of criteria that influence failure of the procedure.

Materials and methods
We treated 435 patients with ureteral lithiasis over a period of 3 years. The apparatus used was the STORZ MODULITH SL20. We determined general stone free rate, the complication rate and the retreatment rate. In order to identify the factor that influence failure of the treatment, we made use of the following analysis criteria: stone position in the four anatomic regions of the ureter (lombar, iliac, pelvic, intramural); aspect of the stone on the plain radiography; size of the stone; the degree of ureterohidronephrosis produced by the stone.

Results
400 patients were declared stone free (general stone free rate 91.9 %). The complication rate was 1.6 % and repetition of the procedure was necessary in 55 patients (retreatment rate 12.6 %). We did not register statistically significant (p value > 0.05) different success rates for the four anatomic regions of the ureter (lombar ureter SF rate 91 %; iliac ureter SF rate 94 %; pelvic ureter SF rate 89 %; intramural ureter SF rate 100 %). We did not register statistically significant (p > 0.05) different SF rates correlated with the aspect of the stone on the plain radiography (nonopaque calculi SF rate 95 %; less opaque than rib calculi SF rate 94 %; more opaque than rib calculi SF rate 91.2 %). The factors that influenced the failure of treatment in a statistically significant way (p value < 0.05) were: the size of the stone > 10 mm (SF rate 73 %) and ureterohidronephrosis of the third degree (SF rate 75 %).

Conclusions
ESWL treatment for ureteral calculi is associated with high SF rate, low retreatment rate and low complication rate, can therefore be considered the best choice of treatment. Regarding calculi larger than 10 mm in size and calculi producing ureterohidronephrosis of third degree, endoscopic manipulation may be considered the first choice of treatment.
RENAL HEMATOMAS FOLLOWING ESWL

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*Department of Urology, Ikeda Municipal Hospital, Japan
**Department of Urology, School of Medicine, Osaka University, Japan

Introduction
All of the ureteral stones are at first treated by ESWL in our department. Generally, it is considered to be more difficult to desintegrate mid and lower ureteral stones by an ultrasound focusing lithotripter than a X-ray focusing lithotripter, because pelvic bone and bowel obstruct the ultrasonographic view. However, we have been getting used to bring focus into ureteral stones by ultrasound and got satisfactory results. In this paper, we report our results of ESWL and mention about strategy to treat ureteral stones by an ultrasound focusing lithotripter.

Method and results
STORZ MODULITH SL20 lithotripter was used to treat 598 cases with ureteral stones for these four years. Sixteen patients received auxilliary procedures; placing JJ-catheter or percutaneous nephrostomy catheter. 95.7% of the patients with the upper ureteral stones, 97.1% with the mid ureteral stones and 98.1% with the lower ureteral stones were treated successfully.

Conclusion
We have got satisfactory results to treat the ureteral stones using an ultrasound focusing lithotripter, especially localizing in the mid or lower ureter. Our strategy to treat the mid and lower ureteral stones is as following: 1.) The stones unable to be brought into the focus without hydroureter should be followed up, because they do not affect the kidneys. 2.) The stones unable to be brought into the focus because of intestinal gas should be treated on another day. 3.) A good day for ESWL comes to us.
Bladder
Internationales Symposium für Urologie
14.-15.10.1994, St. Pölten, Austria

**ESWL VON BLASENSTEINEN - SPIELEREI ODER ALTERNATIVE?**

R. Hausmann
Allg. Oeff. Krankenhaus der Landeshauptstadt St. Pölten, St. Pölten, Austria

**Gedanke**
Lässt sich ohne Effektivitätsverlust durch eine ESWL von Blasensteinen das operative Risiko (v.a. Anästhesierate) vermindern.
Indikationsmöglichkeiten:
- vor geplanter TUR/P (- Verkürzung der OP-Dauer)
- ohne TUR/P bei:
  - internem OP-Risiko
  - Dauerharnableitungen
  - neurourol. Grundkrankheit
  - Fehlen einer subves. Obstruktion
  - TUR/P abgelehnt

**Material und Methode**
Patientenzahl: 27 (10x mit, 17x ohne TUR/P)
Steinzahl: 51
mittl., max. Steindurchmesser: 29,7 mm
mittl. Patientenalter: 71 a
Therapiezahl: 30 (1.1/Patient)
mittl. Zeitbedarf/Patient: 48 min.
Therapie in Bauchlage bei gefüllter Blase, in 81% mit 3-Wege-Spülkatheter, in 63% analgesiefrei.

