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AYURVEDIC AND MODERN CONCEPTS OF RENAL CALCULI – A CRITICAL REVIEW.

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ABSTRACT -

Renal calculi are mineral deposits in the renal calyces and pelvis that are found free or attached to the renal papillae. They contain crystalline and organic components and are formed when the urine becomes supersaturated with respect to a mineral. Calcium oxalate is the main constituent of most stones, many of which form on a foundation of calcium phosphate called Randall's plaques, which are present on the renal papillary surface. Stone formation is highly prevalent, with rates of up to 14.8% and increasing, and a recurrence rate of up to 50% within the first 5 years of the initial stone Episode. Obesity, diabetes, hypertension and metabolic syndrome are considered risk factors for stone formation, which, in turn, can lead to hypertension, chronic kidney disease and end-stage renal disease. Management of symptomatic kidney stones has evolved from open surgical lithotomy to minimally invasive endourological treatments leading to a reduction in patient. morbidity, improved stone-free rates and better quality of life. Prevention of recurrence requires behavioural and nutritional interventions, as well as pharmacological treatments that are specific for the type of stone. There is a great need for recurrence prevention that requires a better understanding of the mechanisms. involved in stone formation to facilitate the development of more-effective drugs.

Key words - Renal calculi, *Ashmarighna Dravya, Pancha-karma,* Calcium oxalate, Nephrolithotomy, Bilateral renal stones.

INTRODUCTION:

Ayurveda, deals with the wellbeing of mankind. *Charaka*, *Sushruta* and *Vagbhata* followed the scientific methods of study to enhance the perception of *Ayurveda* towards humanity. Renal Calculi is known to mankind since times immemorial. *Ayurveda* deals many diseases of *Mutravaha Srotas* as *Mutrakricchra, Mutraghata*, *Mutrashmari* etc. *Mutrashmari* is one of the most common and distressing maladies among urinary disorders.[1]

"तुल्यतामश्मना यान्ति तस्मात्ताश्मरी विदुः।"[2]

Ashmari (calculi) comprises of two words, i.e., '*Ashma'* and '*Ari*.' '*Ashma'* means a stone and '*Ari'* means enemy. *Ashmari* (calculi), specifically called as *Mutrashmari* (urolithiasis), is a disease of *Moothravahasrotas* (urinary tract) and involves formation of stone, resulting into severe pain as given by enemy.[1]

Ashmari has been mentioned in all ancient texts of *Ayurveda*. Clinical features of the disease are described even in *Vedas*, the oldest repositories of human knowledge. *Sushruta* the father of surgery explained urinary calculus under the heading of *Ashmari* in details including etiological factors, classification, symptomatology, pathology,

complications and its management in a most scientific manner. This disease is dreadful and hence considered one of the "*Mahagadas*" by *Sushruta*, may be owing to its potentiality to disturb the anatomy and physiology of urinary system.[3]

A Renal calculus is a crystalline mineral material which accumulate in the urinary system when one or more crystal forming material separates from supersaturated urine. Renal calculi result from the formation of crystals into large lumps or collection of crystals or in to stone.[4] The term Nephrolithiasis is directly derived from Greek word, nephros (kidney) and lithos (stone). The calculus which may form anywhere in the urinary tract (urolithiasis) or specifically in the ureter (ureterolithiasis). As the stone passes through the urinary tract, it can be eliminated (asymptomatic crystalluria) or can obstruct urinary flow, causing "colicky" pain as it passes. Renal colic is defined as a severe intermittent pain in the flank region that radiates to the lower abdomen, groin and genitalia due to the passage of a stone through the urinary system. Pain is often associated with nausea, vomiting, Hematuria and dysuria.[5]

Etiology and pathogenesis of Urolithiasis or renal stone is not very clear. Risk factors for developing kidney stone are familial, obesity (High BMI), not drinking enough water, eating a diet that's high in protein, sodium (salt) and sugar. Main symptoms of Urolithiasis are pain, burning Micturiton, haematuria, Dysurea, tenderness and fever.

