ا

قال تعالى :

(فوجدا عبدا من عبادنا آتيناه رحمة من عندنا

وعلمناه من لدنا علما)

Dedication

To my mother ……………Father and family.

Acknowledgement

This research project would not have been possible without the support of many people. Iwishes to express my gratitude to the supervisor, Dr. Ahmed MostAfa Abukonna who was abundantly helpful and offered invaluable assistance, support and guidance.

Also Special thanks to all my graduate friends, especially group for sharing the literature and invaluable assistance.

Not forgetting to my best friend who always been there.

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Abstract

The general aim of this study was to evaluate the role of spiral computed tomography in the diagnosis of urinary tract stones.

100 patients were enrolled in the study multi detecter ct was performed. The result of the study showed that CT KUB has the ability to detect stones of the urinary tract accurately. And most of these stones appear in male (54.4%). Also the most affected age group is (40-49) with the number of stones that present in right side equal to those at the left side of the urinary tract. The renal pelvis showed the common site for stones 18.3%. Stones of the ureters are more likely to produce hydroureter and hydronephrosis. 50.8

% of stones are associated with hydronephrosis (27.9% mild, 57.4% moderate and 14.7% sever), and stones of the renal pelvis showed the most common site of stones to cause hydronephrosis. Furthermore, the most common site of ureteric stones was middle ureter 71.4%. Also 29.2 of stones are presented with obstructive changes and the upper ureter showed the most common sit for stones that cause obstruction.

Spiral CT has largely replaced plain radiographs and IVP. CT for stones requires no contrast and no patient preparation, and the study is routinely completed in less than 90 seconds.

الخلاصة:

الهدف الاساسي من هذه الدراسه لتقييم وتشخيص حصوي الكلي والمسالك البوليه بالاشعة المقطعيه للسودانين.

اجريت الدراسة علي مائه شخص من مختلف الاعمار ووجد ان الرجال اكثر اصابة بالحصوي من النساء، اكثر الاعمار تاثرا من عمر الاربعين الي تسعه واربعين واكثر الكلية تاثيرا الكليه اليمين.

الحصوي الموجوده في الحالب تودي الي انسداد مما ينتج عن تضحم في الحالب والكليه ، خمسين في المائه من الحصوى مصحوب معها تضحم في الكليه ، اكثر منطقه للحصوي الموجوده في الحالب هي منطقة منتصف الحالب، الاشعة المقطعية بديل للاشعه السينيه في تشخيص الحصوي دون تحضيرات للمريض او اعطاها لمريض الصبغ الملونه والزمن الكلي للفحص لايتجاوز التسعين ثانيه.

Chapter one

1.1 Introduction

The urinary system is consisting of two kidneys, two ureters, urinary bladder, urethra and prostatic gland. Urinary tract obstruction is one of the commonest causes of renal hydronephrosis and renal failure. The early diagnosis of detects are very important to achieve the suitable treatment. There are several modalities which we use it in diagnosis of urinary tract diseases such as conventional x-ray, computerize tomography, magnetic resonance imaging, nuclear medicine and ultrasound. CT scan is frequently used to evaluate the internal structure of the body as stated by David Sutton et.al 1987. The CT scan of the kidneys for stones is a test that specifically looks for stones in the KUB. This scan is frequently done in the emergency room for patient with sudden onset sharp side and acute pain and has blood in their urine. It is also ordered by outpatient doctors as well for similar symptoms. (Armstrong et.al 2004), Spiral CT KUB is more accurate about 80% to detect small stone. (Tagelsir et.al, 2010). Nowadays, many clinical centers chose to send cases with accident and emergency cases, urology for CT scan as their first option for easy diagnosis of the symptoms. (Maepel et.al 2013).

Single-slice and multislice spiral CT have forever changed the imaging of renal stone disease. A review of the techniques, findings, complications, and pitfalls involved is timely given that CT is now the imaging method of choice to detect renal stones and diagnose the complications of renal stone disease, acute flank pain is a common complaint of patients seeking emergency medical attention. Renal colic is the most common cause and is usually the major consideration for diagnostic imaging. Plain-film radiographs of the abdomen (often called KUB, for kidney-ureter-bladder) and excretory urograms (also called IVP, for intravenous pyelogram) are the traditional imaging methods use diagnosis of renal stone disease and its complications. Plain radiographs have sensitivity for stones as low as 45%; however, with a specificity of only 77%.Non-contrast CT has been shown to be more effective than IVP in precisely identifying ureteral stones and is equally effective in determining the presence or absence of ureteral obstruction.Spiral CT has largely replaced plain radiographs and IVP. CT for stones requires no contrast and no patient preparation, and the study is routinely completed in less than 90 seconds (E. Brant et.al 2001).

