



IJRR

International Journal of Information Research and Review  
Vol. 03, Issue, 02, pp.1887-1891, February, 2016



## Review Article

### A REVIEW OF ANCIENT AND MODERN CONCEPT OF UROLITHIASIS

<sup>1,\*</sup>Serajuddin, <sup>2</sup>Iqbal Aziz and <sup>3</sup>Fateh Ali Tipu

<sup>1</sup>P.G. Scholar, Dept., of Jarahat AKTCH, AMU, Aligarh, India

<sup>2</sup>Professor, Dept., of Jarahat AKTCH, AMU, Aligarh, India

<sup>3</sup>P.G Scholar National institute of Unani medicine (NIUM), Bangalore, India

#### ARTICLE INFO

##### Article History:

Received 24<sup>th</sup> November, 2015

Received in revised form

26<sup>th</sup> December, 2015

Accepted 14<sup>th</sup> January, 2016

Published online 28<sup>th</sup> February 2016

##### Keywords:

Urolithiasis,  
Management,  
Review.

#### ABSTRACT

Urolithiasis is a complex process that results from a succession of several physicochemical events including super saturation, nucleation, growth, aggregation, and retention within the urinary tract. It is a disease known from ancient times, and is a problem that has confronted clinicians since the time of Hippocrates, and many family physicians have extensive experience in its clinical management. Urinary tract stones are common more so in men and among Asian especially in warm climates, Medical therapy has been used for many years in the prevention of urinary stones. Medications directed at correcting urinary metabolic abnormalities responsible for promoting stone formation. In addition, intake of citrate-rich juices, such as lemonade, may help to reduce urinary stone formation. This review also summarized the updated clinical management in terms of specific and surgical measures.

Copyright © 2016, Serajuddin et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## INTRODUCTION

Urolithiasis also known as uroliths or calculi, the third most common prevalent urinary disorder that involves the process of stone formation in any part of urinary tract by the successive physicochemical events of super saturation, nucleation, aggregation, and retention at the site of stone formation (Divakar et al., 2010; Bouanani et al., 2010). Traditional system of medicine especially Unani medicine recommends the management of urinary stone disease with drugs followed by surgical procedures, if patient is not relieved. Hippocrates is believed to have been the first person who recognized that high fluid intake increase urine volume and is favorable therapy for urinary disorders (Donald, 1978) Although there are a few recent reports of beneficial effects of medical treatments in enhancing clearance of stones in the distal ureters (Dellabella et al., 2005).

### Ancient Medical Literature

Ancient Arabic medicine was based mainly on classical Greco-Roman works. Muslim scientists did a great duty in the translation of these classical writings in Latin language and transferring them to the European investigators.

\*Corresponding author: Serajuddin,

P.G Scholar, Deptt. of jarahat AKTCH, AMU, Aligarh.

The earliest literary quotations to stone disease, describing symptoms and prescribing treatments to dissolve the stone, are observed within the medical texts of Asutu in Mesopotamia between 3200 and 1200 BC (Shah and Whitfield, 2002) Ancient Greeks, who settled down the basis of philosophy and science, did the first remarkable observations and documentations concerning urinary stone disease. Hippocrates (460–377 BC) described diseases of the kidney and defined symptoms of bladder stones. In his famous Oath of Medical Ethics for physicians, he underlines “I will not cut for the stone, but will leave this to be done by practitioners of this work.” At that time, lithotomy was practiced with only perineal incision by special lithotomists and Hippocrates adamantly stated that wounds of the bladder were lethal (Dimopoulos et al., 1980) Ammonius of Alexandria (276 BC) was the first person to suggest crushing the stone to facilitate its removal, However, his idea did not gain popularity at that time (Riches, 1968) The first recorded details of “perineal lithotomy” were those of Cornelius Celsus (25 BC–40 AD), who lived in Rome and wrote an encyclopedia of medicine (De Medicina) Although he, as a physician, never performed the operation himself, his description of perineal lithotomy was a landmark in the history of urology. This technique, aptly called the “Operation Minor” or “petit appareil”, was used with very little change, indeed if any, for the next 1500 years. Celsus recommended the procedure to be carried out in spring, between ages of 9 and 14, with the help of two strong as well as intelligent assistants.

