

A Dissertation on
"CALCULOUS DISEASE OF THE URINARY TRACT"
- A CLINICAL AND EPIDEMIOLOGICAL STUDY

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CERTIFICATE

This is to certify that this dissertation in "**CALCULOUS DISEASE OF THE URINARY TRACT**" - A **CLINICAL AND EPIDEMIOLOGICAL STUDY** is a work done by **Dr.KUMARESH .T.S.** under my guidance during the period 2003 - 2006. This has been submitted in partial fulfillment of the award of M.S. Degree in General Surgery (Branch - I) by the Tamil Nadu Dr.M.G.R. Medical University, Chennai.

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ABBREVIATIONS

- * RTA - Renal Tubular Acidosis
- * IBD - Inflammatory Bowel Disease
- * PUJ - Pelvi Ureteric Junction
- * VUJ - Vesico Ureteric Junction
- * U/3,M/3,L/3 - Upper Third, Middle Third, Lower Third
- * IVU - Intra venous urography
- * AUG - Ascending Urethrography
- * KUB - Kidney, Ureter, Bladder
- * LUTS - Lower urinary Tract Symptoms
- * HUN - Hydro Uretero Nephrosis
- * BPH - Benign Prostatic Hyperplasia
- * GUTB- Genito Urinary Tuberculosis
- * ANL - Anatomic Nephro Lithotomy
- * PCNL - Percutaneous Nephro Lithotripsy
- * ESWL- Extracorporeal shock wave Lithotripsy
- * O.I.U. - Optical Internal Urethrotomy

INTRODUCTION

Urolithiasis is one of the common clinical condition, a practising clinician is likely to encounter in his practice. The renal calculus disease patient may well test the diagnostic skill of a shrewed physician and subsequent evaluation of the patient may be an acid test for his knowledge and experience. Though the composition of the calculus and treatment modalities might have been changed recently, archaeological studies show the urinary tract stone disease was an affliction of human earlier than 4800 B.C.

This is a study of 112 patients with calculous disease of the urinary tract seen during the period of 3 years, from September 2003 to March 2006 with particular reference to epidemiological workup and clinical evaluation, with thorough clinical examination, plain x-ray KUB, USG, IVU, Blood Examination, Stone analysis and urine examination.

The present study deals with epidemiology of urolithiasis, their distribution along urinary tract, various Investigations to confirm the diagnosis and to arrive at a decision making process and finally the treatment modality at different levels.

AIMS AND OBJECTIVES

- * To evaluate all patients with calculus disease of the urinary tract with special reference to the clinical epidemiology including :
 - a. Age and Sex
 - b. Heredity / metabolic diseases
 - c. Environment
 - d. Urinary infection
 - e. Dietary factors
 - f. Distribution of calculi within the urinary tract

- * To clinically evaluate all patients with thorough clinical examination, their common modes of presentation, associated urological problems and by investigating them to arrive a decision making process.

- * To study various modalities of treatment offered at different levels of calculous impaction and finally the stone analysis.

REVIEW OF LITERATURE

EPIDEMIOLOGY

The prevalence of urolithiasis is approximately 2.3% in the general population and the estimated life time risk of developing a kidney stone is about 12% for Indian males. Approximately 50% of patients with previous urinary calculi have a recurrence within 10 years.

INTRINSIC FACTORS

Genetics

Urolithiasis requires a polygenic effect.

The hereditary diseases identified to be associated with stone disease are cystinuria, renal tubular acidosis and familial idiopathic hypercalciuria.

Age & Sex

Peak age incidence occurs during 3rd to 5th decade. About 3 males are affected for every female. However in cystinuria and hyperparathyroidism, increased frequency in females have been noticed.

EXTRINSIC FACTORS

Geography

Increased risk observed in peoples living at mountain regions and

tropical areas.

Climatic

Acid stones are more common during summer and infection stones (struvite) are more common during winter. Increased mean environmental temperature is related to increased incidence of urinary calculi.

Water intake

Risk factors which promote crystallization of salts in a patient with stone disease includes :

- a. Low urinary volume
- b. Low levels of zinc
- e. Excessive water hardness.

Diet

Several studies have shown that high purine intake increases urinary calcium, oxalate and uric acid excretion. Excess intake of vit.c produces oxalate and increases the risk of stone production. Lack of fibre diet also contributes for stone formation.

Occupation

Increased risk was observed in sedentary personnels, cooks and after a space flight.

INHIBITORS OF CRYSTALLIZATION

Organic

Peptide, Alanine, High Molecular weight glycoproteins namely Nephrocalcin and Tomm Horsfall protein and citrate.

Inorganic

Phosphates, zinc and magnesium.

PATHOPHYSIOLOGY

More than one or three mechanisms are likely to be active in stone formation.

- i. Possible presence of substance that promote crystallization.
- ii. Possible relative lack of substance that inhibits crystallization.
- iii. Possible excessive excretion or concentration of salts in the urine, which leads to supersaturation of the crystallizing salt.
The greater the degree of supersaturation, the greater the rate of growth of the calculi.