**Ergebnisse**
Einer Desintegrationsrate von 100% steht eine Komplikationsrate von 0% gegenüber. Dabei konnte die Steinfreiheit erreicht werden durch:
- spontaner Fragmentabgang 52%
- endoskop. Ausspülung (v.a. beiglzt. TUR/P) 41%
- sec. Punchlithotripsy von Resten 7%

**Diskussion**
Sundry
MODULITH SL 20: NOT ONLY ANOTHER NEW LITHOTRIPTER

Medizinische Hochschule, Hannover, Germany

At the department of urology at Hannover Medical School the MODULITH SL20 (STORZ MEDICAL AG), which can be seen as a new third generation lithotripter was installed in February 1990. The shock-wave is generated by an electromagnetic source and focused in a parabolic reflector. Without the need of electrodes the generator is cost saving. The shock wave energy is widely variable for either anesthesia free treatment or for treatment under a variety of anesthetic conditions in cases of very resistive concrements. Two focusing systems, an in-line ultrasound system and X-ray with C-arm configuration are integrated in the lithotripter. The MODULITH SL 20 is developed for Extracorporeal Shock-Wave Lithotripsy (ESWL) of urinary calculi, gallbladder and biliary duct stones. Furthermore, ESWL of salivary gland stones as a new nonoperative concept in the treatment of sialolithiasis seems to be possible. In addition the multifunctional table can be used for the whole urological routine diagnostic procedures as well as for endourological treatments such as ureterorenoscopy, ureteral laser lithotripsy or percutaneous work-ups.

Generally, the ESWL is totally anesthesia free, only an intravenous pain killer was used in about 80% of our patients. This offers the possibility of outpatient ESWL in all the above mentioned cases. The multifunctionality leads to even more cost reduction. So far 256 patients with 489 urinary concrements have been treated employing the MODULITH SL 20 (average No. of shock-waves 3100, average max. generator voltage 17 kV). These first treatment data show a full disintegration rate of about 70%. In about 90% (n=31) of our patients with biliary concrements no further ESWL was necessary.
THE MODULITH SL 20 (STORZ MEDICAL AG) can be regarded as a third generation lithotripter and has undergone clinical testing since August 1989. Advantages of this new lithotripter are a wide ranging electromagnetic shock wave energy source (200-1200 bar), the shock waves are focused in a parabolic reflector (aperture 40 cm). Two focusing systems, an in-line ultrasound system and an X-ray with C-arm configuration are integrated in the MODULITH SL 20. ESWL of urinary and biliary calculi is possible, ESWL of salivary gland stones seem to be feasible. The machine allows all urological routine diagnostic procedures including endourological treatments and percutaneous work-ups. So far 621 patients with urolithiasis (1034 concrements) have been treated with the MODULITH SL 20 receiving an average number of shock waves of 2800 (average max. generator voltage 17.6 kV). 80 to 90 % of these patients received only intravenous pain killer during treatment. Stone localisation was comparable between the three stone centers. The Hannover group treated 22% (n=106) concrements with a greater stone mass than 20 mm (Mannheim 5% (n=17), Wuppertal 9%, (n=18)). The rates of sufficient disintegration (concrements < 5mm) by discharge ranged between 61% (HMS) and 91% (Wuppertal). Re-ESWL was necessary in 15% (Wuppertal) and 21.5% (Mannheim). Stone free were 68% of the Mannheim patients 4 months following treatment (no data of the other stone centers are available to date). The calculated efficiency quotient (PREMINGER, CLAYMANN) for the MODULITH SL 20 is 0.50. During and following ESWL treatment no severe complications except some cases of arrhythmia and two patients presenting perirenal hematomas were recorded. The MODULITH SL 20 seems to be a safe and effective lithotripter for ESWL of urinary calculi. The pain-reduced and therefore anesthesia-free ESWL allows the treatment on an outpatient basis.