Calus Plinus Secundus (23–79 AD), Galen (131–200 AD), and Paul of Aegine (625–690 AD) were other outstanding Greek physicians, who were practicing lithotomy, basically as described by Celsus (Urquhart-Hay, 1999) Rhazes (841–926 AD) wrote a book on medicine and described perineal lithotomy almost in the same manner as that carried out by Paul of Aegine (Shah and Whitfield, 2002). Albucasis (Ibn Abbas Alzahrawi, 930–1013 AD) from Cordova demonstrated considerable experience in surgery by modifying the technique of lithotomy as practiced by Ancient Greeks (Abdel-Halim, 2003; Kirkup, 1981). The operation was carried out through a perineal incision down to, then through, the bladder neck to reach the stone and extract it. Comparing the descriptions of the operative technique as carried out during ancient Indian and Greek civilizations, the description given by Albucasis in his book *Al-Tasreef* clearly shows how Albucasis remarkably improved the technique of this operation and reduced its risk (Shah and Whitfield, 2002). Albucasis also invented a new lithotomy scalpel, called “nechil”, with 2 sharp cutting edges and being a novel instrument not known before him he made a drawing for it. The scalpel, called “Novacula” used by the Italian surgeon “Marianus Sanctus” in the 16th century, and the scalpel, used by the English surgeon “Shelsden” in the 18th century, were very close in shape to Albucasis’ scalpel (Shah and Whitfield, 2002). Furthermore, in the ancient and Greco-Roman texts before Albucasis, there is no such emphasis on avoiding the midline perineal incision. That innovation in the technique of perineal cystolithotomy, introduced by Albucasis, was of considerable practical anatomical significance. Albucasis was also the first to use forceps to extract a bladder stone.

Before him, extraction of the stone was by an instrument similar to a small spoon that goes around the stone and scoops it out. In Europe, during Renaissance, most of the well-known lithotomists such as the Italian “Marianus Sanctus” (16th century AC), the French “Jack De Beaulieu” (17th century AC), and the English “Shelsden” (18th century AC) were using Albucasis’ lateral approach incising on the left side. He is also considered as the first to use a tool to confirm the presence of the stone before proceeding with the perineal cystolithotomy operation. He also introduced the 2-stage bladder stone operation in complicated cases. Albucasis’ modifications and innovations spread to Europe in the middle Ages and remained widely adopted until the beginning of the eighteenth century, which witnessed the beginnings of the modern method the suprapubic, instead of the perineal, approach for the removal of bladder stones. Hippocrates (370-460 BC) knew both the renal and vesical types of stones and described the typical ureteric colic and symptoms of bladder calculus, Renal tract stones are common more so in men and among Asian especially in warm climates, Medical therapy has been demonstrated to significantly decrease stone recurrence rates and may be cost effective as well. There are general recommendations that all stone formers should follow, regardless of diagnosis, to decrease stone recurrence rate. Stone formers should drink enough fluid to maintain a urine output of 2 liters per day. A low urine volume is among the most common metabolic abnormality found in stone formers and this is a modifiable risk factor (Prasad *et al.*, 2007) Physicians usually do not treat kidney stone they just medicate the pain until the stones pass out their own. Vegetarian diet, heavy on herbs and liquids, can be helpful in the prevention and treatment of kidney stone.

So the best way to prevent kidney stone is to drink plenty of water and take a vegetarian diet high in magnesium. The standard drugs used to prevent urolithiasis are not effective in all patients, and many of them have adverse effects that compromise their long term use. The present day management of urolithiasis with open renal surgery is unusual and rarely used only since the introduction of Extracorporeal Shock Wave Lithotripsy (ESWL) which has almost become the standard procedure for eliminating kidney stones. However, the problem of urinary stones or calculi is a very ancient one and many remedies have been employed during the ages these stones are found in all parts of the urinary tract, the kidney, the ureters and the urinary bladder and may vary considerably in size. Diet containing low amounts of inferior quality proteins and high intake of animal proteins might augment the risk of stone formation. (Havagiray *et al.*, 2010) With the subsequent developments in endourology (ureteroscopy, percutaneous surgery, and ESWL) there is an ongoing search for even less invasive treatments. And civilization in parallel with scientific developments has brought us to a point where we try not to “cut” our patients for stone disease, as Hippocrates admonishes, and rather manage them with minimal invasive alternatives. Currently, open surgery is performed in less than 4% of patients with urinary stones in reference centers (Matlaga and Assimos, 2002)

### Epidemiology

It is estimated that at least 10% of the population in the industrialized part of the world is afflicted by urinary tract stone disease. Kidney stones are common in industrialized nations with an annual incidence of 0.5% to 1.9 %.( Pendse, 1985) In India upper and lower urinary tract stones occur frequently but the incidence shows wide regional variation (Coe *et al.*, 1992). A high and progressively increasing incidence of urolithiasis has been reported in Udaipur and some other parts of Rajasthan in the western part of India (Tiselius, 2000).

