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Extracorporeal shock wave lithotripsy, and its role in urolithiasis, with emphasis on lower pole, inferior calyx kidney stones, lower ureteric, Vesico-Ureteric Junction stones, and gall stone diseases

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Abstract- Objectives: Urolithiasis (urinary tract calculi) is a common clinical problem demanding treatment, with varying incidence, prevalence, geographical distribution etc. This study includes more than 300 patients of renal and ureteric calculi that were completely removed by extracorporeal shock wave lithotripsy (ESWL). Unless associated NonSupportive Anatomical landmarks determinants or other Anatomical abnormalities within the kidney, such as outflow obstruction, e.g., Pelvi- ureteric junction obstruction, leading to future stones formation by promoting stasis, indicating surgical extraction of stone and simultaneous correction of defect, Open surgical stone extraction procedures are considered of decreasing interest, with the advent of recent successful endourology & laparoscopic procedural techniques.

Materials and Methods: More than 300 patients of variable renal and ureteric calculi, including gall stone disease (choledocholithiasis) etc., were included in the study comprising successful management with ESWL . About 20 slides of X-rays Abd. KUB of about seven patients demonstrating gradual removal of renal and ureteric calculi were included. Adequately powered and frequency (time spaced), shock delivery with discrete coherence upon stone throughout the procedure being key to success. Minutely shattered stone particles pass with urine spontaneously, avoiding obstructive complications and thus, minimizing need of double J stent insertion and/or other complications incidence. Supportive measures such as Metabolic evaluation, Stone analysis, Diet regulation, Various regimes of medical treatment including forced diuresis, proper in regards to dosage duration and supportive compliance for stones up to 8 mm and Residual stone fragments utilized, specially for recurrence management. Specialized procedural emphasis upon the ESWL role in Lowerpole Inferior calyx renal stone, Lower ureteric, Vesico-Ureteric Junction stones, and Gall stone disease:solitary gallstones, Choledocholithiasis, Pancreatic calculi, with or without contrast delineation included.

Results: More than 300 patients of renal and ureteric calculi were completely removed by ESWL, maintaining an average of about two sittings and more than 95% success rate, while single sitting clearance achieved in about ≥50% cases.
Conclusions: For all practical purposes, renal and ureteric calculi can be treated with ESWL with almost cent percent (complete) success, up to a solitary stone size of 45 mm, with/without supportive measures, excluding various limiting conditions

Key words: ESWL,OSS(Open Surgical Stone Extraction),Lower pole renal stones(LPS), Lower ureteric, Vesico-Ureteric Junction(VUJ) stones, Choledocholithiasis, Diameter of infundibulum(IW), Infundibulopelvic length(IL), Lower infundibulopelvic angle(LIP), Spatial distribution of calyces

1.INTRODUCTION

Successfully acceptable management modality of urolithiasis, with extendable scope for other stone diseases. [1,2] **Extra corporeal shock wave lithotripsy (ESWL), being convenient noninvasive, safely performed OPD procedure, comprising fragmentation of stone into minute particles, by shock waves. Fragmented stone particles are passed with the passage of urine, in due course of time, resulting in a stone-free patient.**
A patient undergoes the procedure in the morning discharged in the afternoon, and can go to day-to-day work by the next day with advice for follow-up.

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Besides controversially successful various medical therapy regimes, and **OSS (classical open surgical stone extraction),[3] other methods include:** (1) Percutaneous nephrolithotomy(PCNL) for renal calculi, (2) Retrograde ureterorenoscopic Intrarenal surgery, (3) Ureterorenoscopy (URS) and Lithoclastfor ureteric calculi, (4) Laparoscopic ureterolithotomy,(5) Cystolithopexy/Cystolithoclast for vesical calculi,using Lithotrite, (6) Sandwich technique (ESWL + PNL/Ureterorenoscopic Lithotripsy surgery), etc. [5-7]

HISTORICAL ASPECTS:

Urolithiasis Management has undergone drastic changes since early 1980s, with popularization of endourology, ESWL, and PCNL techniques. High-energy shock waves

have been recognized for many years, Beginning 1969, Dornier (German Ministry of Defense) reported studies of shock wave effects on tissue. However, the production and distribution, Dornier HM3 lithotripter availability, began late in 1983, whereas US Food and Drug Administration approval for ESWL obtained in 1984.
Since then, numerous companies came with different models, using various technical know-how and varying efficacies, lithotripters.