HYPERCALCIURIA

Accounts for 75 - 85% of urinary stones. Approximately one half of calcium stones are composed of calcium oxalate and calcium phosphate and

demonstrates intermediate fragility to ESWL.

7/8th calcium stones contains calcium oxalate dihydrate. They may be spiculated, dotted, mulberry or Jack stone appearance. The remaining 1/8th of stones are composed of calcium phosphate (apatite) or calcium oxalate monohydrate. These stones are denser and consequently, least responsive to ESWL.

CAUSES

85% of calcium stones are due to idiopathic hypercalciuria and occurs for more than half of patients with calcium oxalate stones. Hypercalciuria may also be due to absorptive, renal or resorptive.

TABLE - 1

	Absorptive Hypercalciuria	Renal Hypercalciuria
PTH level	↑ed	↑ed
Fasting urinary calcium	N	↑ed
Sr.Osteocalcin	N	↑ed

10-15% of calcium stones are due to hypercalcemic nephrolithiasis.

The causes include :

- i. Hyperparathyroidism (5-10%)
- ii. Renal tubular acidosis
- iii. Malignancy associated hypercalcaemia
- iv. Sarcoidosis (↑ed production of vit-D)
- v. Immobilization (#, CVA)
- vi. Glucocorticoid induced
- vii. Pheochromocytoma
- viii. Familial Hypocalciuria.

RENAL TUBULAR ACIDOSIS : (RTA)

Type I (Distal RTA) is associated with stone disease where as Type II (Proximal RTA) and Type IV RTA does not predispose to stone formation. In Type I (distal) RTA, there is decreased ability to lower urinary pH levels (pH >6) and causes alkaline urine, hypercalciuria, phosphaturia.

HYPEROXALURIA

Most commonly occurs with malabsorption due to any causes, like small bowel resection, jejunum - ileal bypass, vit-c overdose or renal failure.

Idiopathic hyperoxaluria is a rare disease.

HYPOCITRATURIA

Citrate complexes with calcium and inhibits spontaneous nucleation and aggregation of calcium oxalate.

Acidosis is an important risk factor for hypocitraturia and occurs in Distal RTA, Thiazide diuretics, Inflammatory bowel disease, (IBD) Chronic diarrhoea, etc.

HYPOMAGNESIURIA

IBD associated with malabsorption causes hypomagnesiuria.

TRIPLE PHOSPHATE (STRUVITE) STONES

Constitutes 10 - 20% of urolithiasis. They enlarge and branch into calyces to form staghorn calculus. They are caused by urea splitting bacteria like Proteus, Klebsiella, Pseudomonas which potentially lead to renal failure.

HYPERURICOSURIA

Uric acid stones constitutes 5 - 10% of renal stones. These are smooth radiolucent stones on conventional X-rays but opaque on CT. The causes include small bowel resection, gout, cell lysis due to leukemia, starvation etc.

CYSTINE STONES

Cystinuria is an autosomal recessive disorder with defect in the transmembrane cystine transport leading to increased urinary excretion of cystine, ornithine, arginine and lysine.

Diagnosis is by cyanide nitroprusside calorimetric test.

CLINICAL PRESENTATION

ACUTE STONE EPISODE

A urinary calculus usually announces its presence with an acute episode of renal and ureteric colic. Uroliths create symptoms only when they

become trapped in some segment of the upper urinary tract.

First, stones may become impacted in any calyx of the upper urinary tract. Individual calyces may, therefore become distended and painful to create hematuria.

Second area in which a calculus may become impacted is at the PUJ (Pelviureteric junction). It is here that the relatively large diameter of the renal pelvis (1 cm) abruptly decreases to that of ureter (2 - 3mm).

Third area of impaction is at or near the pelvic brim, where the ureter begins to arch over the illiac vessels posteriorly into true pelvis.

Fourth area, especially in females, is the posterior pelvis, where the ureter is crossed anteriorly by the pelvic blood vessels and by the broad ligament.

Finally, the most constricted area through which the urinary calculus must pass is the ureterovesical jn (VUJ). These normal anatomic variations probably explains the frequency with which calculi become impacted in certain portions of the urinary tract than in others. To become impacted, the calculi usually must have one diameter in excess of 2mm. If the smaller diameter is <4 mm spontaneous stone passage is likely.

PHYSICAL SIGNS

The patient almost always have moving pain with irritation. They rarely can find comfort in any given position. Fever is rare unless urinary infection occurs along with the calculus. Acute hydronephrotic kidney may be palpable.

Microscopic or gross hematuria is frequently present in patients with acute colic. Some 80% of patients do not demonstrate hematuria especially if the calculus has caused complete obstruction. When significant number of pus cells are present in the urine, however, a thorough search for infection should be made.

PATIENT EVALUATION

URINALYSIS

Urine is examined for hematuria and pyuria, urine crystals may reveal the type of calculus.