1.2 Problem of the study

Most of diagnostic modalities of urinary tract (conventional x-ray & ultrasound) don't give accurate diagnosis, or may lead to misdiagnosis when patient underwent conventional X-Ray for the kidneys, ureters and bladder due to various types of stone and its appearance. Therefore an introduction of CT KUB to scan the patient with colic pain may give an accurate result and can provide density data for early management and differentiation of stone accordingly.

1.3 Objectives of the study:

1.3.1 The general objective:

The general aim of this study was to evaluate the role of spiral computed tomography in the diagnosis of urinary tract stones.

1.3.2 The specific objective

- To measure the sensitivity of spiral CT scan in detecting of urinary tract stones.
- To correlate the number of the stones and its site to patient age.
- To correlate the stone site and the hydroureter, hydronephrosis and obstructive changes.

1.4 Significant of study:

This study was highlighted on evaluation of renal system stones using MDCT scanner, once we need faster and accurate diagnostic modalities in this situation in order to have high diagnostic accuracy in assessing renal stone related to its general characteristic since MDCT has been proposed as an alternative to conventional x-ray (KUB) for the diagnosis of renal stone.

1.5 Overview of the study:

This study was consist of five chapters, chapter one was an introduction introduce briefly this thesis and contained (general introduction about the renal stone, problem of study also contain general, specific objectives, significant of the study and overview of the study). Chapter two was literature review about role of MDCT scanner in diagnosis of urinary tract stones, and other modalities used. Chapter three was describe the methodology (material, method) used in this study. Chapter four was included result of presentation of final finding of study; chapter five included discussion, conclusion and recommendation for future scope in addition to references and appendices.

2. Charter Two

Literature review

2.1 Anatomy

The urinary system consists of two kidneys, two ureters, a urinary bladder, and a urethra. The kidneys are retroperitoneal structures of the abdomen, having migrated upward from the pelvis during development. They are maintained in their normal position by intra-abdominal pressure and by their connections with the perirenal fat and renal fascia. (JACK T. STERN, et.al 1997)

Figure (2.1) showed the structure and component of renal system

The kidney is bean-shaped with a superior and inferior pole. The mid-portion of the kidney is often called the mid-pole. In adults, each kidney is normally 10-12 cm in length, 3-5 cm in width and weighs 150-260 g. The left kidney is usually slightly larger than the right. The kidney has a fibrous capsule, which is surrounded by para-renal fat. The kidney itself can be divided into renal parenchyma, consisting of renal cortex and medulla, and the renal sinus containing renal pelvis, calyces, renal vessels, nerves, lymphatics and perirenal fat. The renal parenchyma has two layers: cortex and medulla. The renal cortex lies peripherally under the capsule while the renal medulla consists of 10-14 renal pyramids, which are separated from each other by an extension of renal cortex called renal columns. Urine is produced in the renal lobes, which consists of the renal pyramid with associated overlying renal cortex and adjacent renal columns. Each renal lobe drains at a papilla into a minor calyx, four or five of these unite to form a major calyx. Each kidney normally has two or three major calyxes, which unite to form the renal pelvis. The renalhilum is the entry to the renal sinus and lies vertically at the anteromedial aspect of the kidney. It contains the renal vessels and nerves, fat and the renal pelvis, which typically emerges posterior to the renal vessels, with the renal vein being anterior to the renal artery.

Figure (2.2) showed the internal anatomical structure of the pelvi-calceal system in addition to its nerve and blood supply.

The nephron of the kidney is made up of two major parts; the renal corpuscle and the tubules. These are then both sub-divided into various parts and overall it is this structure which allows the kidney to filter the blood and then alter the composition of this filtrate to ensure that waste products are excreted and useful compounds preserved. Renal corpuscle can be subdivided into the glomerulus and the Bowman's capsule. The tubules are split into the proximal tubule, the loop of Henley, the distal tubule and the collecting ducts.

