Chapter 1

Introduction

1.1 AN OVERVIEW TO UROLITHIASIS

Urolithiasis is a Greek word which means the formation of urinary calculi. The urinary calculus is the stone formation in any part of the urinary system. According to its venue of formation, the urolithiasis can be classified as of Nephrolithiasis, Ureterolithiasis and Cystolithiasis (Fig 1.1). If the calculi are formed inside the kidney, it is known as Nephrolithiasis. The condition of growth of urinary stones in the ureters is commonly called as Ureterolithiasis. The stones can be found even in bladders, which are known as Cystolithiasis (Cumming, 1997)

Fig 1.1 Overview to types of urolithiasis

Archaeological studies proved that even ancient man was suffering from urinary stone diseases back in BC 5000 in Egypt. Bladder stones were more prevalent in olden ages whereas kidney stones were detected nearly 100 years ago. The earliest example of urinary calculi was discovered in 1901 by Sir Grafton Elliot Smith from a man buried in a tomb in Upper Egypt.
1.1.1 THE CHEMISTRY OF STONE FORMATION

The Urinary stone formation is a biological process which involves the main principle called crystallization. In order to form crystalline particles in kidney and urine, the body will undergo two main physico-chemical processes i.e, (i) Supersaturation, which is a thermodynamic process and the core reason for the nucleation of crystals., and (ii) A kinetic process which includes nucleation, growth, aggregation and phase transformation of crystals (Kok et al., 1988).

Supersaturation is the excess of free energy and is an unstable state. In order to reach a stable state, the supersaturated solution will have a tendency to deposit excess material in solution as a solid phase (Finlayson, 1978). The factors that result in the supersaturation conditions are urinary pH, solute concentration, ionic strength and urinary complex condition. The ionic strength is determined by the concentration of monovalent ions. The increase in ionic concentration leads to the decrease of activity product and it reaches to a specific point called as solubility product (Ksp). Any concentration above this can initialize crystal growth and nucleation. The solution beyond this stage will never form into crystals or initialize nucleation. All the crystals which occur in urine during this stage will be dissolved or will be form unsaturated compounds inside the urine.

When the solution gets more concentrated, then the activity product reaches to the new stage called formation product (Kfp). Above this stage is unstable and crystallization will start. This crystallization will boost the nucleation and thereby increasing the stone growth. The various state of saturation has been schematically represented in Fig 1.2

1.1.2 THEORIES OF STONE FORMATION

Various theories have been developed to explain the stone formation in which the most relevant ones are briefed below:
1.1.2.1 THE MATRIX THEORY

This theory was proposed by Boyce and Sulkin, 1956. The urinary stones, which contains its organic matrix will be deposited inside a matrix. This is due to the bonding of mucoprotein chemically by sulphate mucopoly-saccharide. This

![Fig 1.2 Stages of Saturation](image-url)

- Initializing the nucleation
- No significant effect from inhibitors
- Crystal growth occurs
- Crystal aggregation occurs
- Inhibitors active
- Involvement of matrix
- No formation of crystals
- Dissolution of existing stones

Fig 1.2 Stages of Saturation
mucoprotein matrix is the reason for stone formation by initializing nucleation and facilitating crystal growth. The contents or the composition of the matrix depends upon the type of crystal content.

1.1.2.2 CRYSTALLIZATION INHIBITOR THEORY

According to this theory, urine is always supersaturated with respect to the stone forming salts and the normal person will excrete these with the urine. This theory was proposed by Vermeulen et al., 1958. The stone forming patients have a less protection from crystal formation because of decreased excretion of crystalluria inhibitors. Further investigation proved that citrate, pyrophosphate and magnesium are the main inhibitors in the urine.

1.1.2.3 HYPER EXCRETION CRYSTALLIZATION THEORY

The formation of crystal which has been explained in Fig 1.2 explains the hyper excretion theory. This theory deals with two basic factors, supersaturation and nucleation where the highly saturated urine leads to the nucleation of crystals as discussed above.