TABLE - 2

Sl.No.	Crystal	Shape under optical microscope
1.	Ca oxalate monohydrate (whewellite)	Dumbell or hourglass
2.	Ca oxalate dihydrate (Weddelite)	Bipyramidal
3.	Ca Phosphate (apatite)	Amorphous
4.	Brushite	Needle Shaped
5.	Struvite	Coffin lid
6.	Cystine	Benzene ring

PLAIN X-RAY (KUB)

Ninety Percent of stones in the urinary tract are radiopaque.

Calcium phosphate stones are most radiopaque, calcium oxalate are almost opaque, magnesium - ammonium phosphate are less radiopaque. Cystine calculi are partly radiodense because of their sulfur content. Only calculi of relatively pure uric acid or xanthine stones are radiolucent. A small ureteric calculus may be difficult to see due to gas and faeces or to confusion with other opacities such as phleboliths and arterial calcification.

ULTRASOUND (KUB)

Upto 25% of patients with ureteric stones have normal ultrasound

appearances. The sensitivity of USG (KUB) in diagnosing a ureteric calculus is only 43%.

Apart from delineating the presence, location and size of the calculus, this modality of investigation also shows the state of renal substance and an obstructed, hydronephrotic kidney.

INTRAVENOUS UROGRAPHY

The first indication for the presence of urolithiasis is delay in the appearance of contrast medium in the nephrogram following its injection. Films at 20, 30 and 60 min shows better localisation and presence of calculus. It is essential to ensure that renal function is not significantly impaired (by serum creatinine concentration) before doing urogram. If there is no visualisation, retrograde pyelography may be indicated.

CT SCAN

Non-contrast Helical / spiral CT gains more importance in detecting radiolucent stones. All stones, regardless of composition are visualised on CT scan with the exception of small percentage of Indinavir stones from patients under Antiretroviral treatment.

RETROGRADE PYELOGRAPHY

Where other techniques are not successful in locating a calculus, this method is useful, especially for radiolucent stones. They are occasionally

needed when there is no function in the affected kidney.

SPECIFIC LOCATION OF CALCULI

Renal calculi

Stones >1 cm do not pass spontaneously and they usually occupy the renal pelvis and calyces, and get impacted at the PUJ. When all forms of renal stones are considered, the incidence in men and women are approximately equal, but calcium containing stones occur in men 3 times more often than in women.

Ureteral calculi

a. Site of Origin

Usually originates in the kidney and then passes into the ureter. Because of the smooth mucosal lining of the ureter and is constantly bathed with urine, primary ureteral stones are rare. They may be formed primarily in association with ureterocele, neoplasms, ectopic ureter, saculations etc.

b. Site of impaction

Most common site is vesico ureteric junction (VUJ) followed by pelvi ureteric junction (PUJ). Other places of impaction were already discussed.

c. Size, weight and shape

Calculi ranges in size from a few mm to 10 cm in length and width.

Stone that weigh more than 0.1 gm have a diameter of >1 cm and associated with urinary infection are not as likely to pass spontaneously.

d. Laterality

Ureteral calculi are equally frequent on the left and right sides, although in certain patients stone formation seems to be limited to one side (ie left). Several comparative studies shows that there is a slight preponderance to left side.

3. VESICAL CALCULI

a. Age

An etiological factor, incidence in calculi of the bladder varies in difference parts of the world. Previously believed that the disease was largely limited to children, but now increased incidence is being observed in adults also.

b. Sex

Vesical calculus is predominantly a disease of males of all ages in all races. Increasing incidence noticed in men > 50 years. Factors that give rise to retention of urine such as stricture urethra, prostatic hypertrophy, diverticulum of the bladder, cystoceles and neurogenic bladder are associated with formation of struvite stones. Other bladder stones are formed on foreign bodies such as sutures or catheters.

Usually a single stone is observed in the bladder, but in the presence of retained urine, multiple stones, 2 or 3 to 100 may be formed. Multiple stones usually occur when there is a diverticulum of the bladder.

URETHRAL CALCULI

Constitutes <1% of all urinary stone disease.

Majority of the urethral calculi in the male consist of stones expelled from the bladder into the urethra. Rarely primary urethral stones are formed when stricture or diverticulum is present.

A stone that progresses through the normal urethra may get arrested in prostatic urethra, the bulb, fossa navicularis or the external meatus.

DIAGNOSTIC AND TREATMENT DECISION PROCESS

After diagnosing a urolith, first assessment is of the degree of seriousness of the disease process.

INDICATIONS FOR HOSPITALISATION

- * In patients with symptoms not controlled with oral medications.
- * In the presence of calculus anuria, usually seen in patients with solitary kidney.
- * In patients with obstructing stone and infected urine with fever.

ANALYSIS OF URINARY STONES

Following treatment of acute phase, stone recovery is of paramount importance. Most medical treatment for stone disease is now based on analysis of calculi and decisions about proper procedures for treatment requires knowledge of stone composition.