Mit Hilfe des dualen und korrelierten Ortungssystems (Röntgen und Ultraschall) des STORZ Lithotripters MODULITH SL 20 können diese geräteunabhängigen Abweichungen unter klinischen Bedingungen ermittelt werden. Es wird über erste Messungen an einem kleinen Patientenkollektiv berichtet und ihre Bedeutung für die Lithotripsie diskutiert.
ESWL is a procedure that usually requires sedation, analgesia or even anesthesia. The amount of analgesia depends on the individual tolerance of each patient, the type of lithotripter, the amount of energy delivered and the position of the treated stone.

The MODULITH SL 20 of STORZ MEDICAL AG used in our department (since August 1990) has a wide aperture electromagnetic generator with isocentric rotation of the generator. This isocentric rotation, designed for an optimal coupling with the patient, makes it possible that once the stone has been correctly localized, the generator can rotate isocentrically without missing the stone from the focal area, modifying only the entry area of the shock waves.

It has been observed that with minimal rotations of the generator modifying the entry area of the shock waves, it is possible to choose the least painful position of the generator.

Since we incorporated this treatment method we have considerably diminished the need for analgesia in our patients.

84% out of 300 patients treated with the standard method required analgesia. In contrast, only 72.3% out of 148 patients treated with isocentric rotation of the generator required analgesia or sedation; 27.7% of these patients were treated with no analgesia at all.

Isocentric rotation of the MODULITH generator makes it possible to find the least painful entry of the shock waves thus allowing for analgesia-free lithotripsy in a considerable number of patients.
ANTIBIOTIC PROPHYLAXIS FOR ESWL

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Extracorporeal shock wave lithotripsy (ESWL) is now considered the preferred line of treatment for all types of urinary calculi. It is common practice at many centers to give prophylactic antibiotics to abolish the possible septic complications from bacteria that might be released from the disintegrated stone. In an attempt to assess the risk of bacteremia during ESWL, a total of 30 patients with 31 stones (22 renal, 8 ureteric, and 1 bladder stone) were treated using a third generation lithotripter, MODULITH SL 20. None of the patients received any antibiotics before or during the treatment. Blood cultures were taken immediately before and after ESWL as well as during the procedure (4 to 5 per patient). In 29 of these patients, no bacteremia was detected. Bacteremia appeared after removing the only ureteric stent in the one patient with staghorn calculus in this group. It was therefore concluded that the risk of bacteremia during ESWL is insignificant and subsequently renders the prophylactic use of antibiotics in ESWL unnecessary.
STONE TREATMENT IN RENAL TRANSPLANT BY SWL

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Introduction
Urolithiasis in transplanted kidney is a rare event. In the early reports surgical treatment of stones in renal transplants was discouraged. Afterwards pyelolithotomy and percutaneous nephrolithotomy have been described. SWL provides an alternative non-invasive method to treat renal calculi in the transplanted kidney.

Methods
Between 1991 and 1996 nine cases with renal or ureteral stones in a transplanted kidney were treated with SWL. The SWL was performed on a Dornier MPL 9000 or a MODULITH SLX STORZ lithotriptor under analgosedation in a prone position with ultrasonic targeting. Out of 9 stones 6 were radiopaque and 3 were radiolucent. The stones were calyceal in 6 cases, pyelic in one case and in other 2 cases in the ureter.
In patients with ureteral stones a nephrostomy was placed before treatment: moreover in one case an ureteral stent was placed with mixed antero-retrograde access. The stone diameter ranged 8 to 23 mm.

Results
With MPL 9000 Dornier lithotriptor the shock wave number ranged 1000 to 2800 with kilovoltage between 16 and 18. With MODULITH SLX STORZ lithotriptor the shock wave number ranged 1300 to 2000 with kilovoltage between 16 to 18. The patients tolerated the procedure well and no complications were observed.
At discharge 5 patients were radiographically free of stone fragments, while 2 were discharged with residual stone fragments. One patient required ureterolithotomy for the failure of SWL.
Before the treatment serum creatinine was lower than 1.8mg/dl in 6 cases, more than 1.8 mg/dl in 3. At discharge we observed no change in serum creatinine levels.