EXTRA SHOCK WAVE LITHOTRIPSY; METHODOLOGY & BIO-PHYSICS:

Shock waves produced by a source, outside a patient body, are propagated inside the body focused on stone. Externally generated relatively weak nonintrusive waves, transmitted through the body, building sufficient strength at the target site to break stone, are achieved by uniqueness of this device. Rapid energy deposition into fluid leads to shock wave production invariably. This is described as surfaces, dividing material ahead, not yet affected by the disturbance at the source from material behind, which has been compressed as a consequence of the energy input (Sturtevant, 1996). With the behavioral characteristic of propagation of nonlinear waves moving faster than the speed of sound, shock waves' speed is in direct proportion to the shock strength.[50]

GENERATOR TYPES

Three primary types of shock waves generators:

(I)Electrohydraulic Shock Wave Lithotripsy (Spark Gap): Spherically expanding shock waves generated by an underwater high-voltage spark discharge causing explosive vaporization at electrode tips, with high-voltage application to two opposing electrodes about 1 mm apart, immersed in water containing hemi-ellipsoid reflector, separated from patients body by an insulated membrane, spherically expanding shock waves coherent to calculus, achieved by placement of focus (F1) electrodes in ellipsoid, with the target stone at other focus (F2). Have clear **Advantage** of effectiveness, **Disadvantages** include substantial pressure fluctuations from shock to shock and relatively short electrode life.

(II)Electromagnetic Generator: Plane waves focused by an acoustic lens, cylindrical shock waves reflected by a parabolic reflector, are transformed into spherical waves. In a water field, a shock tube containing two cylindrical places separated by a thin insulating sheet, electrical current through one or both conductors, resultant strong magnetic field, electromagnetic force, termed magnetic pressure producing under water pressure shock waves, Made target specific coherence, is utilized for stone fragmentation.

Advantages Over The Electrohydraulic Generator:

(1) due to no "variable" in the design, e.g., under water spark discharge, electromagnetic generators are more controllable and repeatable;
(2) energy entrance involving a large body surface area, through patients, rendering EMG less painful.

Disadvantages include a small focal region of high energy resulting in an increased subcapsular hematoma formation rate in modified E.M.Gs

(III)Piezoelectric Generator: Based upon piezoelectric effect phenomenon, utilization of polarized polycrystalline ceramic elements produced plane shock waves with directly converging shock fronts, used for stone fragmentation.

Advantages include accuracy, durability, and less painful anesthetic free treatment due to low energy density at skin entry points. **Disadvantages** being less efficacy due to insufficient power delivery for stone fragmentation.

Others include micro-explosive generators: Using lead azide Pellets & laser beam multistage light gas guns could not gain mainstream acceptance.

With **Intra-Corporeal Appliances:** Produced Shock Waves Are Utilized Within Patients' Body Directly To Stones.

Stone Fragmentation Biomechanics

1. **Electrohydraulic lithotripsy:** Cavitation bubble formation mechanism.
2. **Laser lithotripsy:** Plasma bubble formation, shock wave mechanism, holmium: Yag Laser (yttrium–aluminum–garnet), Erbium: YAG
3. **Ultrasonic lithotripsy:** By ultrasound vibrations
4. **Ballistic lithotripsy:** Projectile movement, Jackhammer effect mechanisms.

Potential Mechanisms For ESWL Stone Breakage: Explained by typical pressure pulse, tensile pressure (positive and negative phase), reversed pressure theories;
(1) Compression fracture, (2) Spallation,
(3) Acoustic cavitations and Bubble formation,
(4) Dynamic fracture fatigue,
Cumulative damage accumulation during course-off treatment leading to eventual stone destruction.

2.MATERIALS AND METHODS

This study comprises more than 300 patients of renal, ureteric calculi, including gall-stone disease, that were completely removed by ESWL(Personally Performed), with an average of about two sittings.

Single sitting stone clearance achieved in several patients.

STONE-LITH(PCK) LITHOTRIPTER

(1) Patient table: Vertical, horizontal (up-side down, toward, and away from machine), hydraulic function,
(2) Ellipsoid,electrodes, connecting tube, insulated membrane,
(3) C-arm unit, integrated U-arm, and
(4) Monitoring unit; Operating unit with Remote control devices [Figures 1 and 2].

Various studies involving several aspects for lithotripter comparisons are available. **Despite claims to the contrary, unmodified HM 3 Dornier lithotripter remains the gold standard for ESWL,** others included for comparative trials

being large variety productions from different manufacturers, besides Siemens Lithostar, EDAP LT.01 and Sonolith 2000, Sonolith 3000 Versions.[48,49]