### Pathophysiology of Urolithiasis

Urolithiasis is a comprehensive syndrome comprising exogenous and/or endogenous etiological factors, and multivariate pathogenesis. Urinary stone formation is a result of different mechanisms, whereas renal tubular fluid is supersaturated with calcium, oxalate ions, uric acid or cystine calculi, infection stones result from bacterial metabolism (Ow Moe, 2006). Microcrystal of calcium oxalate monohydrate, the most common crystal in renal systems, irreversibly bind to cell surface microvilli, are subsequently internalized and can stimulate to proliferation (Cheng *et al.*, 2003). Calcium phosphate crystals and organic matrix initially are deposited along the basement membranes of the thin loops of Henle and extend further into the interstitial space to urolithelium, constituting the so-called Randall plaques (Novak *et al.*, 2009). Medical conditions that increase the risk of nephrolithiasis include primary hyperparathyroidism, (Worcester, 2008) obesity, (Taylor *et al.*, 2005) diabetes, (Obligado and Goldfarb, 2008) and gout (Coll *et al.*, 2002). Dietary factors associated with increased risk of nephrolithiasis include low fluid intake and high dietary calcium. However, evidence is mixed for diets with increased animal protein, low dietary magnesium, low dietary potassium, and increased sodium (Stamatelou *et al.*, 2003; Lieske *et al.*, 2006; Colobawalla *et al.*, 1971).

The increase incidence of stone formation is mainly attributed to changes in life style, mostly sedentary habits and an unhealthy dietary plan. Increase in body weight is also an issue in developed and underdeveloped countries. Major risk factors that contribute to stone formation and its recurrence include "classic" risk factors in the urine (low urine volume, hypercalciuria, hyperoxaluria, hyperuricosuria and hypocitrauria). Many factors like- climate, race, ethnicity, age, sex, body weight is also responsible for this boom. Western countries have also encountered this problem, (Hussain *et al.*, 1995). However, the pathogenesis of kidney stone formation is not a simple process and varies largely based on the stone phenotype, Although several theories exist to explain the pathogenesis of renal calculi, the exact cascade of events that lead to kidney stone formation is still unclear (Miller *et al.*, 2007)

**Types of stone:** There are several types of renal stones that differ in composition and pathogenesis. The most common type of kidney stone is composed of calcium oxalate and is caused by metabolic disorders that are often treatable (Barbasa *et al.*, 2002)

- Calcium stones; Hypercalciuria and Hypocitrauria
- Calcium oxalate stones
- Calcium triple phosphate stones or Struvite
- Uric acid stones
- Cystine stones

Protease related stones (Knoll, 2010)

### Clinical Features

The problem of stone formation produces pain and obstruct the flow of urine as the stones formed are unable to travel through ureter, It also causes, severe back ache (the worst pain known as colicky pain is produced in the lower back), bloody, cloudy, and smelly urine, sickness, urge for urination, burning sensation during urination, fever, chills etc., less urine volume, change in urinary pH, and infections (Mayee and Thosar, 2011). Urolithiasis often is incidentally identified in asymptomatic patients who undergo plain radiographs or computed tomographic imaging for another indication (Chatterjee and Pakrashi, 2005) Potential symptoms of nephrolithiasis include: urinary symptoms such as dysuria, hematuria, and urgency; renal colic with severe abdominal and flank pain, nausea and vomiting, urinary tract obstruction and infection and acute, though generally transient, impairment in renal function. Large struvite stones remain in the renal pelvis and may not cause pain. Some studies have suggested that nephrolithiasis also may increase the risk of chronic kidney disease (Khare,?).