Conclusion
SWL appears to be a successful method to treat renal calculi in transplanted kidneys, although intense monitoring after treatment is necessary since transplant patients may be more susceptible to complications of shock waves.
THE USE OF A TOPICAL NON STEROIDAL ANTI-INFLAMMATORY AGENT TO REDUCE THE NECESSITY FOR OPIATE ANALGESIA DURING LITHOTRIPSY: INITIAL REPORT

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Guy’s Hospital, London, Great Britain

Aims
To test the hypothesis that topical Diclofenac (Voltarol Emulgel) is effective in reducing the necessity for parenteral analgesia during Extracorporeal Shock Wave Lithotripsy (ESWL). There have been reports in the literature about the use of topical anaesthetics (EMLA) and local infiltration anaesthesia to reduce the need for parenteral opiate analgesia during ESWL, but so far, there has been no study testing the hypothesis consideration.

Materials and Methods
We prospectively evaluated 50 consecutive patients undergoing elective ESWL using the STORZ MODULITH SL20 (STORZ MEDICAL AG, Kreuzlingen, Switzerland) electromagnetic third generation lithotripter. 25 patients received an application of the gel approximately half an hour prior to the procedure, the other 25 received a placebo. Analgesia was not routinely administered to adults; however, Fentanyl (Janssen) 100-300 mcg was administered as required; upto 4000 shocks at up to the maximum power level of 1200 bar were administered. Pain scales as well as the necessity for intravenous Fentanyl were documented. Asthmatics, patients with acid peptic disease and those with known hypersensitivity to NSAIDs were excluded from the study.

Results
A single application of NSAID gel reduced the requirement for intravenous analgesia in a significant proportion of patients.

Conclusion
Topical non-steroidal analgesic agents are a safe easy and effective way to reduce the morbidity associated with pain during ESWL. The study is continuing and up to date data will be presented.
RENAL HEMATOMAS FOLLOWING ESWL

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*Department of Urology, Ikeda Municipal Hospital, Japan
**Department of Urology, School of Medicine, Osaka University, Japan

Introduction
Extracorporeal shock wave lithotripsy (ESWL) is a non invasive treatment and has been accepted as the first choice for stones in the upper urinary tract. A renal hematoma is uncommon but a significant complication. We review the clinical course of patients with renal hematomas after ESWL, evaluate the relation between the findings of computed tomography (CT) and the bleeding volume and identify potential risk factors.

Method
797 patients with renal and/or upper ureteral stone(s) were treated with the STORZ MODULITH SL20 for four years. Patients who developed hematomas were evaluated with blood count, ultrasoundsonography (US) and CT. We evaluated many factors regarding patient history and characteristics, parameters of ESWL and findings of US and CT, in order to find those factors which had the greater prevalence in the development of hematoma.

Results
Eleven renal hematomas developed (0.14%). We recognized four subcapsular hematomas. In seven cases, renal capsules were ruptured and hematomas spread to perirenal and/or pararenal space. In cases of perirenal and/or pararenal hematomas, the volume of bleeding increased and the term of the continuous bleeding was prolonged. The presence of preoperative and interoperative hypertension, obesity and the number of shock waves were risk factors for the occurrence of renal hematoma.

Conclusion
In case of the rupture of the renal capsule, the increase of bleeding volume can be prospected, so we must instruct longer term of rest to the patient. We must perform ESWL more carefully in the patient of hypertension and obesity.
System Comparison
MODULITH SL 20 VS. DORNIER HM3.
RANDOM STUDIE

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Department of Urology Klinikum Barmen, Wuppertal, Germany

Der STORZ MODULITH SL 20 ist ein neuer Lithotripter der 3. Generation mit elektromagnetischer Stosswellenerzeugung, akustisch angepasster Wasserkissenankopplung, Röntgen- und Ultraschallortung.