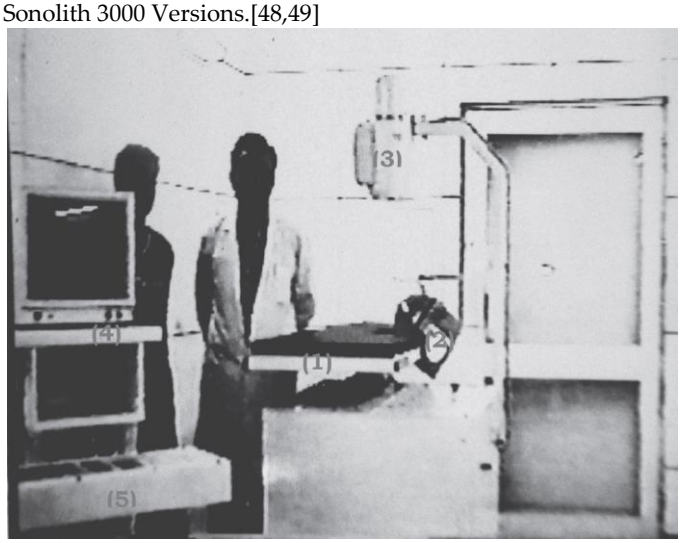

Figure 1: Stone-Lith (PCK) Litho-Triptor

$$\text{Efficient Quotient' (EQ)} = \frac{\text{0\% Stone Free Rate}}{\text{0\% Retreatment Rate + 0\% Auxillary Procedure Rate}}$$

Perfect Lithotriptor: 100% EQ= 100, is 100% stone free,
0% Retreatment Rate &
0% Auxillary (Ancillary) Procedure Rate

Figure 2: lithotriptor efficient quotient (EQ)

TECHNIQUE

1. Preparation: Properly established diagnosis for stone disease excluding distal obstruction, ensured patient compliance after comprehensive awareness of a treatment plan, needed ureteral stenting, urinary asepsis, etc. Avoidance or restriction of aspirin-containing products(as monitored by BT,CT,INR etc), nonsteroidal anti-inflammatory medications, besides exclusion and/ or management of pre-existing illnesses are required. Preprocedural preparations including overnight fasting, bowel preparation, immediate bladder evacuation etc are needed.

2. Patient Position:
(a) Patient stone side toward the machine,
(b)Lies supine, for renal and upper, mid,ureteric calculi, and
(c) Prone position, for lower ureteric/VUJ stones.

3. Stone Localization And Focusing: In vertical and oblique axis of C-arm, achieved by anatomical landmarks (subcostal region, umblicus, ASIS, pubis and other bony points pelvis, vertebrae), maneuvering table movements and may be assisted by patient movement as a whole.

4. Stand By Anesthesia/Analgesia/Under Sedation:
1ml Pentazocine (Fortwin) (+) 2 ml (Phenargan) promethazine, diluted to 5 ml by adding 2 ml distilled water, 3 ml of preparation given slowly intravenously, and remaining 2 ml given intramuscularly, achieves almost complete sedation and analgesia for conducting lithotripsy sitting for about 100 min.
The total dose was titrated depending upon body weight patient's social history (previous painkiller injections, smoking, alcohol etc.) and associated medical problems.

Diazepam was supplemented through intravenous or intramuscular route, sometimes, to facilitate patient compliance for lithotripsy sitting.
Analgesics/antispasmodics/anesthetic agents (alfentanil, midazolam, propofol, fentanyl combinations) were needed rarely, especially in pediatric or apprehensive patients with supportive use of topical agents, Emla cream etc otherwise.

5. Shock Delivery Initiation: This is initiated after patient compliance is ensured,with an advice not to change position, in cautiously pre-prepared lithotripter.

6. Regular monitoring: (a) Stone position and status
(b)Vital signs, especially pulse respiration etc
(c) Regulation shock mode, power, and frequency;
while maintaining patient's compliance throughout are the key components
for the complete stone-free success rate.

7. Postprocedure Advice: Encouraged urine output more than 2500 ml in 24 h, achieved by increased fluid intake or forced diuresis, as indicated.
Urinary antiseptics according to C and S, prophylactic antibiotics, analgesia and other supportive therapy.[8]
Advice to filter all urine and collect stone particles.
FUCs, as advised, for next sitting or otherwise [Figure 3]

3.DISCUSSION

With Gradual Successful Availability Of Recent Noninvasive,Minimally Invasive, And Endoscopic Techniques, Classical Open Surgical Removal Of Calculi (OSS): Pyelolithotomy,Nephrolithotomy, Ureterolithotomy, Cystolithotomy, Urethral Stone Extraction Etc Are Considered Of Decreasing Interest.