Figure (2.3) showed the internal structure of kidney's functional unit

2.1.1 Blood supply:

Blood reaches the kidneys through the renal arteries, which are short and come directly from the abdominal aorta. It divided into several inter-lobar arteries and give rise to the actuatearteries, which cross the border between the cortex and the medulla of the kidney. From the actuate arteries many branches radiate into the renal cortex; the inter-lobar arteries, the afferent arterioles arise at right angle from the interlobular arteries and end in the glomeruli. (M.Y.sukar, et al 2000)

Figure (2.4) demonstrate the and blood pathway from and into the kidney

2.2 The Physiology

The kidneys play a major role in the control of the constancy of the internal environment. The blood flowing in kidneys is first filtered is call glomerular filtration so that the all blood constituents, except blood cell and plasma protein, go into the microtubular system. In these tubules, modifications of the filtrate take so that useful substances, including most of the filtered water, are quickly reabsorbed back into the blood. Unwanted substances that escape filtration are actively secreted into the lumen. The final concentration of electrolytes and other constituents of urine are adjusted according to the requirements of the regulation of the extracellular fluid composition. Glomerular filtration, tubular reabsorption and tubular secretion are rightly described as renal mechanisms that allow the kidney to undertake its various homoeostatic functions. Several hormones act on the kidney to enable it to adjust the final composition of urine in response to changes in the internal environment. The special features of renal circulation deserve an early description. These special characteristics are essential for the nephrons to perform their various functions. Function of the Urinary system will be summarized in; Regulation blood volume and pressure, regulating plasma concentration of sodium, potassium , chloride and other ions, stabilizing blood PH, conserving nutrients, and Detoxifying poisons with the liver. (M.Y. sugar, et al 2000).

Figure (2.5) demonstrate the renal structure with its specific function

2.3 pathology of the renal stone:

2.3.1 Types

Not all kidney stones are made up of the same crystals. The different types of kidney stones include: Calcium; Calcium stones are the most common. They can be made of calcium oxalate (most common), phosphate, or maleate. Vitamin C and spinach contain oxalate. Calcium-based kidney stones are most commonly seen in young men between the ages of

20 and 30, Uric Acid, This type of kidney stone is more common in men than in women. They can occur in people with gout or those going through chemotherapy, Struvite, This type of stone are found mostly in women with urinary tract infection. These stones can be quite large and cause urinary obstruction. Cystine; rare type occur in both men and women who have the genetic disorder cystinuria. And other types of stone such as medications like triamterene and acyclovir also can cause stones (Lights et.al 2012).

- **Risk Factors**

The greatest risk factor for developing kidney stones is making less than one liter of urine per day. This why they are frequently seen in premature infants, who tend to have kidney problems. However, kidney stones are most likely to occur between the ages of 20 and 40. Other risk factors include: ethnicity (Caucasians are more likely to have kidney stones than African-Americans), sex (although kidney stones are most often seen in men, the incidence in women is increasing), past history of kidney stones (once someone has kidney stones, the likelihood of having another episode increases), family history of kidney stones, dehydration (dehydration causes decreased urine flow, which increases risk significantly), obesity, high-protein, salt, or glucose diet, gastric bypass surgery, inflammatory bowel diseases (which can cause increase calcium absorption) and other medical conditions (hyperparathyroidism can cause increase absorption of calcium and phosphorus; renal tubular acidosis can also be a risk factor for kidney stones) (Lights et.al 2012).

2.3.4 Signs and symptoms

Kidney stones are known to cause severe pain. Symptoms of kidney stones may not occur until the stone begins to move down the ureters. The severe pain is called renal colic. Pain may be located on one side of the back or abdomen. In men, pain may radiate to the groin area. The pain of renal colic comes and goes, but is quite intense. People with renal colic tend to be restless. Other symptoms that can be present are: blood in the urine, vomiting, nausea, discolored or foul-smelling urine, chills, fevers (Lights et al 2012).

2.3.5 Complication

Stones don’t always stay in the kidney. Sometimes, they pass from the kidney into the ureters. Ureters are small and delicate, and the stones may be too large to pass smoothly down the ureter to the bladder. Passage of stones down the ureter can cause spasms and irritation of the ureters as they pass, which causes blood to appear in the urine. Sometimes stones block the flow of urine. This is called a urinary obstruction. Urinary obstructions can lead to kidney infection (pyelonephritis) and kidney damage as stated by Lights et al 2012.

2.3.6 Diagnosing Kidney Stones

Diagnosis of kidney stones requires a complete health history assessment and a physical exam. Other tests include: blood tests for calcium, phosphorus, uric acid and electrolytes, blood urea nitrogen (BUN) and creatinine to assess kidney functioning, urinalysis to check for crystals, bacteria, blood, and white cells and examination of passed stones to determine type. The following tests can rule out obstruction: abdominal X-rays, intravenous pyelogram (IVP), retrograde pyelogram, ultrasound of the kidney, MRI of the abdomen and kidneys and abdominal CT scan (Lights et al 2012).