Rugveda and *Atharavaveda* (2000 – 5000 BC) also mentioned the stone and advise people not to ride a horse, *Charaka* has advised medical management and *Sushruta* advised both conservative and surgical removal of stone through perineal root cystolithotomy.[3]

Treatment of renal calculi in modern science is mainly surgery and almost none oral modern medicine available for this purpose. Available management of renal calculi like extracorporeal shock wave lithotripsy, cystolithotomy etc. fail to prevent the recurrences and have many side effects such as sepsis, strictures, splenic rupture, renal hematoma etc.[1]

Ayurveda mentioned a number of herbs for breaking the stone and diuretic herbs for its easy removal by via urine. Ayurvedic texts have mentioned *Mutravirechaniya* (diuretic) and *Ashmarighna Dravya* (lithotriptic) which is very beneficial for urolithiasis. Common drugs mentioned in our texts are *Varuna* (Crataeva nurvala), *Gokshura* (Tribulus terrestris), *Pashanabheda* (Bergenia ligulata), *Shilajit* (Asphaltum Panjabinum), *Yava Kshara* (alkali preparation of Hordeum vulgare L.) etc. *Acharya Sushruta* had also mentioned perineal approach to remove the stone from the bladder when stones are too large and not responding to medicinal treatment.[1]

AIM AND OBJECTIVES:

To study *Mutrashmari* (Renal Calculi) from Ayurvedic and Modern point of view.

RENAL CALCULI:

- DEFINITION

A Renal calculus is a crystalline mineral material which accumulate in the urinary system when one or more crystal forming material separates from supersaturated urine. Renal calculi result from the formation of crystals into large lumps or collection of crystals or in to stone.[4]

- ETIOLOGY

1. In *Ayurveda*, main Etiology responsible for the formation of calculi is non-adoption of *Pancha-karma* (five methods of purification of the body), unhealthy diet and lifestyle.[6]
2. In conventional medicine, there are three important factors responsible for urolithiasis such as heredity, geographical condition and dietetic factors[7].

- RISK FACTORS[1,8]

Following risk factors increase the risk of kidney stones:

1. Obesity- High body mass index (BMI) and more weight gain have direct relation with increased risk of kidney stones.

2. Family history- If any person has family history of kidney stones, then more chance to develop stones.
3. Dehydration- Not drinking enough water and warm climates increase risk of kidney stones.
4. Dietary factors- High protein, high sodium (salt) and high sugar in diet may increase risk of kidney stones.
5. Digestive diseases and surgery- Certain surgery such as gastric bypass surgery and chronic diarrhoea affect absorption of calcium and increase more chance of stone formation.
6. Vitamin A deficiency- It causes desquamation of epithelium which acts as a nidus for stone formation.
7. Hyperparathyroidism causes hypercalciuria causing multiple bilateral stones.
8. Altered urinary crystalloids and colloids.
9. Other medical conditions- Other medical condition such as renal tubular acidosis (RTA), urinary tract infections and cystinuria can increase the chance of stone formation.
10. Urinary stasis due to obstruction to urine flow.

➢ COMPOSITION OF KIDNEY STONE[9]

1. A kidney stone is a cluster of crystals when they formed together to create a hard lump in one or both kidneys.
2. They can vary in size from a few millimetres to several centimetres.
3. The majority of stones will pass out of the body in the urine without any help, but some will require intervention to remove them.
4. The Urinary stone have been developed with the crystals of phosphate, uric acid, magnesium ammonium phosphate with apatite and struvite.
5. Among the urinary stones, calcium- containing stones have been found to about 75% of all urinary calculi, which may be present in the form of crystals of pure calcium oxalate (50%), calcium phosphate (5%) and a mixture of both compounds (45%).
6. The diet can affect the concentration of certain substances in the urine and can affect the acidity of urine.
7. Calcium oxalate stones can be found in any pH of urine. The formation of uric acid stones is more in acidic urine while calcium phosphate stones form in more alkaline urine.

➢ TYPES OF RENAL CALCULI

"चतस्रोऽश्मयों भवन्ति श्लेष्माधिष्ठानाः, तद्यथा- श्लेष्मणा वातेन, पित्तेन, शुक्रेण चेति।" - सु. नि. ३-३[10]

According to *Ayurveda, Ashmari* is of four types i.e., *Vatika, Paitika, Shlaishmika* and *Shukraja*. The *Vatika, Paitika* and *Shlaishmika Ashmari* may be similar to calcium oxalate, uric acid and calcium phosphate calculi respectively.