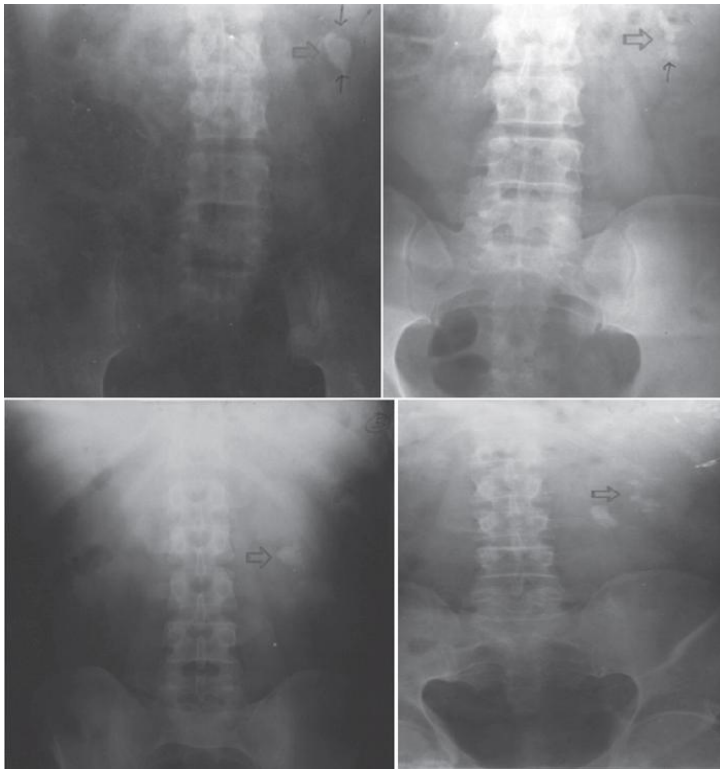

Figure 3: Screening Stages For Subsequent Complete Removal Left Renal Stone About More Than 3 Cms

ESWL has emerged as a convenient, practically safe, noninvasive OPD procedure, with comparative result outcomes, in the absence/exclusion of nonsupportive anatomical parameters, and associated with anatomico-functional urinary tract abnormalities, such as outflow obstruction e.g. PUJ obstruction, promoting future stone formation by stasis, are indication for surgical exploration of stone, and simultaneous correction of defect and/or associated management.

Advantages (lithotripsy):

(1) Noninvasive,
(2) Usually done as OPD procedure,
(3) Patient resumes routine work within 24 h and is stone free within 1-to-2-month time,
(4) Avoiding hazards of anesthesia and surgical procedures in patients not willing for and/or unfit for such extensive procedures.

ROLE OF DOUBLE 'J' STENT

Adequately powered and frequency (time spaced), shock delivery with discrete coherence upon stone throughout the procedure being key to success. As minutely shattered stone particles passing with urine spontaneously,
Thus, avoiding obstructive complications and hence minimizing the need of 'ureteral stenting' (various availables) including double J stent insertion, besides exclusion and/ or management need for pre-existing illnesses.

However, in large, hyperdensity stones, double J stenting may be of great importance preventing obstructive processes like **"Stone/Steine Strasse."**[24-26] **Indications Include:**
(1) Obstructive uropathy ↑ duration,
(2) Associated infection, (3) DTPA renal scan, with/without diuresis or other indices, revealing decreased renal function.

UROLITHIASIS MEDICAL THERAPY REGIMES:

(I)FORCED DIURESIS(LASIX THERAPY);

Done for stones Size up to 5-8 mm, remnant post-ESWL stones.
Recommended ideal forced diuresis regimen: Complete compliance achievement ensures promising good results.
5% DNS ≈ 1,500 ml (3 vacs)
(+) R/L ≈ 1,500 ml (3 vacs)
(Alternating) In 24 hours
Repeat for 3 days.
Inj. Lasix 1 amp. Im, after (II) and (IV) Vac
(regular BP monitoring).
The role of injection Drotaverine (Drotin), Hyoscine (Buscopan), Diclofenac (Voveran) Bd/Tds, is to achieve round the clock analgesia and spasmolytic effect, as needed.
The complete treatment schedule duration varies from 1 to 4 days. The patient encouraged for high fluid intake with normal diet, to ensure about >1.5 to 2 litres/24 h urine output. Straining of all urine is done to filter passed stone particles (Stone analysis sampling).
(II)MEDICATIONS;Commonly used preparations: **Zyloric (Allopurinol)—**for Uricemia (S. uric acid ≥7 mg%) decreases S. uric acid and thus disintegrating uric acid (invisible) component of stones, **Various Other Ayurvedic Preparations:** Cystone, Neeri, Distone, Calcury, Smash, Expel, Nephrol Etc. & Commonly Available Urinary alkalizers.
Tamsulosin (0.4) OD (breakfast): Relieving lower urinary tract syndrome, obstructive uropathy symptoms, thus facilitating downward stone movement and passage with urine, Supported by **Mefenamic acid and Drotaverine preparations (Tab. Drotin-M etc.).**
The role of Aminophylline, Nifedipine Deflazacort, and other hormonal preparations have been reported.