2.3.7treatment

Treatment is tailored according to the type of stone. Urine can be strained and stones can be collected for evaluation. Drinking six to eight glasses of water a day increases urine flow. People who are dehydrated or have severe nausea and vomiting may need intravenous fluids (Lights et al 2012). Other treatment options include: **Medication**; Pain relief may require narcotic medications. The presence of infection requires treatment with antibiotics. Other medications include: allopurinol for uric acid stones, diuretics, sodium bicarbonate or sodium citrate and phosphorus solutions. **Lithotripsy;** Extracorporeal shock wave lithotripsy uses sound waves to break up large stones so they can more easily pass down the ureters into your bladder. This procedure can be uncomfortable and may require light anesthesia. It can cause bruising on the abdomen and back and bleeding around the kidney and nearby organs. Tunnel Surgery (Percutaneous Nephrolithotomy); Stones are removed through a small incision in your back and may be needed when: the stone causes obstruction and infection or is damaging the kidneys, the stone has grown too large to pass and pain cannot be controlled. And Ureteroscopy; when a stone is stuck in the ureter or bladder, your doctor may use an instrument called an ureteroscope to remove it. A small wire with a camera attached is inserted into the urethra and passed into the bladder. A small cage is used to snag the stone and remove it. The stone is then sent to the laboratory for analysis as stated by Lights et.al 2012.

2.4 Multi detector CT scan:

We use multi-detector CT scanning technology to see areas inside the body with micro-level detail. The multi-detector CT scanner allows us to obtain multiple slices in a single rotation, resulting in images that are of high quality, detail and clarity. Using this technology, we can also acquire data with great speed, so patients spend less time being scanned. In addition, the increased width of the scanning space of this tool makes for a more comfortable, less claustrophobic experience for patients.

2.4.1 X-Ray Tube and Generator

State-of-the-art X-ray tube/generator combinations provide a peak power of 60–100 kW, usually at various, user-selectable voltages, e.g., 80 kV, 100 kV, 120 kV and 140 kV. Different clinical applications require different X-ray spectra and hence different kV settings for optimum image quality and/or the best possible signal-to-noise ratio at the lowest dose. In a conventional tube design, an anode plate of typically 160–220-mm diameter rotates in a vacuum housing. The heat storage capacity of anode plate and tube housing–measured in Mega Heat Units (MHU)–determines the performance level: the bigger the anode plate is, the larger the heat storage capacity, and the more scan-seconds can be delivered until the anode plate reaches its temperature limit. A state-of-the-art X-ray tube has a heat storage capacity of typically 5 to 9 MHU, realized by thick graphite layers attached to the backside of the anode plate. An alternative design is the rotating envelope tube (STRATON, Siemens, Forchheim, Germany, Schardt et al. 2004). The anode plate constitutes an outer wall of the rotating tube housing; it is therefore in direct contact with the cooling oil and can be efficiently cooled via thermal conduction. This way, a very high heat dissipation rate of 5 MHU/min is achieved, eliminating the need for heat storage in the anode, which consequently has a heat storage capacity close to zero. Thanks to the fast anode cooling, rotating envelope tubes can perform high power scans in rapidsuccession. Due to the central rotating cathode, permanent electro-magnetic deflection of the electron beam is needed to position and shape the focal spot on the anode. The electro-magnetic deflection is also used for the double z-sampling technology of a 64-slice CT system (Flohr et al. 2004).

2.4.2 Gantry

Third-generation CT scanners employ the so-called “rotate/rotate” geometry, in which both the X-ray tube and detector are mounted onto a rotating gantry and rotate around the patient (Fig. 1.2). In a MDCT system, the detector comprises several rows of 700 and more detector elements that cover a scan field of view (SFOV) of usually 50 cm. The X-ray attenuation of the object is measured by the individual detector elements. All measurement values acquired at the same angular position of the measurement system form a “projection “or “view.” Typically, 1,000 projections are measured during each 360° rotation. The key requirement for the mechanical design of the gantry is the stability of both focal spot and detector position during rotation, in particular with regard to the rapidly increasing rotational speeds of modern CT systems (from 0.75 s in 1994 to 0.30 s in 2007). Hence, the mechanical support for the X-ray tube, tube collimator and data measurement system (DMS) has to be designed so as to withstand the high gravitational forces associated with fast gantry rotation (~17 g for 0.42 s rotation time, ~33 g for 0.33-s rotation time).