### Investigations

Imaging is important to

- Establish the clinical diagnosis is correct,
- locate the stone, and establish the stone size,
- Direct further management with this information,
- CT scanning without contrast is the most accurate imaging available,
- Ultrasounds scan with kidney Ureter Bladder (KUB),

- X – ray (Suman Kumar Mekap *et al.*, 2011),
- Nuclear scans,
- Computed Tomography,
- Retrograde Pyelography (Mayee and Thosar, 2011)

**Management of Urolithiasis:** For treatment of urolithiasis medicinal or surgical procedure is carried out (Orson and Kidney Stone, 2006) the accepted management of stone disease ranges from observation (watchful waiting) to surgical removal of the stone. Various factors such as size of calculi, severity of symptoms, and degree of obstruction, kidney function, location of the stone and the presence or absence of associated infection influence the choice of one type of intervention over the other (Nabi *et al.*, 2007)

### Medical Management

Physicians usually do not treat Urolithiasis they just medicate the pain until the stones pass out their own. Vegetarian diet, heavy on herbs and liquids, can be helpful in the prevention and treatment of kidney stone. So the best way to prevent kidney stone is to drink plenty of water and take a vegetarian diet high in magnesium. The severe nature of renal colic has promoted a lower threshold at which narcotic analgesic, thiazide like diuretic and potassium citrate is prescribed Available standard pharmaceutical drugs used in preventing and curing renal calculi are not effective in all patients and may produce adverse effects on long term use. Physicians need to identify the etiology and then treat with dietary modification and medications that can prevent further stone production. Taking the time to evaluate and classify patients into the proper categories simplifies medical treatment and may ultimately lower overall medical costs and morbidity, and refer to urologist; (Havagiray *et al.*, 2010) Urolithic activity is aimed at the dissolution of urinary stones (Chaban *et al.*, 2014) A great interest in phytotherapy and alternative therapies has been shown in recent years especially those drugs originated from plant. There were several reasons behind this great interest to plant derived drug, like inefficiency of synthetic conventional drugs, abusive of the drug, incorrect use result in side effect problems, difficult access to the conventional drugs in some areas in the world. Moreover, phytotherapeutic agents considered as harmless from folk medicine and ecological view (Goldfrank, 1982; Vulto *et al.*, 1988; Mentz and Schenkel, 1989; Rates, 2001).

### Surgical management (Honeck *et al.*, 2009)

The present day management of urolithiasis with open renal surgery is unusual and rarely used only since the introduction of Extracorporeal Shock Wave Lithotripsy (ESWL) which has almost become the standard procedure for eliminating kidney stones.

- Approximately 1 in 5 stones will not pass spontaneously and will require some form of intervention.
- If the ureter is blocked or could potentially become blocked (e.g., when a larger stone will fragment following other forms of therapy), a JJ stent is usually inserted using a cystoscope. It is a thin hollow tube with both ends coiled (pigtail). It is also used as a temporary holding measure, as it prevents the ureter from contracting and thus reduces

pain, buying time until a more definitive measure can be undertaken.

Procedures to remove stones include, (Renal or ureteric colic, 2015)

- Extracorporeal shock wave lithotripsy (ESWL) - shock waves are directed over the stone to break it apart. The stone particles will then pass spontaneously.
- Percutaneous nephrolithotomy (PCNL) - used for large stones (>2 cm), staghorn calculi and also cystine stones. Stones are removed at the time of the procedure using a nephroscope.
- Ureteroscopy - this involves the use of laser to break up the stone and has an excellent success rate in experienced hands.
- Open surgery - rarely necessary and usually reserved for complicated cases or for those in whom all the above have failed - e.g., multiple stones.

Several options are available for the treatment of bladder stones. The percutaneous approach has lower morbidity, with similar results to transurethral surgery while ESWL has the lowest rate of elimination of bladder stones and is reserved for patients at high surgical risk (Torricelli *et al.*, 2013)

## Conclusion

Urolithiasis is a complex process that has confronted clinicians since the time of Hippocrates, clinical management in terms of specific and surgical measures known from ancient times