STONE ANALYSIS

Done with Samples of fragmented stone particles passed with urine spontaneously or otherwise extracted [Figure 4]. Stone composition Delineation rendered by spectroscopy techniques, provides guidelines for dietary regulation and subsequent management for stone disease, especially for recurrence.[23]**The composition Studies** reveal either of the following ingredients: **Calcium oxalate monohydrate stone, Calcium oxalate Dihydrate stone, Uric acid stone, Cysteine stone, Purine stone, Hydroxyapatite stone, Carbonate stone, Struvite stone (infection), and Others, e.g., soft radiolucent stone "Indinavir"(a Protease inhibitor) and stone formed during Aids treatment, etc.[21,22]**

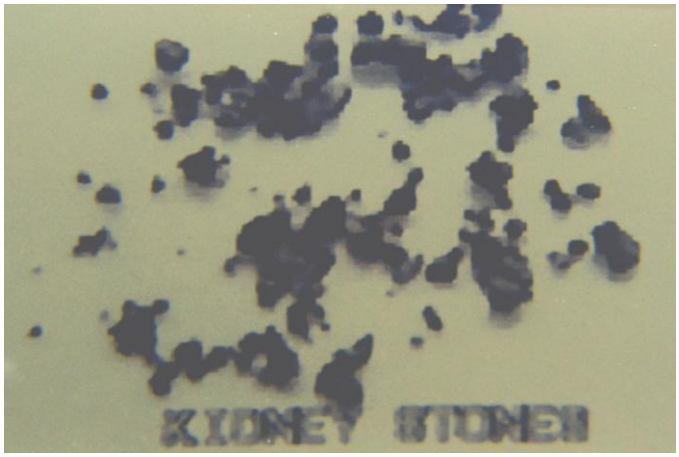

Figure 4: Fragmented Stone Particles Passed With Urine

The Various Constituents, alone or in varying proportions/ percentages, provide directive for comprehensive management, guidelines for stone disease.

DIETARY REGULATION

According to stone composition and availability of food products, various scientifically approved diet regulation regimes are available by different laboratories and pharmaceutical companies, especially **Restricting** oxalate, calcium, urate, and other mineral-containing food items, while **Promoting** intake of food substances with ingredient content known to be effectively helpful for stone disease.

METABOLIC EVALUATION

Consideration of metabolic evaluation of patients with stone disease provides useful **Diagnostic and/or Therapeutic tool** for medical and surgical management guidelines, more so in recurrence cases.

Various used indices: Urine for crystalluria, Serum Uric acid, Serum calcium, Serum phosphorous, Serum Magnesium, Parathormone assay etc, Management for comprehensive treatment plan for stone disease.

SUPPORTIVE MANAGEMENT EMPHASIS:

INFERIOR CALYCEAL STONES, LOWER POLE KIDNEY STONES [11]

Choice of patients, anatomical and/or other determinants, consideration and **Postprocedural Period Advice; For Foot End Elevation (To Gain Gravitational Support), Aided By Proper Forced Diuresis Regime** for about 1–3 days, have shown considerably good results to flush out minute stone particles, leaving stone-free patients [Figure 5].[15,19,20]

During/After Procedure 'Inverse Positioning', 'Shake-Up' Methodology Techniques had synergistic result outcome effects.[14,16-18]

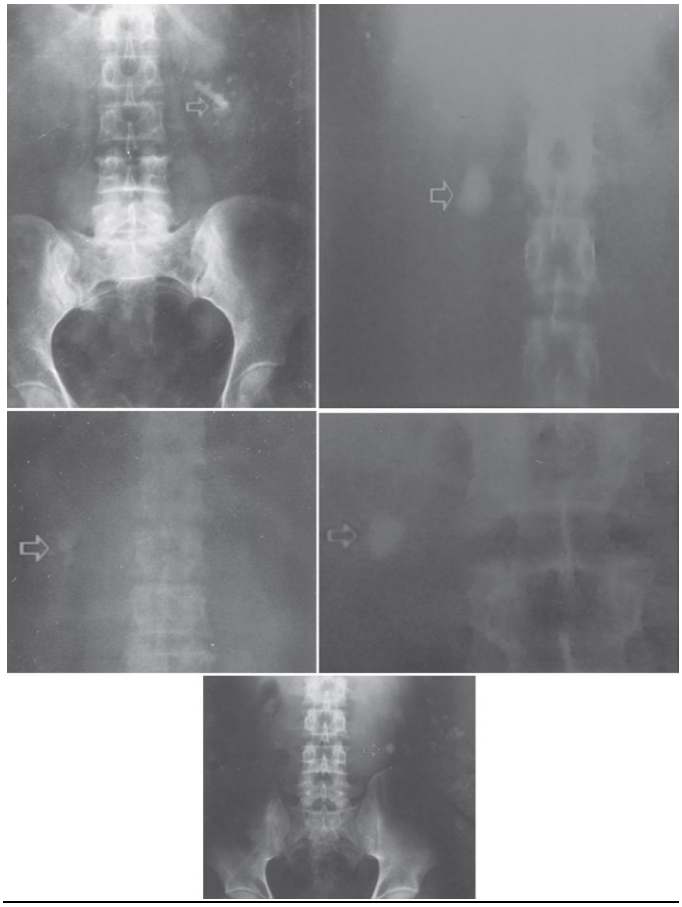

Figure 5: Kidney And Ureteric Stones Of Different Sizes, Locations(LPS Etc.) Removed Completely

LOWER URETERIC STONES

Being technically difficult eitherwise, have comparatively low success rate usually, and are less attempted by lithotripsy. However, ESWL gives good result yield, and not uncommonly performed in patients demanding specific treatment modality, reluctance, or contraindication for surgery.