2.4.3 Data Rates and Data Transmission

With increasing numbers of detector rows and decreasing gantry rotation times, the data transmission systems of

MDCT scanners must be capable of handling significant data rates: a four-slice CT system with 0.5-s rotation time roughly generates 1,000×700×4×2 bytes = 5.6 MB of data per rotation, corresponding to 11.2 MB/s; a 16-slice CT scanner with the same rotation time generates 45 MB/s, and a 64-slice CT-system can produce up to 180–200 MB/s. This stream of data is a challenge for data transmission off the gantry and for real-time data processing in the subsequent image reconstruction systems. In modern CT systems, contactless transmission technology is generally used for data transfer, which is either laser transmission or electro-magnetic transmission with a coupling between a rotating transmission ring antenna and a stationary receiving antenna. In the image reconstruction, computer images are reconstructed at rate of up to 40 images/s for a 512×512 matrix using special array processors.

2.4.4 Imaging Techniques

Also known as CT-KUB, renal stone CT is a spiral CT exam of the urinary tract that is used to diagnose the presence of urinary tract calculi and to detect acute urinary obstruction caused by stones. No oral or IV contrast is administered (E. Brant 2001).Spiral CT is markedly faster than conventional CT, allowing acquisition of a complete data set in a single breath-hold. This speed prevents the miss-registration of slice location that is characteristic of conventional CT. Multislice spiral CT further decreases the time of acquisition, allowing for thinner slice collimation and retrospective reconstruction of thin slices to review problematic areas of interpretation. Data acquisition is continuous from the top of the kidneys through the base of the bladder (mid-liver [T-12] through symphysis pubis) using a maximum of 5-mm collimation with table speed of 5 mm/sec. Slice collimation with multislice CT is usually 2.5 to 3 mm with table speed up to 5 mm/sec.Multislice technique allows slices as thin as 1 mm to be obtained for problem-solving. Scanning can be performed using 2.5-mm collimation with fusion of images for viewing at 5-mm thickness. The thinner slices can be viewed retrospectively without rescanning the patient. Thin slices allow identification of very small stones that may be overlooked with thicker slices. Turning the patient to a prone position permits differentiation of stones impacted at the ureterovesical junction from stones that have already passed into the bladder. When noncontrast renal stone CT is equivocal, intravenous contrast may be given to clarify the diagnosis. The pyelogram phase of contrast excretion is of most interest. Optimally, the ureters will be contrast-filled. An intravenous injection of 100 cc of 60% contrast is given; power injection is not needed. The renal stone protocol outlined above is repeated with a scan delay of three to five minutes after completion of contrast injection. This prolonged scan delay usually results in filling of both collecting systems and ureters. Thin slices (1 to 3-mm collimation) can be obtained through any area in question (E. Brant 2001).

2.4.5 CT Interpretation

CT may detect stones not evident on standard plain radiographs or IVP, It may also provide an alternative diagnosis for the patient's symptoms, including other urinary pathology, acute appendicitis, diverticulitis, pancreatitis, adnexal masses, or leaking aneurysms. While only about 85% of urinary stones are seen as calcific densities on plain films, CT detects nearly all calculi. Calcium oxalate and calcium phosphate stones are most common (73%) and typically have a CT attenuation of 800 to 1000 HU. Struvite, or magnesium aluminum phosphate, stones (15%) are seen with chronic infection. Their CT attenuation ranges from 300 to 900 HU. Uric acid stones (8%), which are usually radiolucent on plain film, have an attenuation of 150 to 500 HU. Cystine stones (1% to 4%) are moderately radiopaque because of their sulfur content. Calcium may be present in cystine stones, which have attenuation values of 200 to 880 HU, depending on calcium content. High CT attenuation makes stones easy to differentiate from other urinary tract filling defects such as tumors, hematoma, fungus balls, or sloughed papilla. Virtually all stones, even those that are radiolucent on plain-film radiographs, are identified as high-attenuation foci on CT images viewed on soft-tissue windows. Bell reported the mean attenuation of a series of calculi detected on CT as 305 HU with a range of 221 to 530 HU.Ureteral calculi are usually geometric or oval in shape and are seldom completely round. this feature is useful in differentiating stones from phleboliths. The positive predictive value of geometric shape in identifying a calculus has been reported as 100%. The single exception to the high-density appearance of stones on CT is crystalline stones in the urine related to use of protease inhibitors in the treatment of HIV disease. These stones are nonopaque on CT scans but may cause ureteral obstruction. Retrograde ureterogram, contrast-enhanced CT, or IVP demonstrates these stones as tiny radiolucent filling defects in the ureter.