According to the modern science, Renal stones can be divided into two groups[11]-

1. Primary stones – appear in apparently healthy urinary tract without any antecedent inflammation. These stones are usually formed in acid urine. These usually consist of calcium oxalate, uric acid, cystine, xanthine or calcium carbonate.
2. Secondary stones – usually formed as a result of inflammation. The urine is usually alkaline. These are mostly composed of calcium-ammonium-magnesium phosphate (so called triple phosphate). Majority of secondary stones are phosphate stones.

- CALCIUM OXALATE[12]

a. Called as Mulberry calculi.
b. Common type of stone.
c. It is irregular having sharp projections.
d. It is hard and single.
e. Produces haematuria very early, resulting in deposition of blood over the stone giving a dark colour to the stone.
f. It occurs in infected urine.

g. It is visualised in plain X-ray KUB.

- URIC ACID STONE[12]
  a. Multiple, small, hexagonal, faceted, yellow coloured.
  b. Contain calcium oxalate which makes them opaque. Pure uric acid stones are radiolucent.
  c. Occur in acidic urine.
  d. Common in patients who consume red meat.
  e. Best responsive to lithotripsy.
- CYSTINE CALCULUS[12]
  a. Cystinuria is an inborn error of metabolism which occurs due to decreased reabsorption of cystine from the renal tubules.
  b. Occurs in young girls at puberty.
  c. Increased excretion of cystine in urine results in cystine stones.
  d. Stones are hard and radio-opaque due to sulphur.
- PHOSPHATE STONE[12]
  a. Smooth, round.
  b. Consists of triple phosphate of calcium, magnesium and ammonium.
  c. Dirty white to yellow in colour.
  d. Commonly occur in renal pelvis, it grows within the major and minor calcyes and slowly forms **staghorn calculus**.
  e. This calculus produces recurrent urinary tract infection and haematuria and slowly damages the renal parenchyma.
- DRUG INDUCED STONES[12]
  a. Some drugs are also participating in the formation of renal stones which can be used for another disease.
  b. They are indinavir, atazanavir, guaifenesin, triamterene, silicate (antacids) and Sulfa drugs.
  c. These stones are rare and are always seen on X-Rays (radiolucent).

➢ CLINICAL FEATURES:[13]

- SYMPTOMS
  1. Pain – it is leading symptom of renal calculus. Three types of pain are usually noticed-
     i. Fixed renal pain: If the stone is free and obstructs a calyx or ureteropelvic junction, there will be pull flank pain due to capsular and parenchymal distension. Dull aching or boring type of pain is also experienced in case of big phosphate calculus. The pain is situated in the renal angle posteriorly and in the corresponding hypochondrium anteriorly. This pain characteristically gets worse on movements.
     ii. Ureteric colic: This occurs when the stone attempts to pass down the ureter or temporarily blocks the Pelviureteric junction. It is an agonising pain which radiates from the loin to the groin. The pain comes suddenly during which the patient rolls about drawing up his knees towards the chest, tossing on the bed rather agony. This colic is often accompanied by profuse sweating, nausea and vomiting. The pulse quickens and the temperature goes down below normal. The colicky pain persists for a variable period, usually 6 to 8 hours, and passes off as suddenly as it came. Ureteric colic may pass off with compensatory polyuria or passage of stone in the urine.
     iii. Referred pain: This is rare and is sometimes referred to all over the abdomen. Sometimes pain may be referred to the opposite kidney, which is known as Renorenal reflex.
  2. Hydronephrosis- sometimes patient complains of a lump in the loin and dull ache, which are due to hydronephrosis caused by renal stone.
  3. Occasionally haematuria – Haematuria occurs in small amount to make the urine dirty or smoky during or after an attack of pain.
  4. Urinary tract infection which is relatively symptomless.

- PHYSICAL SIGNS

1. Tenderness- mostly present at the 'renal angle' posteriorly.
2. Muscle rigidity- may be found in many cases. Rebound tenderness anteriorly can be elicited, particularly if acute infection is associated with.
3. Swelling-
   i. It is oval or reniform in shape.
   ii. It is almost fixed and cannot be moved.
   iii. It moves slightly up and down on respiration.
   iv. A kidney lump is ballotable.
   v. Fingers can be insinuated between the lump and the costal margin.
   vi. Abdominal distension and diminished peristalsis may be accompanied.
   vii. A band of resonance can be elicited on percussion.