1.1.3 DIFFERENT TYPES OF URINARY STONES ACCORDING TO ITS CHEMICAL COMPOSITIONS AND FACTORS OF ORIGIN

The natural urinary stones vary from person to person in their size, texture and chemical composition. Out of millions of stones analysed throughout the world, the researchers found that majority of the stones are mainly composed of some of the common chemical constituents. According to these chemical constituents, the stones are categorized into different types which are shown in Table 1.1.
Table 1.1 The most frequently observed chemical composition of urinary stone and its mineral names and chemical formula

<table>
<thead>
<tr>
<th>Chemical Nomenclature</th>
<th>Chemical Formula</th>
<th>Mineral Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium oxalate monohydrate</td>
<td>CaC$_2$O$_4$.H$_2$O</td>
<td>Whewellite</td>
</tr>
<tr>
<td>Calcium oxalate dihydrate</td>
<td>CaC$_2$O$_4$. (2+x) H$_2$O</td>
<td>Wheddelite</td>
</tr>
<tr>
<td>Calcium phosphate</td>
<td>Ca$_3$(PO$_4$)$_3$(OH)</td>
<td>Apatite</td>
</tr>
<tr>
<td>Calcium hydrogen phosphate</td>
<td>CaHPO$_4$.2H$_2$O</td>
<td>Brushite</td>
</tr>
<tr>
<td>β- Tricalcium phosphate</td>
<td>β-Ca$_3$(PO$_4$)$_2$</td>
<td>Whitlockite</td>
</tr>
<tr>
<td>Octacalcium phosphate</td>
<td>Ca$_8$H$_2$ (PO$_4$)$_6$.6H$_2$O</td>
<td></td>
</tr>
<tr>
<td>Magnesium ammonium phosphate hexahydrate</td>
<td>MgNH$_4$PO$_4$.6 H$_2$O</td>
<td>Struvite</td>
</tr>
<tr>
<td>Magnesium hydrogen phosphate trihydrate</td>
<td>MgHPO$_4$.3H$_2$O</td>
<td>Newberryite</td>
</tr>
<tr>
<td>Uric acid</td>
<td>C$_5$H$_4$N$_4$O$_3$</td>
<td></td>
</tr>
<tr>
<td>Uric acid dehydrate</td>
<td>C$_5$H$_4$N$_4$O$_3$. 2H$_2$O</td>
<td></td>
</tr>
<tr>
<td>Monosodium urate monohydrate</td>
<td>NaC$_5$H$_3$N$_4$O$_3$. H$_2$O</td>
<td></td>
</tr>
<tr>
<td>Ammonium acid urate</td>
<td>NH$_4$C$_5$H$_3$ N$_4$O$_3$</td>
<td></td>
</tr>
<tr>
<td>Xanthine</td>
<td>C$_5$H$_4$N$_4$O$_2$</td>
<td></td>
</tr>
<tr>
<td>Monosodium xanthine</td>
<td>NaC$_5$H$_3$N$_4$O$_2$</td>
<td></td>
</tr>
<tr>
<td>Hypoxanthine</td>
<td>C$_5$H$_4$N$_4$O</td>
<td></td>
</tr>
<tr>
<td>l- cystine</td>
<td>(-SCH$_2$CHNH$_2$COOH)$_2$</td>
<td></td>
</tr>
<tr>
<td>Silicon dioxide</td>
<td>SiO$_2$</td>
<td>α- Quartz</td>
</tr>
</tbody>
</table>
1.1.3.1 CALCIUM OXALATE STONES

Calcium oxalate stones are the most frequently occurring kidney stones in human being. In total an average of 70-75 % of stones will contain a derivative of calcium oxalate. Men are more prone to calcium stones than women. The calcium oxalate stones are mainly of two types namely calcium oxalate monohydrate (COM) and calcium oxalate dihydrate (COD).

COM stones are known as Whewellite, which is commonly found in blackish brown colour. COM crystals can be observed in various shapes and structures like dumbbells and spindles as shown in Fig 1.3.