METHODS OF STONE ANALYSIS

1. Chemical

- * Qualitative spot test
- * Quantative analysis
- * Chromatographic and autoanalysed methods

2. Optical

Binocular dissection microscopy with petrography
(Polarisation)

3. Instrumental

- * Radiographic crystallography
- * Thermo analytic
- * Scanning Electron Microscopy
- * Transmission Electron Microscopy

Although many types of stone analysis have been proposed, the most practical type is the chemical analysis. For the practicing surgeon without access to large analytic laboratories, the most useful methods, are chemical analysis and petrographic methods through the polarising microscope. Because it is relatively simple to instruct laboratory personnels in these techniques, almost any small hospital laboratory or large clinic have the ability to analyse the urinary calculi.

TABLE - 3

NORMAL 24 hrs URINE VALUE (mgm)

Biochem Component	Males	Females
Calcium	<300	<250
Oxalate	<50	<50
Uric acid	<800	<750
Citrate	450-600	650-800

TABLE - 4
NORMAL SERUM LEVELS (mg/dl)

Biochem. Component	Values
Calcium	8.5 - 10.3
Phosphorus	3 - 4.5
Uric acid	
Males	4 - 7.0
Females	2.5 - 6.0

TREATMENT OF UROLITHIASIS

Can be divided into

- * Treatment of acute episode
- * Interval treatment
- * Prevention of recurrences or new stone formation.

TREATMENT OF THE ACUTE EPISODE

EXPECTANT TREATMENT

If the greatest diameter of the stone is <4 mm, spontaneous passage is very likely, but surface characteristics of the stone may be as important as size.

The first priority is to relieve pain, NSAID's is most commonly used where morphine is the choice when there are contraindications to NSAID's are present like, pregnancy, Asthma and peptic ulcer.

The common measure of forced diuresis in the acute situation may be unhelpful, as an increase in diuresis may decrease peristalsis and hinder the passage of stones.

Indications for Emergency intervention

1. Significant obstruction with infection
2. Intractable pain
3. Progressive renal deterioration
4. Anuria due to obstruction in a solitary kidney
5. Pyelonephritis (without significant obstruction) not responding to antibiotic treatment.

THE OPTIONS FOR EMERGENCY TREATMENT ARE :

1. Nephrostomy
2. Stenting
3. Utereroscopic stone extraction
4. ESWL, if on site.

INTERVAL TREATMENT**a. Surgical Treatment**

Surgery forms the mainstay of treatment of calculous disease of the urinary tract both in the acute phase and as interval treatment, after an acute episode.

Various modalities of surgical treatment includes, percutaneous nephrolithotomy (PCNL), extracorporeal shock wave lithotripsy (ESWL), ureterorenoscopy (URS) and open stone surgeries.

ESWL

Indications include,

1. Renal Calculi

Stones <2 cm diameter - 90% chances of fragmentation and clearance.

Stones in the lower pole / calyceal diverticular region give lower success rate.

2. Ureteral calculi

ESWL is recommended as the first line treatment for most patients with stones 1 cm or less in the proximal ureter.

ESWL and ureterorenoscopy are equally acceptable choices for stone of this size in the distal ureter.

3. Bladder Calculi

Can be treated with the patient prone.

CONTRAINDICATIONS TO ESWL

Absolute : Pregnancy
Uncontrolled coagulopathy
Uncontrolled hypertension

Urinary tract obstruction distal to the stone

Urinary tract infection with fever.

Relative : Urinary tract infection

Distal ureteric calculi in women of child - bearing age.

Complications of ESWL

1. Stein strasse "stone street"
2. Bleeding
3. Gastrointestinal side-effects, like pancreatitis, elevation of hepatic enzymes, incidental fragmentation of gall stones, causing biliary colic.
4. Mortality (0.02%)
5. Hypertension (Controversial)

Ureterorenoscopy (URS)

The indications are :

- * Ureteric calculi that cannot be visualised for ESWL or which have not responded to ESWL.
- * Renal calculi not responding to ESWL or residual stones after percutaneous treatment.
- * Radiolucent stones or filling defects which need to be inspected.

Stenting with a double pigtail (JJ) stent is generally recommended after ureteroscopic treatment.

PERCUTANEOUS NEPHROLITHOTOMY (PCNL)

PCNL was the first key hole surgery.

The absolute indication are :

- * Staghorn calculi and large (> 3 cm) renal calculi
- * Failed ESWL for stones < 3 cm
- * Cystine stones refractory to ESWL
- * An infected obstructed system - PCNL is done in 2 stages insertion of a nephrostomy followed by nephrolithotomy after 1-3 days.

The relative indications for PCNL

- * Horse shoe kidney - where imaging is difficult.
- * Morbidly obese patients where stone imaging and the weight of the patient may be problems.
- * Upper and midureteric calculi - with a dilated system above the stone.