Die Steinverteilung war für den STORZ MODULITH / Dornier HM3 53% / 73% Nierensteinen und 17% / 27% Harnleitersteine. Die Steingrösse lag beim STORZ MODULITH / Dornier HM3 bei 6-60 mm (im Mittel 11 mm) / 5-52 mm (im Mittel 9,5 mm). Die mittlere Stosswellenzahl war beim STORZ MODULITH / Dornier HM3 2310 / 2167 bei einer mittleren Generatorspannung von 17,6 / 18,8 KV. Beim STORZ MODULITH / Dornier HM3 erhielten 31% / 41% der Patienten präoperative Eingriffe, 8% / 9% mussten post-ESWL auxiliär instrumentiert werden.

Die Steindesintegration war erfolgreich beim STORZ MODULITH / Dornier HM3 in 94% / 93% bei 1,3 / 1,25 Behandlungen pro Patient (einschliesslich 14 / 26 Patienten mit geplanter Mehrfachbehandlung).

Eine Analgesie mit Alfentanil (0,5-6,0 mg) war beim STORZ MODULITH / Dornier HM3 notwendig in 55% / 97%; 12% / 3% der Patienten konnten ohne jegliche Anästhesie behandelt werden.

During the first ten years of ESWL, the Dornier HM3 represented the "golden standard" with respect to disintegrative efficacy. Third generation lithotripters (i.e. MODULITH SL 20, Lithostar Plus) comparable results, however, providing the advantages of combined sonographical and fluoroscopic stone localization.

In a retrospective study, comparing MODULITH SL 20 and Lithostar Plus, we could demonstrate that urinary and biliary calculi were treated effectively by both machines (stone-free rate after 5 months SL 20: 83%/Lithostar +: 78%) with a low re-treatment rate (SL 20: 19.4 % / Litho +: 20.3 %).

Both lithotripters showed similar results including treatment time (SL 20: 42 min./Litho +: 46 min.) and auxiliary measures prior and after ESWL (SL 20: 32%, 17% / Litho +: 36%, 15%). Therefore, we initiated a prospective randomized phase-III-trial to evaluate the efficacy of both machines. Criteria of stratification are stone size, localisation and composition. Additionally further parameters of success are taken into consideration like time for localization, treatment time and the number of technical breakdowns. Since January 1991, 30 patients have entered the protocol. First data will be presented.
22nd Congress of the International Society of Urology
03.-07.11.1991, Sevilla, Spain

3rd GENERATION LITHOTRIPSY: STORZ MODULITH SL 20 RANDOMIZED STUDY AGAINST DORNIER HM 3

A. Lampel, D. Schultz-Lampel, P.C. Rixen, J.W. Thüroff
Department of Urology, Klinikum Barmen, Wuppertal, Germany

The MODULITH SL 20 is a 3rd generation tubless lithotriptor with an electromagnetic shock wave source and both X-ray and ultrasound imaging systems. Between February 1990 and January 1991 we randomized 510 consecutive patients with 778 stones for treatment with the STORZ MODULITH SL20 (n = 280 patients) and modified (40 nF generator) Dornier HM3 (n= 260 patients). Distribution of stone location was for STORZ MODULITH / Dornier HM3, 83 % / 63 % renal stones and 15 % / 37 % ureteral stones. Stone size ranged for STORZ MODULITH / Dornier HM3 from 5-40 mm (mean 11 mm) / 5-40 mm (mean 9.5 mm). The mean number of shock waves was for STORZ MODULITH / Dornier HM3 2310 / 2167, voltage was 17.6 kV / 18.8 kV. For STORZ MODULITH / Dornier HM3 31 % / 51 % of patients had preoperative catheterization and 8 % / 9 % required post-treatment auxiliary instrumentation.

Stone disintegration was successful with STORZ MODULITH / Dornier HM3 in 91 % / 93 % at 1.3 / 1.25 treatments per patient (including 12 / 18 patients with planned slaged treatment). I.v. analgetics (alfentany, 0.5-0.6 mg) were used with STORZ MODULITH / Dornier HM in 88 % / 97 %; 12 % / 3 % were treated without any medication.