![Fig 1.3: The optical image of COM crystals](image)

The mineral name of COD is Weddelite, which is light yellow in colour. The COD appears mainly in octahedral in shape as shown in Fig 1.4.
The higher content of calcium in urine, which medically termed as hypercalciuria, is the main reason of the formation of calcium oxalate stones. The high intake calcium capsules and vitamin D capsules leads to the sedimentation of calcium particles in kidney. Even the patients detected with Hyperparathyroidism is highly prone to calcium oxalate crystals since the rise of parathyroid hormone will take the calcium from the bone and passes it through the blood. More than the high level of calcium, even the increase in the level of oxalate also leads to the stone formation. Some people are born with a genetic disorder, in which a lot of oxalate will be excreted through urine which is medically termed as hyperoxaluria.

1.1.3.2 CALCIUM PHOSPHATE STONES

Calcium phosphate stones are less in common compared to calcium oxalate stones, though it has been observed that 50% of the urinary stone contains calcium phosphate traces. The calcium ions combine with phosphoric to produce these kinds of stones. Calcium phosphate stones are mainly found in five different types.

Carbonate apatite is the main type of calcium phosphate stones, which is a carbonated calcium phosphate stones. These stones mainly grow when there are infections. They appear in white or yellow shade which has a chalky texture as interior. Hydroxyapatite is another type of stones in this category which is similar to carbonate apatite but does not contain carbon (Prien and Prien Jr., 1968). These stones are
uninfected stones and appear in hexagonal shape. The calcium apatite stone is shown in Fig 1.5.

Brushite is another but uncommon type of calcium phosphate stones which is mainly associated with apatite or calcium oxalate monohydrate stones (Prien and Clifford Frontel, 1947). They appear in cream white colour with a bladed structure and soft in texture. Anhydrous Tri calcium phosphate (Whitlockite) highly resembles the apatite stones in its structure. It is rhombohedral in crystallization and appears in a creamy white colour (Prien and Clifford Frontel, 1947). Octocalcium phosphate stones are the uncommon type of stones that appear in calcium phosphate category, in which this stone is highly found along with apatite stones. They are white fine grained powder in structure.

![Calcium apatite stones](image)

**Fig 1.5: Calcium apatite stones**

1.1.3.3 STRUVITE STONES

Magnesium ammonium phosphate hexahydrate (MAPH) or struvite stone are more prone to women. MAPH stones happen due to the infections present in the urinary tract. These stones are very hard and painful one and even can be staghorn calculi. Struvite stones can be found in mixture with other stone types whereas the pure struvite stones are in white or yellowish shade with rough texture. These staghorn calculi mainly occur in alkaline infected urine. The struvite urinary crystals can possess varies shapes like dendrite, leaf shaped crystals etc as shown in Fig1.6.
1.1.3.4 URIC ACID STONES

Some people, whose purine metabolism is weak, excrete more amount of uric acid in urine which leads to a medical condition termed as hyper uricemia. This condition is the main cause in the production of uric acid stones. They mainly appear as a combination with other stone types though the pure uric acid stone will appear in rounded shape with red or orange in colour as shown in Fig 1.7. The uric acid crystals are orthorhombic in structure and they are radiolucent (Prien and Prien Jr., 1968).

1.1.3.5 XANTHINE AND CYSTINE STONES

Xanthine and Cystine stones are also a by-product of improper genetics in human. These are very rare kind of urinary stones. Xanthine stones appear in round brown in colour (Sutor, 1990). Cystine stones can be easily identified since it has a waxy appearance which will be in yellow colour and gets darker with time and the cystine urinary crystals exhibit a hexagonal shape (Prien and Prien Jr, 1968).

1.1.3.6 DRUG LITHIASIS

Drug lithiasis is the common category which contains many other type of stone composition which mainly formed due to the excessive intake of certain drugs. These stone types do not generally possess a typical shape or size and can accompany with the other prominent stone compositions.
One of the common drug stone is silicate stones, which is caused due to the excessive intake of antacids and painkillers which contain magnesium silicate or magnesium alumina meta silicate (Stoller and Bolton 1995). Some of the other types of drug stones are triamterene, allopurinol etc.