## REFERNECES

- Abdel-Halim, R. E., Altwajjiri, A. S., Elfaqih, S. R. and Mitwalli, A. H. 2003. "Extraction of urinary bladder stone as described by Abul-Qasim Khalaf Ibn Abbas Alzahrawi (Albucasis) (325–404 H, 930–1013 AD). A translation of original text and a commentary," Saudi Medical Journal, vol. 24, no. 12, pp. 1283–1291. View at Google Scholar · View at Scopus
- Barbasa, C., Garciaa, A., Saavedra, L. and Muros, M. 2002. Urinary analysis of nephrolithiasis markers. Journal of Chromatography B.; 781: 433–455.
- Bouanani, S., Henchiri, C., MigianuGriffoni, E., Aouf, N. and Lecouve, M. 2010. Pharmacological and toxicological effects of Paronychia argentea in experimental calcium oxalate nephrolithiasis in rats. *J Ethnopharmacol*, 129:38–45.
- Chaban, N.G., Stepanov, A.E., Rapoport, L.M., Tsarichenko, D.G. and Podvolotsky, D.O. 2014. Phytochemicals basics of creating products for calcium oxalate stones litholysis. *Bulletin of MITHT* 9(2): 37-45.
- Chatterjee, A. and Pakrashi, S.C. 2005. The Treatise on Indian Medicinal Plants, 2nd ed. New Delhi: *National Institute of Science Communication and Information Resources*, Vol 1.
- Cheng, H.Y., Lin, T.C., Yu, K.H., Yang, C.M. and Lin, C.C. 2003. Antioxidant and free radical scavenging activities *Terminalia chebula*. *Biol Pharm Bull.*, 26: 1331 – 1335.
- Coe, F.L., Parks, J.H. and Asplin, J.R. 1992. The pathogenesis and treatment of kidney stones. *N. Engl. J. Med.*, 327: 1141-52
- Coll, D.M., Varanelli, M.J. and Smith, R.C. 2002. Relationship of spontaneous passage of ureteral calculi to stone size and location as revealed by unenhanced helical CT. *AJR Am. J. Roentgenol*, 178: 101- 103.
- Colobawalla, B.N. 1971. Incidence of urolithiasis in India. ICMR Tech Rep Series No 8. 42-51.
- Dellabella, M., Milanese, G. and Muzzonigro, G. 2005. Medical-expulsive therapy for distal ureterolithiasis: randomized prospective study on role of corticosteroids used in combination with tamsulosin-simplified treatment regimen and health-related quality of life. *Urology* 66: 712–715.
- Dimopoulos, C., Gialas, A., Likourinas, M., Androustos, G. and Kostakopoulos, A. 1980. "Hippocrates: founder and pioneer of urology," *British Journal of Urology*, vol. 52, no. 2, pp. 73–74. View at Publisher · View at Google Scholar · View at Scopus
- Divakar, K., Pawar, A.T., Chandrasekhar, S.B., Dighe, S.B. and Divakar, G. 2010. Protective effect of the hydro-alcoholic extract of *Rubia cordifolia* roots against ethylene glycol induced urolithiasis in rats. *Food Chem Toxicol*; 48:1013-1018.
- Donald, P.G. 1978. Sruvit stones. *Kidney international*;13:372-382.
- Goldfrank, L. 1982. The Pernicious Panacea: Herbal Medicine. *Hospital Physician*; 10:64-86.
- Havagiray, R., Shashi, A., Jain, S.K. and Sabharwal, M. 2010. Herbal treatment for urinary stones. *Ijpsr*. 1: 24-29.
- Havagiray, R., Shashi, A., Jain, S.K. and Sabharwal, M. Herbal treatment for urinary stones. *Ijpsr*. 1: 24-29.
- Honeck, P., Wendt-Nordahl, G. and Krombach, P. *et al.* 2009. Does open stone surgery still play a role in the treatment of urolithiasis? Data of a primary urolithiasis center. *J Endourol*.
- Hussain, M., Lal, M., Ahmed, S., Zafar, N., Naqvi, S.A., Abidul-Hassan, Rizvi S. 1995. Management of urinary calculi associated with renal failure. *Am. J. Urol.*, 45(8):205-208.
- Khare, C.P. *Indian Herbal Remedies: Rational Western Therapy, Ayurvedic, and Other Traditional Usage*.
- Kirkup, J. R. 1981. "The history and evolution of surgical instruments.I. Introduction," *Annals of the Royal College of Surgeons of England*, vol. 63, no. 4, pp. 279–285. View at Google Scholar · View at Scopus
- Knoll, T. 2010. Epidemiology, pathogenesis and pathophysiology of urolithiasis. *Europe Urol Supplements*. 9(12): 802 – 806.
- Lieske, J.C., Pena de la Vega, L.S., Slezak, J.M., Bergstralh, E.J., Leibson, C.L. and Ho. K.L. 2006. Renal stone epidemiology in Rochester, Minnesota: An update. *Kidney Int.*, 69:760-764.
- Matlaga, B. R. and Assimos, D. G. 2002. "Changing indications of open stone surgery," *Urology*, vol. 59, no. 4, pp. 490–493. View at Publisher · View at Google Scholar · View at Scopus
- Mayee, R. and Thosar, A. 2011. Evaluation of *Lantana camara* Linn. (*Verbenaceae*) for antiurolithiatic and antioxidant activities in rats. *Int J Pharm Clin Res.*, 3(1): 10 -14.
- Mayee, R., Thosar, A. 2011. Evaluation of *Lantana camara* Linn. (*Verbenaceae*) for antiurolithiatic and antioxidant activities in rats. *Int. J. Pharm Clin. Res.*, 3(1): 10 -14.
- Mentz, L.A. and Schenkel, E.P. 1989. A coerência e a confiabilidade das indicac,ões terapêuticas. *Caderno de Farma'cia* 5(1-2):93-119.