As complications we encountered with STORZ MODULITH / Dornier HM3 6 / 4 peri-renal hematomas, 2 / 0 cases with arrhythmia and 10 / 8 cases with fever or urosepsis. In conclusion, the STORZ MODULITH SL 20 is a multifunctional table with both X-ray and ultrasound-imaging systems, which is an equieffective lithotripter compared with the Dornier HM3.
COMPARISON OF DIFFERENT LITHOTRIPTERS USING A STANDARDIZED IN-VITRO STONE MODEL

Department of Urology, Klinikum Mannheim, Mannheim, Germany

Determination of disintegrative efficacy by in-vitro stone fragmentation serves the characterization and comparison of shock wave sources. We propose a reliable and standardized model for in-vitro disintegration in order to compare the different SW source systems.

A stone cube (dental cement with microspheres, 1 g) was positioned in a conical network (mesh 2 mm). SW were applied until the fragments passed through the net. SW number and generator voltage were correlated for the whole energy range.

<table>
<thead>
<tr>
<th>Lithotripter</th>
<th>SW-range Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODULITH SL 20</td>
<td>maximal desintegration</td>
</tr>
<tr>
<td></td>
<td>large range</td>
</tr>
<tr>
<td>Lithostar Plus</td>
<td>high max. desintegration</td>
</tr>
<tr>
<td>Overhead</td>
<td>low range</td>
</tr>
<tr>
<td>Lithostar Under-</td>
<td>medium desintegration</td>
</tr>
<tr>
<td>couch</td>
<td>large range</td>
</tr>
<tr>
<td>MPL 9000</td>
<td>high desintegration</td>
</tr>
<tr>
<td></td>
<td>low range</td>
</tr>
<tr>
<td>HM3</td>
<td>high desintegration</td>
</tr>
<tr>
<td></td>
<td>low range</td>
</tr>
<tr>
<td>Piezolith 2300</td>
<td>lowest desintegration</td>
</tr>
<tr>
<td></td>
<td>large range</td>
</tr>
</tbody>
</table>

SW number desintegrating the stone at low and high energy level.

The proposed in-vitro stone model is standardized and has proven reproducible and only slightly influenced by artefacts. This model is appropriate for characterization of the disintegrative capacity of various types of SW sources and offers a simple way for a fast and reliable evaluation of the disintegrative capacity of a lithotripter during clinical routine.
MPLX 9000 VERSUS MODULITH SL 20 - UNTERSCHEIDLICHE EFFIZIENZ BEI URETERKONKREMENTEN

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Allg. Oeff. Krankenhaus der Landeshauptstadt St. Pölten, St. Pölten, Austria

Verglichen werden der MPLX 9000 mit dem MODULITH SL 20 in der Effizienz der Therapie von Ureterkonkrementen. Dabei sollen zur besseren Transparenz alle interventionsbedürftigen Harnleitersteine betrachtet werden.


Von diesen wurden am MPLX 147 in 203 Behandlungen angegangen, am MODULITH SL 20 waren bei 163 Patienten 238 Behandlungen nötig.

Dabei war der Erfolg der ESWL Monotherapie mit 83,1% (MODULITH SL 20) gegenüber 64,9% (MPLX 9000) beim MODULITH SL 20 deutlich besser. Auxiliäre Massnahmen und endoskopische Desintegratentfernung waren in etwa vergleichbar, jedoch lag die Rate der sekundären Ureteroskopie wegen Erfolglosigkeit der ESWL sowie die Rate der primären Ureteroskopie wegen Unmöglichkeit der ESWL im Zeitraum, in dem der MPLX in Verwendung stand, deutlich höher.

Im Zeitraum der MPLX waren Ortungsprobleme 12 Mal, Adipositas 7 Mal und organische Kontraindikationen 2 Mal der Grund für eine primäre Ureteroskopie.


<table>
<thead>
<tr>
<th></th>
<th>MPLX 9000</th>
<th>MODULITH SL 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erfolg ESWL in situ</td>
<td>64,9%</td>
<td>83,1%</td>
</tr>
<tr>
<td>Erfolg ESWL u.aux.Massn.</td>
<td>8,3%</td>
<td>10,3%</td>
</tr>
<tr>
<td>ESWL und URS der Desintegrate</td>
<td>8,3%</td>
<td>3,0%</td>
</tr>
<tr>
<td>ESWL ohne Erfolg u.sec. URS</td>
<td>9,5%</td>
<td>2,4%</td>
</tr>
<tr>
<td>Primäre URS</td>
<td>12,5%</td>
<td>1,2%</td>
</tr>
</tbody>
</table>
Insgesamt war inkl. auxiliärer Massnahmen am MPLX in 73,2% ein Erfolg möglich, beim MODULITH SL 20 beträgt der Prozentsatz 93,6.