Fig 1.7: Uric acid kidney stone

1.2 TREATMENTS OF UROLITHIASIS

1.2.1 PERCUTANEOUS NEPHROLITHOTOMY (PCN)

Tunnel surgery or Percutaneous Nephrolithotomy is the current surgical procedure prevailing in hospitals to remove urinary stones. These surgical procedure is opted in the condition that

- The stone is making infection in the urinary system
- The stone is too large and cannot be passed through the ureters
- If the patient is suffering from unbearable pain.
1.2.1.2 PROCEDURE

This surgery is mainly done for big stones near to pelvic region. A pyelogram is used initially to locate the position of the stone and after that a 1 cm incision is made in the back side of the body near the kidney. A PCN needle connected to the guide wire will be passed into the pelvis of the kidney which is shown in Fig 1.8. The needle will be then withdrawn placing the guide wire inside the pelvis. The dilators and working sheath is passed through the guide wire and a nephroscope is passed later to remove the stones from the kidney.

![Image of Percutaneous Nephrolithotomy](image)

Fig 1.8. The working illustration of Percutaneous Nephrolithotomy surgical setup

1.2.1.3 DISADVANTAGE OF TUNNEL SURGERY

Though this treatment is widely used, there are very prominent disadvantages or after effects for this tunnel surgery (Wynberg JB et al., 2012) as follows:

- Damage to colon
- Urine leakage may persist for more than a week
- Prone to urinary infection
- Bleeding
1.2.2 EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY (ESWL)

ESWL was a revolutionary invention or a boom in the medical history. This treatment is a non invasive technique used to remove the renal stones. The primary study on this technique has started in Germany during 1960’s by the Dornier Laboratories (Spinark and Resnick, 1990). This technique was supported by laws of acoustic physics.

During 1980, the medical practitioner Chaussy has successfully treated his patient using this technique (Chuassy 1982) and this success of ESWL has chosen it to be the efficient mode of treatment for urolithiasis. The patients were highly accepting this treatment since it does not involve any cut or scar in the patient body, and they can take the treatment as being an outpatient.

1.2.2.1 PRINCIPLE AND COMPONENTS OF ESWL

A typical shock wave lithotripter consists of mainly four components namely:

- Energy source or shock wave generator
- Focussing unit
- Coupling Medium
- Stone localization System

The shock wave will be produced from the energy source in the lithotripter in mainly three different ways.

Electrohydraulic (EH) shock wave generators are the primary and most common shock wave generator which used spark gap technology (Bourlion et al.,1994). In this technique a spark gap electrode is placed inside a container filled with water. A high voltage electric current will be made to pass through the electrode which results in the discharge of energy in the form of vaporization bubbles inside the water. These bubbles will expand and collapse immediately which results in the production of high pressure waves.

In electromagnetic shock wave (EM) generator, an electromagnetic coil is used. A high voltage is passed through the coil, which results in a frequency vibration. Its
amplitude is increased by passing through secondary coils and through adjacent metallic walls. The high frequency vibrations will be made to pass through the water which results in the formation of shock waves.

The last type of shock wave generating source is Piezoelectric (PE) shock wave generator. This generator uses the basic principle of piezoelectricity in which they use piezoelectric crystals or ceramics which will be placed inside the water. High frequency electric pulses will be passed through these crystals which results in producing a mechanical stress to the crystals. This continuous stress inside the water produces shock waves. The three different source generators are showed in the Fig 1.9.

Fig 1.9: Different types of shock wave generators used in ESWL
The shock waves generated in the source will be focussed towards the stone location in the patient using a focussing system. The focusing system changes according to the source used in the lithotripter. In EH a system, a metallic ellipsoid is used as a focussing system whereas in EM systems, an acoustic lens is used to focus the shock wave. In PE systems, the piezoelectric crystals or ceramics will be arranged as a hemispherical curve, which act as a focussing unit.

The shock waves produced have to travel from its generator to the patient’s body where both the surfaces hold different densities. As the wave pass through two different medium of different densities, it is prone to have a loss in its energy. In order to avoid this, a coupling medium is used. Water has been used as a common coupling medium in shock wave lithotripter, since the density of the water is similar to the density of soft tissues in the body.