Complications of Access include

Haemorrhage, pneumothorax, hydrothorax and injury to the neighbouring viscera.

The risk of fluid absorption and sepsis increases after this procedure
Mortality rate following PCNL is 0.1 - 0.7%.

Open Stone surgery

In developing countries, open stone surgery still has a significant role. The procedures performed are pyelolithotomy, anastrophic and radial nephrolithotomy and partial nephrectomy.

Non - Surgical Treatment

- * Uric acid stones can be dissolved by a high fluid intake with alkalization of the urine. Allopurinol, an uricosuric agent prevents reformation of uric acid stones.
- * Cystine stones are dissolved by alkalization and with cystine competing agents, such as D-penicillamine and α - mercaptoproionyl glycine (MPG).
- * Struvite stones may undergo partial or complete dissolution after antimicrobial therapy.

Prevention of Recurrences

50 - 75% of patients have recurrences within 10 years of the first episode. Ideally, prevention requires analysis of the chemical composition of the stone and diagnosis of the cause.

DIETARY ADVICE

1. Increase in the fluid intake to produce atleast 2 lts. of urine output per day decreases the risk of stone formation.
2. Restriction of calcium is not advised as it increases oxalate absorption.
3. High levels of dietary protein and sodium increases the risk of calcium oxalate and uric acid stone recurrence.
4. Citric acid (lemon, orange) and dietary fibres reduces the risk.

MATERIALS AND METHODS

The present study involves a total of 112 patients with calculous disease to the urinary tract observed during the period of 3 years, from September 2003 to March 2006.

The study was conducted both by prospective as well as by retrospective methods, by analysing the case sheets on a random basis.

All patients of prospective study were followed up in speciality department, where they were subjected to a detailed clinical epidemiological workup. Complete hemogram, urinalysis, urine culture, serum biochemistry, were performed in all cases.

Chemical analysis of stones were performed in 39 cases postoperatively after stone retrieval by open surgeries.

Radiological investigations included plain x-ray KUB, ultrasound IVU series, CT, depending on clinical situation. Ultrasound KUB was often performed while endoscopic procedures were usually undertaken for therapeutic reasons.

EXCLUSION CRITERIA

- * Paediatric urolithiasis was excluded as they were referred directly to childrens hospital.

- * Cases directly attending to the speciality outpatient department were not included in the present study.

HUN / BPH / GUTB / Stricture Urethra, etc.

Method of Diagnosis :

USG, X-ray (KUB), IVU, AUG, CT Scan, Sr.Biochemistry and 24 hrs urinalysis.

Mode of Treatment :

Endoscopic / open stone surgery

Stone Analysis :

OBSERVATIONS

1. AGE AND SEX INCIDENCE

a. UPPER URINARY TRACT STONE DISEASE

(Renal, Ureteral, Multiple Stones)

AGE

- * Max. Age Incidence (37%) for upper urinary tract stone disease was observed in between 30 - 40 years.
- * 75% of total cases observed were found during 2nd and 5th decade.
- * Only 5 cases were found <20 years.

SEX

- * Male : Female ratio observed is 1.5 :1.
- * Almost Equal Sex Incidence Noticed

Age (Yrs)	Male	%	Female	%	Total	%
11 - 20	2	4	3	8	5	6
21 - 30	12	24	7	21	19	22
31 - 40	18	35	13	38	31	37
41 - 50	6	12	8	24	14	16
51 - 60	9	17	-	-	9	11
61 - 70	3	6	2	6	5	6
> 70	1	2	1	3	2	2
Total	51	100	34	100	85	100

b. LOWER URINARY TRACT STONE DISEASE

(Vesical, Urethral Stones)

AGE

- * Max. Age Incidence (52%) for vesical and urethral stones was observed to be within 40 - 60 years.
- * 20% of cases were found in between 20 - 30 years.
- Only one patient of teen age was found to have vesical calculus.

SEX

* Of the 27 cases of lower urinary stones, only one female patient was found to have bladder stone.

* 96% male predominance observed.

Age (Yrs)	Male	%	Female	%	Total	%
11 - 20	1	4	-	-	1	4
21 - 30	5	19	0	0	5	19
31 - 40	4	15	-	-	4	15
41 - 50	6	23	1	100	7	26
51 - 60	7	27	-	-	7	26
61 - 70	1	4	-	-	1	3
> 70	2	8	-	-	2	7
Total	26	100	1	100	27	100

2a. DISTRIBUTION OF CALCULI

(In General)

- * Of the 112 cases studied, it was observed ureteral stones were the commonest (46 cases).
- * 25 cases of Renal stones and 24 cases of bladder stones observed.
- * 3 cases of urethral stones found.
- * Stones at multiple sites accounts 14 cases

Site	No	%
Renal	25	22
Ureteral	46	41
Vesical	24	21
Urethral	3	3
Multiple sites	14	13
Total	112	100

2b. DISTRIBUTION OF RENAL CALCULI

- * Most common site of stone impaction was the renal pelvis (63%).
- * Stones on right kidney were found to be more frequent (60%) than the left.
- * B/L renal stones were found in 6 cases of 35.