Patient's Position Being Prone, Cautious Shock Power Delivery In View Of Adjacent Anatomical Structures, Especially In Females, With Advice For Empty Urinary Bladder Etc Are Useful Precaution Guidelines For Success. Properly Administered Forced Diuresis Regime Compliance have shown manifold increase in result outcome as supportive measure, minimizing the use of 'DJS', avoiding obstructive phenomenon, e.g., stein-a-strasse, by expelling out minutely shattered stone particles.[12,13]

ROLE IN GALL STONE DISEASES

In Cholelithiasis (Solitary Gallstone), Choledocholithiasis, T-tube drainage or otherwise, **Contrast Delineated Stones Are Fragmented Into Minute Particles, Pass Away Down The Gastrointestinal Tract, Leaving Stone-Free Patient.**

In the nonavailability of ERCP and related procedures, it

has shown good results in CBD stone patients and may be suggestive of alternative to ERCP (MRCP), as adjunct to laparoscopic cholecystectomy etc.
Role in pancreatic duct calculi in association with ductal stricture and/or otherwise: ERCP and lithotripsy.

RENAL ANATOMY"PREDICTIVE FACTORS" / "DETERMINANTS"

(1) Cong. Anomalies: include Ureteropelvic junction obstruction, Horse shoe kidneys, other Ectopic or fusion anomalies, Hydronephrosis, and Calyceal diverticulae[9,10] In cases of ureteropelvic junction obstruction, in addition to anatomic obstruction, coexistent metabolic abnormalities are contributing to stone formation.[4] Suggestive Treatments for PUJ obstruction with stone; classical open surgical stone extraction and pyeloplasty, PNL with concomitant endopyelotomy, and recently laparoscopically (an antegrade approach preferred with existing stone, although retrograde can be performed) [Figure 6].

(2) Calyceal Diverticulitis: This occurs when Cong. eventrations of the renal collecting system is lined by transitional cell epithelium.
Treatments include traditional open surgical nephrostomy with infundibulum closure and diverticular cavity fulguration, invasive surgical PNL ureteroscopy, ESWL, and laparoscopy.
Reported Stone free rate for calyceal diverticular stone treatment with ESWL averages only 21%.

(3) LPS (Lower Pole Stones)[29]
Inferior Calyceal Stones: Can Be Managed EitherWise Or By ESWL, As Discussed With The Special Emphasis Supportive Measures & MethodologyTechnique.

(4) Various Parameters: Anatomical Features (Landmarks): [32-34]

- **Lower Pole Infundibulopelvic Angle (LIP):** Lower border of pelvis with the medial border of lower pole infundibulum is equal to or more than 70–90°.[30,35]
- **Ureteropelvic Axis:** Central point of renal pelvis and central point of the proximal ureter.
- **Diameter Of Infundibulum (IW):** More than 4–5 mm.
- **Infundibulopelvic Length (IL):** < 3 cm.
- **Spatial Distribution Of Calyces, Distorted Calyces System**

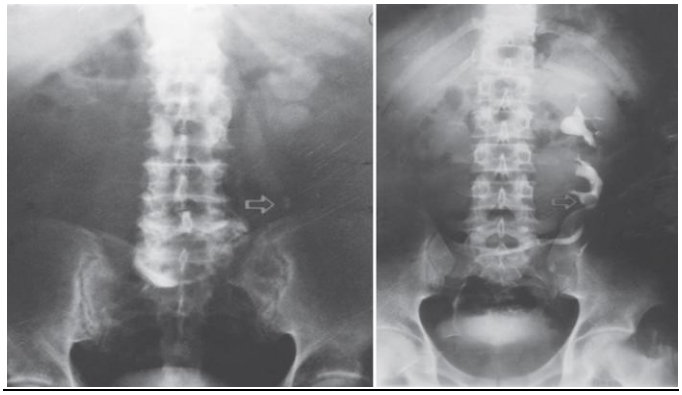

Figure 6: IVP Films –
(A)Left Mid Ureteric Stones With Hydroureteronephrosis
(B) Horse Shoe Shaped Kidney, Renal Ectopia Pelvic Kidney, Renalpelvis Stone About 1.5 Cms
Subsequent IVPs After About > 6 Months:WNL, Single Sitting Clearance.

AGE RELATED CHANGES IN ESWL 'RESISTIVE-INDEX'.[31]

1. Presence of distal obstructions: Obstructive uropathy, urolithiasis, hydronephrosis; poor results of ESWL, and other important reasons for residual fragments,
2. Febrile urinary tract obstruction,
3. Distal calculi in females,
4. Morbid obesity (more than 100 pounds): However, the patient body weight limit for Dorniers H3 Lithotripter is about 280 pounds.
5. Other associated anatomico functional problems: Spinal deformity, limb contractures, etc.