Localization system is mainly imaging technique which is used to find the position of stone, direct shock waves towards the stones and to track the progress of the treatment and change the mode if necessary. The main imaging systems clinically used is fluoroscopy and ultrasonography. The fluoroscopy technique is very widely used and is an excellent method to detect radio opaque substances inside the body but is a failure to detect radiolucent stones like uric acid stones. Ultrasonography can overcome this disadvantage since this technique can detect both radio opaque as well as radiolucent objects inside the body and this technique prevent the body from the exposure of ionic radiations too. The new technology ESWL machine is shown in Fig 1.10.

![Fig 1.9: Clinically used ESWL system](image)
1.2.2.2 DISADVANTAGES OF ESWL

Though the invention of ESWL was a revolution in the history of treatments, but still they face some of the major disadvantages as given below:

- Not significantly successful for big stones
- Treatment may require multiple sessions to clear the entire stones
- Risk of hypertension
- Risk of uncontrolled diabetes
- Pain and discomfort after treatment
- May cause ureters damage

1.2.3 LASER LITHOTRIPSY

Laser lithotripsy is the most recent development in the field of surgical treatment for urolithiasis, which overcomes the disadvantage of ESWL. Laser lithotripsy is an invasive technique in which the laser light is used to disintegrate the stones in the urinary system. This technology was first invented at Wellman Center for Phytomedicine at Massachusetts General Hospital in 1980s.

1.2.3.1 PROCEDURE OF LASER LITHOTRIPSY

In Laser lithotripsy the laser light is passed through the an optical fibre into the body where stone is present and this energy from the laser light falls to the stones and ablate it in seconds as shown in Fig 1.11. The laser lithotripter consists of a laser source, an optical fibre and ureteroscope. The most commonly used laser source is Holmium: YAG lasers which have a wavelength of 2100 nm. They have the combined effect of CO₂ and Nd: YAG lasers which are prominent is ablation and coagulation hence has been widely used than other lasers. Effect of Thulium lasers in medical application is also under study. The lithotripter source will have an inbuilt laser where its power, frequency and energy can be adjusted according to requirement of surgery.
Ureteroscope is a device which is used to locate the stone as well as helps to monitor the movement of optical fibre inside the body. This scope will be inserted inside the urinary tract of the patient. Optical fibre carries the laser light. These fibers are inserted in the working channel of ureteroscope and this scope leads the fibre to touch the urinary stones. The clinical setup of laser lithotripsy is shown in Fig 1.12
1.2.3.2 DISADVANTAGE OF LASER LITHOTRIPSY

The laser lithotripsy treatment has overcome almost all the disadvantages of ESWL, but this treatment itself has some of the cons. Since the treatment involves a laser source, which is highly expensive, the cost of treatment is too high which is not affordable for everyone in the society. Since the treatment does not reach to all the communities, the treatments efficiency has been questioned globally.

1.2.4 AYURVEDIC TREATMENT AND MEDICATIONS

In this 21st century, for majority of diseases, alternative medicines have been a high area of interest for researchers. This has been proved by the amount of research carried out in various alternative areas of medicine other than Allopathy like Ayurveda, Siddha, and Unani.

Ayurveda is a branch of medical science which was developed in India thousands of years ago. This is a traditional medicine which has derived from Vedic tradition (David et al., 2001). Ayurveda is one of the disciplines of ‘Upaveda’ in Vedic tradition. Ayurveda medical practise includes the intake of herbal medicines, oil massage, metal supplements and surgical techniques. The Ayurveda says that there are three elemental substances in the body called the ‘Doshas’ which include Vatta, Pitha and Kapha. According to Ayurveda, the imbalance in these three components in the body is the reason for all medical ailments.