Site	No	%
Pelvis	22	63
Lower calyx	5	15
Middle calyx	4	11
Upper calyx	4	11
Total	35	100

Laterality	No	%
Right	21	60
Left	8	23
Bilateral	6	17
Total	35	100

2c. DISTRIBUTION OF URETERAL CALCULUS

- * It was observed that stones in the lower third ureter and vesico

ureteric Jn. were more common than upper ureteric stones.

- * Stones Above pelvic brim constitutes 40% and Below pelvic brim constitutes 60%.
- * Ureteral stones were found to have almost equal incidence on right (52%) as well as on left (45%) side.
- * B/L ureteral stones found in 2 cases of 56.

Site	No	%
Above pelvic Brim (U/3 + M/3)	22	40
Below pelvic Brim (L/3 + VUJ)	34	60
Total	56	100

Laterality	No	%
Right Side	29	52
Left Side	25	45
Bilateral	2	3
Total	56	100

2d. DISTRIBUTION OF CALCULI

- * 3 cases of male urethral calculi observed during the study where the site of blockage were one at fossa nasicularis and the other 2 at posterior urethra.
- * Stones at multiple sites observed includes
either B/L renal or B/L ureteral or
multiple renal on the same side or renal with ureteral or
vesical with urethral stones.
- * One case of post ESWL steinstrasse was noticed.

3. EPIDEMIOLOGY

- * Only 2 cases with metabolic disorder was found. Both cases have primary hyperoxaluria.
- * Climatic influence on stone disease found in 20% cases. 23 cases presented during summer season (March - June).
- * Only 8 cases showed Diet / fluid influence on stone disease.
- * Urinary infection was observed in 19% of cases. Patients with multiple stones and Bladder stones were found to have urinary infection.
- * The most common organism in urine c/s was E.Coli.

Pseudomonas was found in 2 cases.

Factor	No	%
Hot climate	23	20
Diet / fluid	8	7
Metabolic	2	2
Urinary infection	21	19

Organism	No	%
E.coli	14	68
Klebsiella	3	14
Proteus	2	9
Pseudomonas	2	9
Total	21	100

4a. CLINICAL PRESENTATION

- * Pain was the commonest symptom observed (68%)
- * Upper urinary stone disease presented with colic either renal or ureteric as the most common symptom (87%).
- * Lower urinary stone disease presented with either one or more symptoms of LUTS like dysuria, hesistancy, terminal hematuria and dribbling.
- * Hematuria noticed in 15% cases and positive urine culture found in 21 cases (18%).
- * Palpable mass was found in 5 patients. Hydronephrosis (2 cases) and pyohephnosis (3 cases).

Symptoms / Signs	Upper		Lower		Total	
	No	%	No	%	No	%
Colic / pain	74	87	2	5	76	68
Fever	6	7	2	5	8	7
Hematuria	9	10	8	22	17	15
Palpable Mass	5	5	-	-	5	4
LUTS	4	4	16	43	20	12
+ve urine c/s	14	16	7	19	21	18

4b. ASSOCIATED UROLOGICAL PROBLEM

- * It was observed hydroureteronephrosis was found in 9 cases and were more frequently found in multiple site stones.
- * Pyonephrosis found in 3 cases, of which 1 had staghorn calculus.
- * BPH was the most common associated urological problem with lower urinary stones.
- * One case of genitourinary tuberculosis with stone disease noticed.
- * 6 cases of stricture urethra associated with urethral and bladder stones observed.

Associated problem	No	%
HUN / PUJ Obstruction	9	38
Pyonephrosis	3	12
BPH	8	33
GUTB	1	4
Stricture urethra	6	20

5. METHOD OF DIAGNOSIS

- * USG (KUB) and x-ray (KUB) were done in almost all cases and constitutes 64% and 87.5% respectively as a diagnostic tool for stone disease.
- * CT (Scan) helped in 10 cases of doubtful diagnosis and planning treatment.
- * IVU was done in 37 cases with normal urea, creatinine levels.
- * Ascending urethrogram (AUG) was done in 6 cases of stricture associated with vesical and urethral stones.

Investigation	No	%
X-ray (KUB)	98	87.5%
USG (KUB)	72	64%
IVU	37	33%
CT San	10	9%
Urinalysis for crystals	-	-
AUG	6	1%

- * Serum biochemistry for renal parameters showed \uparrow ed levels in 9 cases (obstructive uropathy).
- * Sr. Biochemistry and 24 hours urine for calcium, phosphorus and oxalate showed 2 case of primary hyperoxaluria.
- * Urinalysis for crystals was not done in any case.