➢ DIAGNOSIS[9]

1. Blood testing: Blood tests measure too much of calcium or uric acid in the blood. Blood test results help monitor the health of the kidneys and may lead doctor to check for other medical conditions.
2. Urine testing: The 24-hour urine collection test may show that the kidneys excreting too many stone-forming minerals or too few stone-preventing substances. For this test, doctor may request that at least perform two urine collections over two consecutive days.
3. Imaging: Imaging tests may show the availability of kidney stones in urinary tract. Options range from simple abdominal X-rays, which can miss small kidney stones, to high-speed or dual energy computerized tomography (CT) that capture even tiny stones. Other imaging options include an ultrasound, a non-invasive test, and intravenous urography, which involves injecting dye into an arm vein and taking X-rays (intravenous pyelogram) or obtaining CT images (CT urogram) as the dye travels through the kidneys and bladder.

➢ TREATMENT

ACCORDING TO THE AYURVEDIC TEXTS:[1]

In *Ayurvedic* texts mainly three types of drugs *Mutravirechaniya* (diuretic) *Ashmarighna Dravya*(lithotriptic)and *Kshara Karma* (alkali therapy) have mentioned for treatment of *Ashmari roga* (Urolithiasis).

a. *Mutravirechaniya Dravyas* (Diuretic herbs): - In *Mutravirechaieya Dravyas* mainly *Gokshura* (Tribulus terrestris), *Punarnava* (Boerhaavia Diffusa) *Ikshu* (Saccharum officinarum Linn), *Pashanabheda* (Bergenia ligulata) and *Shali* (Oryza sativa Linn.)

b. *Ashmarighna Dravyas*(lithotriptic herbs):– Mainly *Dravyas* of *Veeratarvadi gana*, *Mushkakadi* Gana and *Ushakadi Ganaare* used as *Ashmarighna Dravyas*. *Pashanabheda* (Bergenialigulata), *Varuna* (Crataeva nurvala) *Kulattha* (Dolichos biflorus Linn.), *Shigru mula* (Roots of Moringa olifera Lam.) etc. give *Ashmarighna* effect.

c. *Kshara Karma* (alkali therapy): - Mainly Palasa *Kshara* (Butea monosperma) and *Yava Kshara* (Hordeum vulgare L.) uses for treatment of *Ashmari* (Urolithiasis). *Kshara* act as diuretics, lithotriptic, and alkalizer.

- Herbal drug uses in *Ashmari roga* (Urolithiasis)

1. *Punarnava* (Boerhaavia Diffusa): - *Punarnava* significantly decrease the stone forming substance (calcium, oxalate and phosphorous) in the urine
2. *Varuna* (Crataeva nurvala): - Main constituent of *Varuna* stem bark is lupeol which showed remarkable reduction in renal oxalate level and increase in antioxidant status.

3. Shigru (Moringa Oleifera): - Many studies showed Shigru have analgesic and antispasmodic action. It also prevents stone forming constituents in the kidneys of calculogenic rats.
4. Pashanabheda (Bergenia ligulata): - It prevents calcium oxalate (CaC2O4) crystal formation and decreased antioxidant enzyme activities of the kidneys.
5. Kushmanda seeds (Benincasa hispida Cong.): - Kushmanda significantly decrease the levels of oxalate, protein and calcium level in urinary. Elevated levels of sodium, phosphorus, calcium and Creatinine was reduced by Kushmanda seed.
6. Kantkari (Solanum xanthocarpum): - The study reported that treatment with Kantkari decreases hyperoxaluria, calcium and uric acid, improves renal function, and also produces antioxidant effects.
7. Bakul (Mimusops Elengi): - Alcohol extracts of Bakul showed antiurolithiatic and antioxidant activity. It also reduces deposition of stone forming constituents in the kidneys.
8. Jasmine (Jasminum auriculatum): - help in significant reduction of elevated urinary oxalate.
9. Fenugreek seed (Trigonella foenum-graecum):. In an animal study it was found that Fenugreek seed significantly reduced calcification in the kidney and helped prevent kidney stones.
10. Shatavari root (Asparagus racehorses): This important Ayurvedic rasayana (rejuvenative remedy) was found to inhibit formation of calcium oxalate stones in test animal.
11. Gokshura fruit/root (Tribulus terrestris): This herb is an Ayurvedic rasayana, nephroprotective agent, and is commonly used in India to treat urinary tract disease. In animal studies it prevented the formation of kidney stones and may have even helped to reverse early-stage Urolithiasis. In vitro research suggests that Tribulus also protects against calcium oxalate induced renal injury.
12. Barberry root bark (Berberis vulgaris): Barberry was found to inhibit calcium oxalate crystallization and prevent kidney damage caused by oxidative stress. The water extract was the most effective preparation.