1.2.4.1 AYURVEDA FOR UROLITHIASIS

Kidney stone or urolithiasis can be cured using medicinal plants which are ‘diuretic’ in nature. Diuretic is the property of increasing the flow of urine. In Ayurveda, there are lot of medicinal plants which come under this category, in which some of the prominent Ayurvedic plants used traditionally for curing kidney stones is described below

*Bergenia Ligulata (Pashanabeda)* is the most common and widely used diuretic plant which has shown its effect as an alternative medicine for urolithiasis as well as hypertension. This plant belongs to the family Saxifragaceae and genus *Bergenia* (Umashankar et al., 1999). This plant has been experimentally proved for the
inhibition of calcium carbonate stones and proved to have antioxidant effects which prove its curing effect in renal diseases. These plants are mainly found in Indian subcontinent.

*Arctostaphylos uva-ursi* is another folk medicine which has been used traditionally to cure urolithiasis. These are widely found in Europe and North American continent. This plant has been proved to have mild diuretic nature. In 19th century these plants has been even used as an antibacterial drug.

*Tribulus terrestris* is an Ayurvedic medicinal plant which comes under the family Zygophyllaceae. It is widely distributed throughout the world, though its origin is from North America. In Ayurveda the powder made by drying the fruit of this plant has been used for treatment of kidney, bladder and reproductive medical issues (Gauthaman K et al., 2012)

*Crateva magna* is a tree found in India mainly near the Himalayan areas. The bark of this plant has been found to have medicinal use and is used in Ayurvedic and Siddha treatments. The extract from the bark has been proved to have diuretic nature hence has been used traditionally for curing renal calculi. The images of the Ayurvedic plants used for renal calculi is shown in Fig 1.13
1.3 ARTIFICIAL URINARY CRYSTAL GROWTH

The natural urinary crystals which grow inside the human body have their own unique shape and chemical composition. These morphology and functional groups of the natural kidney stones can only studied after removing the kidney stone. Hence to have a detailed study on the drug effect or treatment effect on renal calculi, it has been necessary to develop the urinary crystals *invitro* which mimic the characteristics of natural urinary stones.
The crystals can be grown *invitro* using two different techniques namely

- **Solution growth technique**: This technique is widely used for the growth of organic and inorganic crystals. The crystallization is done from low temperature solutions, hence the technique is called solution growth (Opalko et al., 1997). There are two methods used to achieve this technique which includes slow cooling method and slow evaporation method. In slow cooling method, the temperature of the solution is slowly reduced to cool the solution which leads to the supersaturation of the solution which triggers the growth of crystals. In slow evaporation method, a constant temperature is maintained and catalyses the evaporation of the solution which leads to the saturation of the solution and triggers the growth of crystal (Brice 1986).

- **Gel Growth Technique**: The biological crystals are grown mainly by using this technique. Especially, the growth of urinary crystals has been successfully done using gel growth technique (Iwata 1986). In brief, this technique helps the growth of crystals in a gel medium, whereas the gel medium acts as a matrix for its growth. The gel which is used for this method can be either a physical gel like gelatin, agar agar etc or can be a chemical gel like silica (sodium meta silicate). For the growth of urinary crystals, silica gel has been used as a standard matrix.

**1.3.1 PRINCIPLE OF GEL GROWTH METHOD**

In gel growth technique two chemical solutions will be used. The selection of chemical solution depends on the crystals which have to be developed. These chemicals diffuse inside a gel medium under a constant pH and specific gravity to form the crystals which is expressed below

\[ KX + PY \rightarrow KP + XY \]

Where KX and PY are two chemical solutions which are poured into the gel. It reacts to form PY which is the desired crystal and XY is a product which is highly soluble in the medium (Henisch 1970).
The gel growth technique can be obtained in two different ways namely

- Single diffusion gel growth technique
- Double diffusion gel growth technique

1.3.2 SINGLE DIFFUSION GEL GROWTH TECHNIQUE

In this technique, the two chemical solutions can be termed as an inner reactant and an outer reactant. The chemical component which is soluble in the water and at the same time chemically inactive inside the gel will be selected as the inner reactant. While preparing the gel, the inner reactant is mixed within the gel preparing medium and allowed to set. Once the gel matrix is formed, the outer reactant will be poured to the test tube. This reactant will diffuse inside the gel and react with the inner reactant to form the crystals. Hence the crystals will be formed inside the gel matrix which is shown in Fig 1.14. During the process, some other compounds can also be formed which will be soluble in water present in the gel medium.