CONTRAINDICATIONS:

1. Pregnancy (only absolute contraindication)For LithoTripsy,
2. Uncontrolled coagulation disorders,
3. Uncontrolled hypertension: Relative renal hypertension.

COMPLICATIONS

1.Haemorrhage:
Post-lithotripsy Hematuria: Varying severity and duration, usually controlled by medical therapy, including hemostats, e.g., Tranexamic acid up to 2 - 4 g/day doses, have shown very good result besides other supportive measures including cause evaluation and management.

2.Hemorrhage And Edema: Peri-Renal, subcapsular, and Intra-Parenchymal of varying severity.
Need Increased caution In Bleeding—Diasthesis, hemophilia, polycystic (autosomal dominant) kidney disease, hydronephrosis etc.[37]

3.Infection: Obstructive uropathy, infected stone nidus, needs proper management with broad-spectrum/specific antibiotics (c and s), along with spasmolytics, analgesics etc. Incomplete stone fragmentation Being the most important factor for the failure rate; can be prevented by appropriate discrete shock delivery in patient compliance.

4.Clinically Insignificant Residual Fragments(CISF): are Diagnosed by USG, radiology, Nephrotomography, Nephroscopy, CT scan, etc. They are important contributory factors for recurrence by providing 'nidus' for future stone formation and should be avoided by proper procedural & Supportive techniques. Necessary management is achieved by available medical therapy regimes, with ingredient-specific medications (role of specific alkalizers), diet regulations etc.[41-43] Routine urine test for crystalluria, sediments, and casts provides useful index besides various metabolic evaluators. [44]

5.Histological Damage: Acute/chronic renal injury: Structural/ functional changes, various studies, variable results available. **ESWL is recognized as a form of trauma similar to renal contusions with occasional resultant adverse sequelae.** However, in the absence of human error, the latest sophisticated versions of lithotripters, especially Dornier's Lithotripter, renal injury and other adverse bio-effects are **Negligibly Minimal In Normal Individuals**. An adverse longterm effect study is not available for justification.[45]

6.Hypertension: There is variable evidence that ESWL results in hypertension. However, studies reveal that with successful management of stone disease, the pre-existing hypertension (? cause) management needs comparatively less or to the extent of no medication. Studies for resistive index, renovascular status (altered plasma flow intra renal blood flow changes), blockage by aminophylline, nifedipine, and allopurinol have been reported. Regarding plasma renin activity phenomenon and other factors, various study reports are available.[38,39,40]

7.Extrarenal Tissue Injuries: E.g., liver, skeletal muscles, evident by Serum Bilirubin, Lactic Dehydrogenase, Glutamic Transaminase, And Creatinine Phosphokinase.[36]
Upper GIT; Gastric, Duodenal Erosion, most common extra-renal complicationPancreatitis single case in 6800 cases. Acute fatal pancreatitis,Lithotripsy for renal calculi,
BJU International (2001) reported.

8.Steinstrasse (Street Of Stone): The incidence of accumulation of stone fragments obstructing ureter after ESWL being 2–10%, large stone burden staghorn calculi, bilateral ESWL, pre-existing ureteral obstruction are known risk factors [Figure 7A and B].[27,28]

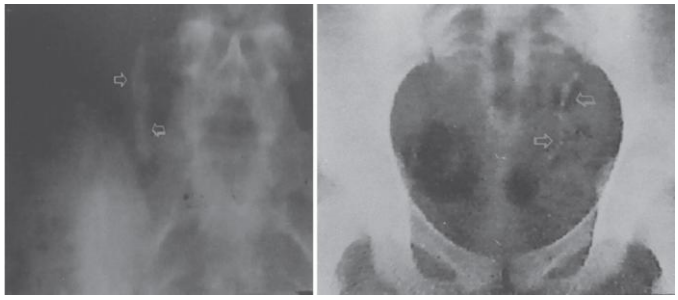

Figure 7: (A)Stone particles passage Rt. Mid ureter
(B)Depicting Stone Particles Passage In Lower Ureter
Phenomenon Known As "Stone/ Steine Strasse"

Pre-ESWL Ureteral Stenting Significantly Decreases But Do Not Eliminate Steinstrasse (Controversial Reports).
Spontaneous stone clearance occurs in 60–80% cases; failure to resolve within 3–4 weeks time, with special indications for bilateral obstruction, solitary kidney, severe refractory pain or infected hydronephrosis,
Necessitates intervention aiming prompt urinary track decompression by ureteral stenting, nephrostomy tube drainage, URS management including basket extraction etc. ESWL aimed for fragmentation of steinstrasse has a high success rate with minimal complications.