6. TREATMENT MODALITY

a. RENAL CALCULUS

- * One case of renal stone was managed conservatively during this study.
- * Pyelolithotomy was the most common procedure done for renal stone obstructing at pelvis (68%).
- * 3 cases of anatomic nephrolithotomy done and
- * 4 cases of nephrectomy done for obstructed and infected system with non functioning kidney (with opposite side normal functioning kidney).
- * ESWL / PCNL was not done in any case.

Treatment	No	%
Conservative	1	4
Pyelolithotomy	17	68
Nephrolithotomy (Anatomic) ANL	3	12
ESWL / PCNL	-	-
Nephrectomy	4	16

6b. URETERAL STONES

- * Ureterorenoscopy (URS) with lithotripsy and DJ stenting was done in most cases for ureteral stones (51%).
- * Whereas Meatotomy was done in stones at VUJ (17%).
- * Open stone surgery for larger (>1cm) ureteral stones, ie. uretero lithotomy was done in 12 cases.
- * Conservative treatment was observed in 3 cases only, as OP cases were excluded in the study.

Treatment	No	%
Conservative	3	6
URS / Stenting	24	51
Meatotomy	8	17
Uretero lithotomy	12	26

6c. MULTIPLE SITE STONE DISEASE

- * Obstructive uropathy and infection were more frequently observed in multiple stone disease.
- * URS / DJ stenting was observed in 43% and ureterolithotomy was done in 2 cases (14%).
- * One case of post ESWL steinstrasse was noticed, for which URS / DJ stenting was done.
- * One case of nephrectomy done for non functioning calculous pyonephrotic kidney.

Treatment	No	%
Conservative	2	14
URS / Stenting	6	43
Ureterolithotomy	2	14
Pyelolithotomy	1	7
Nephrectomy	1	7
Cystoscopy / vesicolithotripsy / O.I.U	2	14

- B/L stone disease were treated according to the site, side of obstruction and clinical presentation (symptomatic side).

6d. VESICAL AND URETHRAL CALCULUS

- * Cystoscopy and vesicolithotripsy was most commonly done for bladder stones (63%).
- * Vesicolithotripsy with TURP was done in 4 cases of bladder stones associated with BPH.
- * Vesicolithotomy was done in 5 cases.
- * Urethral stones at posterior and bulbar urethra were retrieved by (O.I.U) optical internal urethrotomy to relieve stricture and lithotripsy.
- * One case of fossa navicularis stone was retrieved by meatotomy.

BLADDER STONES

Treatment	No	%
Vesicolithotripsy	15	63
Vesicolithotomy	5	20
Vesicolithotripsy / TURP	4	17

URETHRAL STONES

O.I.U / Lithotripsy	2
Meatotomy	1

7. STONE ANALYSIS

- * Of the 112 cases studied, stone analysis were performed in 39 cases after postoperative stone retrieval.
- * Done in, Renal stones - 23 cases
 Ureteral stones - 10 cases and
 Vesical stones - 6 cases
- * The most common stone was found to be calcium oxalate with phosphate.
- * Struvite stones found in 3 cases of staghorn calculus.

Sl.No.	Composition	No.	%
1.	Pure calcium oxalate	2	5
2.	Calcium oxalate and phosphate	34	87
3.	Struvite (Mg-ammonium phosphate)	3	8
4.	Uric acid	-	-
5.	Cystine	-	-

DISCUSSION

- * The observed age and sex incidence and the review of literature is tabulated below.

	Upper		Lower	
	Observed	Literature	Observed	Literature
Age (Yrs) - Peak Incidence	20 - 40 yrs	3rd - 5 th decade	40 - 60 years	>50 years
Sex (M.F)	1.5 : 1	3:1	96% males	Male predominance

- * Maximum age incidence for urinary calculi observed were in accordance with literature, both for upper and lower urinary stone disease.
- * Sex preponderance was in accordance with literature for vesical stones where as increasing female preponderance was observed for renal / ureteral stones.
- * Of the 112 cases studied, only 5 cases were <20 years of which 2 cases had primary hyperoxaluria (metabolic), as paediatric urolithiasis was excluded.
- * The incidence of calculi were definitely high during hot environment, as evidenced by their presentation during summer season (20% of cases).

- * The role of fluid intake / dietic influence on renal calculus disease could not be evaluated as history of many Patients were highly unreliable.
- * 19% cases have clinical evidence of urinary infection and the most common organism grown in culture was E.coli. Those with multiple site stones and bladder stones mostly had urinary infection.
- * Regarding distribution of calculi along the urinary tract, ureteral calculus were most frequent (41 cases) than renal calculus. Vesical calculus (24 cases) showed increasing incidence as renal stones and 3 cases of urethral stones were observed during the study.
- * Among the renal stones, renal pelvis was the commonest site of stone impaction. 83% had single stone and 17% had multiple stones.
- * There was a slight prepondance on right side both for renal stones (60%) as well as ureteral stones (52%). Literature says several of the comparative study shows left sided preponderance of ureteral calculi.
- * The site of stone impaction for ureteral stones was found to be below the pelvic brim (60%) more often than above pelvic brim (40%).
- * Pain was the commonest clinical presentation, although small minority of patients presented with hematuria (12%) and fever (6%). 4 patients had palpable mass due to hydronephrosis. LUTS were the most common presentation of vesical calculus.