- Miller, N.L., Evan, A.P. and Lingeman, J.E. 2007. Pathogenesis of renal calculi. *Urol Clin North Am.*, 34: 295–313
- Nabi, G., Downey, P., Keeley, F., Watson, G. and McClinton, S. 2007. Extra-corporeal shock wave lithotripsy (ESWL) versus ureteroscopic management for ureteric calculi. *Cochrane Database Syst Rev.*, CD006029
- Novak, T.E., Lakshmanan, V., Trock, B.J., Gearhart, J.P. and Matlaga, B.R. Sex prevalence of pediatric kidney stone disease in the united states: an epidemiologic investigation. *Urology.* 2009; 74: 104 – 107.
- Obligado, S.H. and Goldfarb, D.S. The association of nephrolithiasis with hypertension and obesity: a review. *Am J Hypertens.* 2008; 21: 257-264.
- Orson, W., Kidney stone. 2006. Pathophysiology and medical management. 367: 333
- Ow Moe. 2006. Kidney stones: Pathophysiology and medical management, *Lancet.* 367: 333 – 344.
- Pendse, A.K. 1985. Urolithiasis in Udaipur and Jodhpur: A comparative study on prevalence and urinary profile. *Bull III, Ann Conf Urol Soc India* 12.
- Prasad, K.V.S.R.G., Sujatha, D., Bharathi, K. 2010. Herbal Drugs in Urolithiasis . *Pharmacognosy Reviews.* 2007; 1: 175-177.
- Rates, S.M.K. 2001. Plants as a source of drugs (Review). *Toxicon* 39:603-13.
- Renal or ureteric colic - acute; NICE CKS, April 2015 (UK
- Riches, E. 1968. “The history of lithotomy and lithotripsy,” *Annals of the Royal College of Surgeons of England*, vol. 43, no. 4, pp. 185–199. View at Google Scholar · View at Scopus,
- Shah, J. and Whitfield, H. N. 2002. “Urolithiasis through the ages,” *BJU International*, vol. 89, no. 8, pp. 801–810, View at Publisher · View at Google Scholar · View at Scopus
- Stamatelou, K.K., Francis, M.E., Jones, C.A., Nyberg, Jr L.M. and Curhan, G.C. 2003. Time trends in reported prevalence of kidney stones in the United States: 1976-1994. *Kidney Int.*, 63:1817-1823.
- Suman Kumar Mekap, Satyaranjan Mishra, Sabuj Sahoo, Prasana Kumar Panda. 2011. Antiurolithiatic activity of *Crataeva magna* Lour. bark. *Ind J Nat Prod and Resour.* 1(2): 28 - 33.
- Taylor, E.N., Stampfer, M.J. and Curhan, G.C. 2005. Obesity, weight gain, and the risk of kidney stones. *JAMA* 293: 455-462.
- Tiselius, H.G. 2000. Stone incidence and prevention. *Brazilian Journal of Urology*, 26, 452-462.
- Toricelli, F.C., Mazzucchi, E. and Danilovic, A. *et al.* 2013. Surgical management of bladder stones: literature review. *Rev Col Bras Cir.*, May-Jun;40(3):227-33.
- Urquhart-Hay, D. 1999. “The knife and the stone,” *Australian and New Zealand Journal of Surgery*, vol. 69, no. 4, pp. 267–275. View at Publisher · View at Google Scholar · View at Scopus
- Vulto, A.G., Smet, P.A.G.M. 1988. In: Dukes MMG (Ed.). *Meyler’s Side Effects of Drugs*, 11th Ed. Elsevier, Amsterdam, 999-1005.
- Worcester, E.M. and Coe, F.L. 2008. Nephrolithiasis. *Prim Care.*, 35: 369- 391.

\*\*\*\*\*