- PATHYAPATHYA CHART[14]

Food habits	Pathya	Apathya
Vegetables	Carrots, Karela (Bitter guard), Potatoes, Radish, Pumpkin.	Brinjal, Beans, Lady finger, Capsicum, Tomato, Cucumber,Palak.
Cereals	Barley, Moong dal, Horse gram	Fine wheat flour (Maida), Oatmeal, Bran.
Fruits	Bananas, Lemon, Apricots, Plums,Apple, Almonds	Black Grapes, Amla, Kiwi, Strawberries, Chickoo.
Miscellaneous	Coconut water, Lemonade, Aloe Vera Juice, pineapple Juice, Butter milk	Coffee, Cashew nuts, Chocolates.
Healthy food(Kidney)	Papaya, Garlic, Yoghurt	Rajmah, Mushroom, Cauliflower, Peas.
Vihara (Activities)	Regular exercises	Day sleep, Controlling natural urges, Sweating

ACCORDING TO THE MODERN TEXTS:[15]

The treatment of renal stone can be divided into nonoperative and operative treatment.

I. Nonoperative treatment-

i. Conservative treatment:

Small stones: The small stones do not require much treatment; they get off the body by drinking precised amount of water. Drinking plenty of water to about 4-5 lit/day helps to get rid of stones throughout the body through urine. The movement of stones creates pain; the moving pain can be treated with certain pain relievers.

Medical therapy for kidney stones: Usually doctors prescribe with alpha blockers; they relax the muscles in the ureters, which help to pass the kidney stone more quickly. Diuretics are also useful for increasing the urine flow to pull out the stone.

ii. Extracorporeal shock wave lithotripsy (ESWL):

In this process the large kidney stones are broken into small pieces by using sound waves or shock waves to create strong vibrations. The small pieces of broken stones can be flushed out of the body through urine.

It is not effective in fragmenting cystine stones because of its crystal lattice.

II. Operative treatment-

1. Endoscopic procedures
2. Open procedures
3. Special situations

- ENDOSCOPIC PROCEDURES

1. Percutaneous nephrolithotomy (PCNL)-

Retrograde pyelography (RGP) is done when the stone is located in the pelvis of the kidney. Under the guidance of C-arm(fluoroscopy) small 1cm incision in the loin made and the PCN needle is passed into the pelvis of the kidney. Then the guidewire is passed through the needle. The needle is withdrawn, with the guidewire left within the pelvis. Graduated dilators are passed and the tract is widened. Then a nephroscope is passed into the pelvis and if the stone is small, it can be taken out and if it is big, it may have to be crushed using ultrasound probes. Ultrasound or pneumatic energy is used for fragmenting.

Complications of PCNL:

Haemorrhage

Injury to colon, sepsis

Urinary leak may persist for a few days

2. Ureteroscopy

Ureteroscopy is the procedure for removing stones which gets stuck in the ureters or bladder. Ureteroscopy can be examined the upper urinary tract stones. This procedure is painful and contains a small wire which connects with a camera at the end. The wire is inserted into the urethra and passed into the bladder for removal of stones with a cage connected with it.

- OPEN PROCEDURES

Depending upon the location of the stone, various types of procedures are done.

1. Pyelolithotomy- removal of the stone through an incision on the pelvis of the kidney when the stone lies within the pelvis.
2. Nephrolithotomy- removal of stone through renal parenchyma is practised when the pelvis is mostly intrarenal or when the kidney cannot be mobilised sufficiently to expose pelvis.
3. Pyelonephrolithotomy- removal of the stone through both the pelvis of the kidney and through the renal parenchyma.
4. Partial nephrectomy- when the stone from a lowermost calyx is impacted, a lower pole nephrectomy can be done.
5. Nephrectomy- removal of whole kidney, indicated in case of hydronephrotic and grossly infected kidney containing stones, provided the opposite kidney is healthy.

6. Nephrostomy- simple drainage of kidney with removal of calculi, should be the operation of choice in grossly infected cases and when patient is too ill.