- * Hydroureteronephrosis was commonly associated with upper urinary stones where as BPH (3%) and stricture urethra (20%) were commonly associated with vesical / urethral stones. One case of GUTB was observed during the study.
- * Although the sensitivity of USG (KUB) is 43%, it was observed that USG (KUB) was the most common method of stone diagnosis and it was performed along with X-ray (KUB) in almost all cases. IVP was done in 37 cases and AUG was done in 6 cases. It was the combined methods of investigations helped not only in diagnosing the calculus but also to plan for treatment process.
- * Regarding the treatment, pyelolithotomy was the common procedure done for renal stones obstructing the pelvis. Nephrectomy was performed in 4 cases for obstructed and infected system with non function kidney.
- * Patients with renal stones <1cm and symptoms not subsided by conservative methods were referred to centres for ESWL.
- * URS (Ureterorenoscopy) / lithotripsy / DJ stenting was the most common procedure performed for ureteral stones <1cm size.
- * Open stone surgery for ureteral stone (uretero lithotomy) was done in 12 cases with larger stones (> 1 cm).
- * Meatotomy was done for stones at VUJ.

- * Conservative treatment for ureteric colic was observed only in 3 patients as op cases were excluded in this study.
- * The treatment for multiple site stones was done depending on the side / site of obstruction and the clinical presentation (symptoms). It was found that obstructive uropathy and the infection were more common with multiple site stones.
- * Cystoscopy and vesicolithotripsy was the most commonly done procedure for vesical stones (63%). Open stone surgery for bladder stones were done only in 5 patients with Larger stones. TURP was combined with vesicolithotripsy in cases associated with BPH.
- * Urethral stones were treated with O.I.U (Optical Internal Urethrotomy) for relieving stricture and lithotripsy for posterior urethral stones and stone at fossa navicularis was treated by meatotomy.
- * Of the 112 cases studied, stone analysis were performed in 39 cases after post operative stone retrieval.

Calcium oxalate and phosphate stones were major constituents of stones, and the comparative study also support this. 3 cases of staghorn calculi had struvite stones.

CONCLUSION

- * Urolithiasis is predominantly a disease of males of 3 - 5 th decade.
- * Increasing incidence in female has been noted with upper urinary stones.
- * 2 cases of metabolic disorder (Hyperoxaluria) were found.
- * There was a definite association of stone disease with hot environment and people with restricted fluid intake.
- * Urinary infection was observed in majority of patients with multiple stones and vesical stones.
- * The most common organism in urine culture was E.Coli.
- * Ureteral stones were found more frequently than renal / vesical stones with slight predominance on right side and mostly obstructing below the pelvic brim.
- * Renal stones also show a predominance towards right side with mostly obstructing at Renal pelvis. 83% had single stone whereas 17% had multiple stones.
- * Pain was the commonest presentation although hematuria, fever and palpable mass were found in minority of patients with upper urinary stones. Vesical calculus mostly presents with LUTS.

- * BPH and stricture urethrae were commonly associated with lower urinary tract stones.
- * USG (KUB) and X-ray (KUB) were performed in almost all cases which diagnosed calculus disease in majority of patient.
- * In patients with renal stones, open stone surgeries (Pyelolithotomy / nephrolithotomy) still have a significant role than endoscopic treatment (PCNL). Cases with smaller stones were referred out for ESWL.
- * In patients with ureteral and vesical stones, endoscopic stone retrieval by ureterorenoscopy (URS) and cystoscopy respectively remained promising results than with open stone surgeries.
- * Calcium oxalate and phosphate were the major constituents of stones.

BIBLIOGRAPHY

1. Bailey and Love's short practice of surgery: 24th Edition P-1317 to 1323; P-1347 to 1350.
2. Essential surgical practice - Sir Alfred Cushing; Robert J.C. Steele, Abdul Rahim Moossa: 4th Edition; Page-1269-1280.
3. Drach GW: Urinary lithiasis: chapter 96 and 99; Page - 3209 to 3301 in Campbell's urology.
4. Dretler, S.I.: Calculi/ureteral stone diseases options for management: Urological clinics of North America: June 1998.
5. Patrick SJ, Marthi I Reswiek; Urinary stones: Chap 16 pp. 271 in General Urology; E.A. Tanago and J.W.M.C. Aniah in Appleton and Lange 1900.
6. Urolithiasis-Current concepts and management Protocol: Urological North American Clinics: May 2000.
7. D.E.Nurre: P.D. McIneshey, P.J. Thomas and A.R.Mundy: British Journal of Urology; May 1998.
8. H-G Tiselius, D.Ackermann, P.Alken, C.Buck, N.Gallueni; Guidelines on urolithiasis; European Association of Urology (Medline).