Fig 1.14: Crystal grown in single diffusion method
1.3.3 DOUBLE DIFFUSION GEL GROWTH TECHNIQUE

This technique is selected when both the chemical compounds used are soluble in water and inactive in gel medium. In this method, a U tube is used for the growth of crystals. Initially the gel is prepared inside the U tube. The two chemical solutions used for the crystal growth will be poured through the two openings of the U tube respectively. The chemicals will fuse into the gel and meet at a common point, most probably at the bend of the tube, which results in the crystal growth as shown in Fig 1.15.

![Crystal grown in double diffusion method](image)

1.3.4 ADVANTAGES OF GEL GROWTH TECHNIQUE

The gel technique has been widely used for the growth of biological crystals because of its noticeable advantages as mentioned below:

- The rate of reaction is always under the control in this technique.

- Since it reduces the convection during crystal growth, the chances of defects will be less.
• The concentration of reactant can be easily changed according to our necessity.

• The growth of crystal can be continuously monitored through the transparent medium.

• The crystals will be in fixed positions without overlapping.

• The developed crystals can be easily harvested without damage in crystal faces.

1.4 GLOBALIZED RESEARCH ON RURAL HEALTH CARE

In the present scenario, the medical practitioners as well as the scientists work hand in hand to improve the life style of people across the globe. In this the most blooming area is to develop the rural areas. The medical help in rural area throughout the world, especially in developing and poor countries, is below the standard level. Hence immediate attention has to given to improve their health as well as to spread a concern among them regarding the necessity of a good health background.

1.4.1 IMPROVEMENT OF RURAL HEALTH CARE CENTERS

Multi speciality hospitals and highly sophisticated labs are highly concentrated on urban areas. The rural areas have been ignored for a long period, which lead to the mortality of people. The contagious diseases easily spread across the slum area because of the high contamination in water and unhygienic life style. This situation leads to the increase in death of new born or genetically affected infants.

This has drawn the attention of medical practitioners and scientists to improve the rural health centres. A proper health centre has been included as a basic amenity for under rated areas. Volunteers have been working these days to support this society. In the improvement of rural health centre, the most revolutionised invention is the development of portable screening gadgets.

1.4.2 PORTABLE SCREENING GADGETS

In 1970 Clemens has made a revolutionary invention in inventing the initial model of glucometer, which made the world to be surprised about the idea of checking diabetes
without a sophisticated lab environment. This was the birth of portable screening or detection gadgets. Even a person without medical background can keep a track on his health conditions in day by day basis, without running to hospitals, in a cost effective way.

As years passed, many scientists has improved and made the glucometer more accurate and even lead to the development of portable pressure monitoring device. Now, these two portable detection gadgets has been a vital part of every home. Another interesting portable strip which made a revolution was pregnancy strip. Pregnancy detection in a sophisticated lab requires a lot of test, and maybe a multiple visit. These inventions have made the life of human being a lot easier. When it comes to rural sector, these inventions are of highly useful since these instruments are user friendly and the people themselves can screen whether they are prone to disease, and if they are then a visit to a hospital can be done.

These devices can be at times fall under either false positive or false negative. If the result in the machine shows positive to a disease, even if a patient is not, is said to be false positive whereas sometimes it may not detect the disease condition of the person which is said to be false negative. In either case, the probability for a wrong result is less than 0.5% hence the success rate of these inventions has been high.

1.5 SCOPE OF THESIS

Urolithiasis, as mentioned above, has been a highly threatening and painful disease which is highly common in all part of work and in almost all sector of society. As per discussed in the previous sections, in urolithiasis the current treatment modality used have significant disadvantages. It is highly necessary to improve the diagnosis and treatment methodology for urolithiasis which is more reliable and accurate. This thesis works on this problem and scientifically, both experimentally and theoretically, proved and proposed more effective way of diagnosis and treatment for urolithiasis which can be a another breakthrough in the field of Urology.