4.RESULTS

The study includes about more than 300 patients with renal and ureteric calculi that were completely removed by ESWL, with an average of about two sittings and complete one sitting clearance, in several cases.[Figure-8]

DJS insertion was done in < 10% cases, especially in large stones >4 cm, and in cases of repeated resistant urine c and s, associated obstructive lesions delineation by radiodiagnosis and various scans indicating decreased renal function status etc.
Proper forced diuresis compliance was encouraged and used in about 15–20% cases; improved results outcome was achieved by reducing number of sittings in large kidney and ureteric stones, while improved overall treatment efficacy in LPS, inf. calyceal, lower ureteric, especially VUJ stones, residual stone fragments and also as an adjunct to medical therapy, achieved in selected cases.

Prophylactic Medical Therapy,In about 10–15% cases was administered, with crystalluria as important therapeutic parameter.

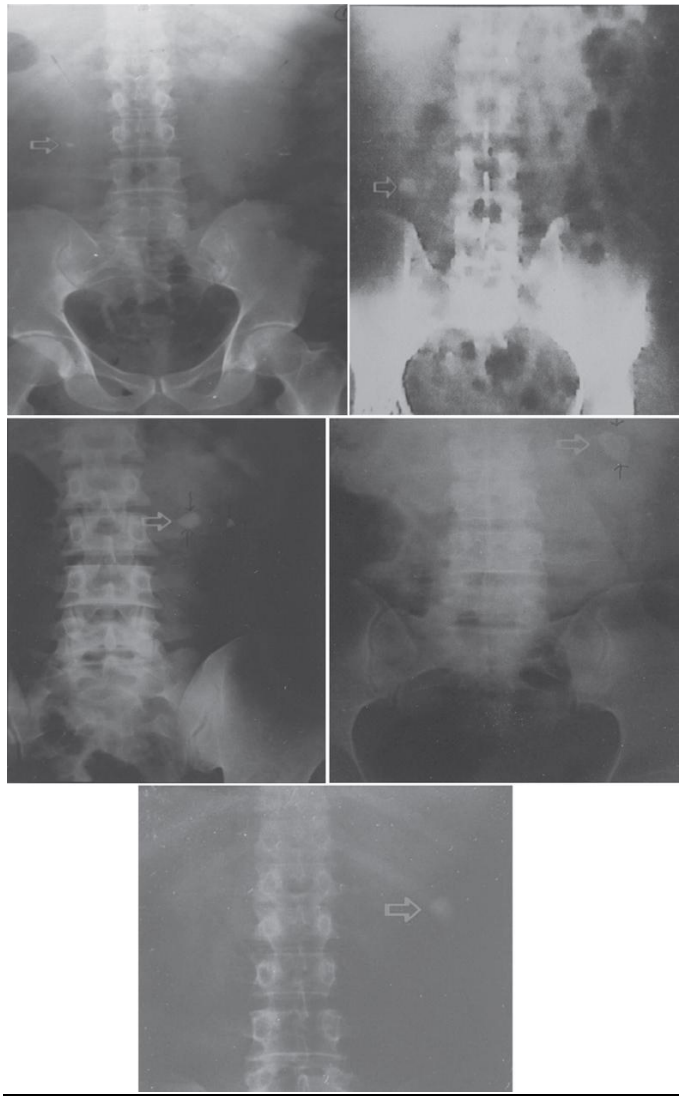

Figure 8: Kidney And Ureteric Stones Of Different Sizes, Location, Completely Removed

Special emphatic care compliance, in regards to supportive measures, especially gravitational support etc in LPS, Inf.calyx, lower ureteric, VUJ stones and **Appropriate Shock Delivery** upon discretely contrast delineated gall stones**(choledocholithiasis), Carefully Conducted Lithotripsy Sittings,**with intensive radiological screening for complete stone Removal, supported by sterile urine for urinary asepsis, evidence and diet regulation in accordance with stone analysis, stone composition and metabolic evaluators (indices) management **Formed The Crucial Guidelines To Achieve About >95% Success Rate.**

4.CONCLUSIONS

Being A Well-Established Routine Urological Technique, Great Majority Of Urolithiasis Patients Can Be Best Managed By ESWL. This Study Concludes That For All Practical Purposes, Renal And Ureteric Calculi Can Be Treated With ESWL, With Almost Cent Percent (Complete) Success Up To A Solitary Stone Size Of About 4 – 5 Cm, With Varying Retreatment And Ancillary Procedures Support The Rapid Worldwide Acceptance Of ESWL. However, recent availabilities of successful minimally invasive endourology and laparoscopic procedures are debatefully comparable with regards to individual choice, availability compliance, and comparative result outcome variations.[46,47]

While The Basic Fundamental For Successful Extraction Of Complete Stone, Leaving No 'Nidus' For Future Stone Formation, With Supportive Scientific Diet Regulation Advise, In Accordance With/Without Stone Analysis, Geographical Consideration, And Management Of The Altered Biochemical Indices, Associated Medical Problems, Etc., Needs To Be Cautiously Secured Irrespective Of Stone Removal Technique, As Complete Comprehensive Management Of "Stone Disease."

5. REFERENCES

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