Die mittlere Zeit bis zur Steinfreiheit im Ureter betrug beim MPLX 9,76 Tage, beim MODULITH SL 20 7,04 Tage.

Wie lassen sich diese Unterschiede erklären?

Wir machten die Beobachtung, dass die Erfolgschancen stark von der Steinhöhe und damit den gerätespezifischen Ortungsmöglichkeiten abhingen. Dazu wurde der Harnleiter in 5 Zonen eingeteilt.

In Zone 1, dem infundibulären Ureter, ist die Ultraschallortung beim MPLX vorteilhafte, beim MODULITH ist eine kombinierte Ortung möglich. Durch die verlässliche Ultraschallortung ist hier der MPLX zumindestens gleichwertig. Im proximalen Harnleiterabschnitt bis zum Sacroiliacalgelenk und vor allem in dem Teil des Ureters, der in Knochendeckung liegt, ist für eine in situ Therapie eine Röntgenortung nötig. Immer dann bringt der MODULITH SL 20 deutliche Vorteile, vor allem wenn der Stein in Knochendeckung liegt. Im distalen und unmittelbar prävesikalen Ureterabschnitt war am MPLX nur eine Ultraschallortung möglich; beim MODULITH SL 20 besteht eine kombinierte Ortungsmöglichkeit mit Vorteilen der Röntgenortung je höher der Stein liegt.

Beim MODULITH SL 20 führt allerdings der größere Fokusabstand zu einer größeren Eindringtiefe der Stosswellen, was vor allem bei Adipositas eine ESWL besser ermöglicht.

**ERFOLG ESWL UND AUXILIÄRE MASSNAHMEN**

<table>
<thead>
<tr>
<th></th>
<th>MPLX 9000 (%)</th>
<th>MODULITH SL 20 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infundibulärer Ureter</td>
<td>94,1% n=17</td>
<td>94,7% n=19</td>
</tr>
<tr>
<td>Proximaler Ureter</td>
<td>87,5% n=48</td>
<td>97,2% n=36</td>
</tr>
<tr>
<td>Mittlerer Ureter</td>
<td>25,0% n=13</td>
<td>95,5% n=22</td>
</tr>
<tr>
<td>Distaler Ureter</td>
<td>60,0% n=35</td>
<td>86,8% n=53</td>
</tr>
<tr>
<td>Prävesikaler Ureter</td>
<td>78,2% n=55</td>
<td>97,1% n=35</td>
</tr>
</tbody>
</table>

Insgesamt glauben wir, dass die höhere Effektivität des MODULITH SL 20 in der Therapie von Harnleitersteinen einerseits durch die bessere Röntgenortung, andererseits durch den größeren Fokusabstand bedingt ist.
B2-P4
CLINICAL EXPERIENCE AND RESULTS OF ESWL TREATMENT FOR 3003 URINARY CALCULI WITH THE STORZ MODULITH SL20 LITHOTRIPSY AT THE SINGAPORE GENERAL HOSPITAL

Department of Urology, Singapore General Hospital, Singapore

Introduction: The introduction of ESWL in the 1980s heralded a paradigm shift to non-invasive management of urinary stone disease. The third generation equipment was introduced with the advantages of high efficacy, treatment without anaesthesia and a combined ultrasonic and fluoroscopic localization system. At our Urology centre, we have been equipped with the Storz Modulith SL20 lithotripter. We report our experience in treating over 2700 patients with over 3000 urinary calculi over a five year period. To our knowledge, this data represents the world’s largest clinical experience reported to date.