- SPECIAL SITUATIONS

1. Bilateral renal stones: Kidney with better function has to be operated first. 1-2 weeks later, the opposite side can be operated.
2. If there is pyonephrosis with a severe degree of fever, pain and tenderness, nephrostomy is done and a tube drain is placed in the pelvis of the kidney for drainage of pus and urine. Once the pus is cleared, fresh assessment of renal function is done. If the kidney is nonfunctioning, nephrectomy is done. If the kidney is functioning ESWL/PCNL/open procedure is done. This is known as percutaneous nephrostomy (PCN).

CONCLUSION:

Kidney stone is one of most common problems in developing countries and rest of the World which affects urinary system. Some of the medical condition increase the risk of kidney stones problems such as high fat diet, inadequate nutrition, addition of food that contains oxalate crystals, high protein diet and post-surgery defects. The stones can be developed by common physiological functions such as abnormal growth of Para thyroid glands, which controls the metabolism of calcium. This condition creates high level of calcium in the blood and urine which causes kidney stones. Kidney Stone formation depends upon various factors such as like metabolic, environmental, and nutritional factors. Improvement of diagnostic modalities has led to a better understanding of the disease[9].

In modern medicine its main treatment is surgery with more rate of recurrence. Herbal drugs come out as a miracle for the management and prevention of recurrent urolithiasis. In Ayurvedic texts mainly three types of drugs Mutra-virechaniya (diuretic), Ashmarighna Dravya (lithotriptic) and Kshara Karma (alkali therapy) have mentioned for treatment of Ashmari roga (Urolithiasis). Ayurveda also explains detailed information regarding the dietary habits and lifestyle which is beneficial for Ashmari(urolithiasis)[1].

Thus, this literature review study concludes on the basis of various articles, research papers and textuals about the ayurvedic and modern concepts about renal calculus- its etiology, pathogenesis, types, diagnosis and treatment.

REFERENCES:

1. Saxena V. and Sajwan N., Ashmari (Renal Stone) and its management in Ayurveda, 2018, ISSN: 2456-4419
2. Joshi S.G., Shalyashalakyatantra, Pune Sahitya Vitaran, Ashmari sharkara vidnyaaniya, Chapter 21, pg no. 493
3. Chakradhar K.V., A Comparative Clinical Study on Renal Calculi – An Ayurvedic Perspective, 2012, ISSN: 2279-0853
4. Kok, D. J., Clinical implications of physiochemistry of stone formation. Endocrinol. Metab. Clin. North Am, 2002, 31: 855-867.
5. Pearle MS, Calhoun EA, Curhan GC., Urologic diseases in America project: urolithiasis. J Urol, 2005; 173: 848-857. (Population based data review)
6. Sharma PV, Sushruta samhita, Chaukhambha Vishvabharati, Varanasi, 2005, Nidansthan 3-4(2)
7. Das S., A concise textbook of Surgery, Kolkata, 2001, the kidney and ureter, chapter 48, pg no. 1165-1166
8. Sriram Bhat M, SRB's Manual of Surgery, Jaypee Brothers Medical Publishers, New Delhi, 6th Edition, Urology, Chapter 26, pg no. 1005-1006
9. Khan F., Haider F., KumarSingh M., Sharma P., Kumar T., Neda E.N., A comprehensive review on kidney stones, its diagnosis and treatment with allopathic and ayurvedic medicines, 2019
10. Athavale P.G., Drushtarth Sushrut Chintan, Shree Dhanvantari Book Publishers, Nagpur, Nidansthan 3/3, pg no. 461

11. Das S., The concise textbook of Surgery, Kolkata, 10th edidtion, The Kidney and Ureter, Chapter no. 48, pg no. 1205
12. Shenoy K.R., Manipal Manual of Surgery, CBS Publishers and Distributors Pvt. Ltd., Fourth edition, Kidney and Ureter, Chapter no. 39, pg no. 936
13. Das S., The concise textbook of Surgery, Kolkata, 10th edidtion, The Kidney and Ureter, Chapter no. 48, pg no. 1206,1207,1208
14. Shagufta P., Kidney stone/Renal calculus – A case study, 2018, ISSN 2349-7033
15. Shenoy K.R., Manipal Manual of Surgery, CBS Publishers and Distributors Pvt. Ltd., Fourth edition, Kidney and Ureter, Chapter no. 39, pg no. 937,938,939