Material & Methods: We studied prospectively the outcome of 2700 patients treated for 3003 urinary calculi over a 5 year period. All patients underwent ESWL using the Storz Modulith SL20, predominantly on an outpatient basis. The treatment outcome of 1666 renal calculi and 1427 urolithic calculi were analyzed and stratified according to size and site. Follow-up was done at 3 months.

Results: Follow-up status was available for 91.8% of patients. For renal calculi, the overall success rate was 81% and the majority of failures were stones larger than 2 cm and those situated in the lower pole of the renal calyx. The retreatment rate was 29.7%. For ureteric calculi, the overall success rate was 83% with similar clearance rates throughout the ureter. Failures were for stones larger than 2 cm. Retreatment was required in 22.8% of patients. 137 calculi required auxiliary endoscopic procedures and 2 required open surgery for clearance of the remaining stone burden. There was no mortality and the morbidity rate requiring hospital admission was 2.9%. The commonest cause for admission was for pain control in 1.8%.

Conclusions: To our knowledge, this represents the largest experience with this lithotripter to date. It is safe, well tolerated and highly effective and it establishes ESWL as the treatment of choice for the majority of urinary calculi.

B2-P9
OUTCOMES FOR SHOCK WAVE LITHOTRIPSY ON 400 CONSECUTIVE PATIENTS TREATED ON A STORZ MODULITH SLX LITHOTRIPSER

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Albany, New York, USA

Introduction: The Karl Storz Modulith SLX is a 4th generation, multifunctional lithotripsy unit with an electromagnetic shock wave generator. This study represents the results of the first 400 patients treated with this device at our institution.

Methods: The first 400 patients treated with this lithotripter were followed using a post-operative questionnaire sent to their surgeon within three months of the ESWL. Patients were considered stone free if no fragments could be identified on a post-operative abdominal X-ray. Non-significant fragments were considered less than 2 mm in size. An efficiency quotient was calculated in the standard fashion.

Results: Our overall efficiency quotient for the Storz Modulith lithotripter was 0.47. This was a generalized decline in efficiency. We noted a trend not to retreat patients who have an initial shock wave procedure that fails but a high percentage of retroperitoneal laser lithotripsy following the primary shock wave treatment.

Conclusions: The Storz SLX lithotripter is more powerful than the unmodified Dornier HM-3 with varying power output. Our outcomes remain within the published range for this device. We also note a generalized downward trend in our EQ data. The exact etiology for this is not yet clear.

C2-P7
URETERAL SHOCK-WAVE LITHOTRIPSY USING THE STORZ MODULITH SLX: FIRST REPORT

Agnes Yost, R.N., Summa F. Mattis, M.D., and Steven Stremm, M.D.,
Cleveland, Ohio, USA

Introduction: Results of extracorporeal shock-wave lithotripsy (ESWL) using the Modulith SLX electromagnetic unit have not been previously published. This study evaluates single-center results for treatment of ureteral calculi using this machine.

Methods: From February 1999 to April 2001, 50 patients with ureteral calculi underwent 55 treatments using the Modulith SLX electromagnetic unit. Patient demographics, stone and treatment parameters, auxiliary procedures, complications, and radiographic results were all prospectively entered into a database. Stone-free results were determined by abdominal x-ray and renal ultrasound 1 month after ESWL.

Results: Data is summarized in the table below: Male/Female (%) 78/22 Age, mean (years, range) 50 (18-84) Stone burden, median (mm2, range) 36 (8-240) Location: Proximal ureter (%) 87 Mid Ureter (%) 4 Distal Ureter (%) 9 Shock Waves, median, right side 3273, left side 2873, total waves, median, right side 1725-4000, left side 1725-4000 Total auxiliary procedures (%) 6 stones (5%), emergency (3%) 1 Retrograde manipulation (2%) 20 Others (%) 7 Any auxiliary procedures (%) 66, stone free (%) 70, residual (<3 mm) 30, residual (0-0.5) 43 Treatment (%) 9 Complications (%) 7 efficiency Quotient (%) 0.4

Conclusions: Treatment of ureteral stones using the SLX Modulith resulted in a 70% stone-free rate. The majority of treatments (69%) underwent auxiliary measures. Use of the SLX for the treatment of ureteral calculi, particularly proximal ureteral calculi, yields acceptable results.