The burden of stones in the kidneys is easily determined by CT. Stones are seen in the region of the minor calices or medullary pyramids. The stone burden is defined as the number and size of stones present and is used to determine therapy, such as lithotripsy. The tips of the renal pyramids may show high attenuation, especially when the patient is dehydrated. This normal finding of “white pyramids” should not be interpreted as representing renal stones. Noncontrast spiral CT has a reported sensitivity of 94% to 98% and specificity of 96% to 98% for acute ureteral obstruction caused by an impacted stone. CT evaluation of acute ureteral obstruction caused by stones includes the following: A stone is demonstrated in the ureter. The most common locations for stone impaction are at the uretero-pelvic junction, where the ureter crosses the pelvic brim, and at the uretero-vesical junction. The ureter is followed on consecutive slices until a stone is identified. Scrolling on the CT monitor is the easiest way to follow the course of the ureter. Knowledge of the anatomy of the ureter and adjacent vessels is crucial for accurate interpretation, the size of the stone is measured and its location precisely reported. Stones smaller than 4 mm nearly always pass spontaneously; stones of 6 mm pass about half the time and those larger than 8 mm rarely pass spontaneously. Size and location are important factors in determining the treatment of stones that do not pass spontaneously. Stones larger than 5 mm and located in the proximal two-thirds of the ureter are more likely to require lithotripsy or endoscopic removal, to confirm a stone in the ureter, look for a tissue rim sign (present in about 76% of cases). The tissue rim sign describes a halo of soft tissue that surrounds stones in the ureter. The soft-tissue rim is the wall of the ureter. The tissue rim sign may be absent because of bloom effect artifact or a very thin ureteral wall, examination of the CT scout scan is useful for detecting stones and other abnormalities and should be included in every CT interpretation. If the stone is visible on the scout scan, plain radiographs can be used to monitor its passage. Calculi not visible on plain radiographs can be followed, when necessary, with unenhanced CT, Secondary findings of urinary obstruction are common but often subtle.

Comparison to the opposite side is highly useful in differentiating preexisting findings from acute obstruction and the obstructed kidney may be enlarged and slightly decreased in CT density because of edema. The pelvi-calyceal system is usually, but not always, mildly dilated. Dilated calyces are best seen at the poles as rounded fluid-filled structures that displace renal sinus fat. Comparison with the opposite kidney is always helpful. Profound dilatation of the collecting system is evidence of chronic, rather than acute, obstruction, Periureteral and perinephric fat stranding occurs secondary to edema produced by obstruction ·The amount of edema present correlates with the severity of obstruction. Unilateral absence of “white pyramids” on the affected side has been described as a subtle sign of obstruction; the ureter is mildly dilated to the level of the stone. Normal ureteral peristalsis produces transient focal areas of dilatation and narrowing. This must be differentiated from diffuse dilatation to the level of obstruction. The ureter below the obstructing calculus is not dilated. Moderate or severe hydronephrosis suggests longer-standing obstruction and should cause suspicion of other causes of ureteral obstruction, Focal perinephric fluid collections may occur secondary to forniceal rupture caused by obstruction and high urine output and axial plane CT images may be reformatted into coronal plane images that resemble IVP images in problematic cases and this procedure is time-consuming and seldom necessary for diagnosis. Some referring physicians may routinely request coronally reformatted images, however, because they resemble the trusted IVP (E. Brant et.al 2001).

2.4.6 Pitfalls in Diagnosis

No imaging test is perfect. A variety of pitfalls complicate interpretation of renal stone CT. An extrarenal pelvis may mimic pelviectasis. Peripelvic cysts can simulate hydronephrosis. Many patients, especially older ones, have preexisting stranding in the peripelvic fat. Comparison with the opposite side is critical to detection of asymmetric stranding, Phleboliths, which are calcifications that originate in thrombi within pelvic veins, commonly mimic stones. Most phleboliths are found in perivesical veins, in periprostatic veins in men, and in periuterine and perivaginal veins in women. They are occasionally seen in gonadal veins that parallel the course of the ureters, most phleboliths are round; they are seldom oval and are never geometric in shape, Visualization of a central lucency is highly characteristic of phleboliths but is less often evident on CT than on plain radiographs.A tail sign represents a tail of noncalcified vein extending from the phlebolith. A tail sign has been reported with 21% to 65% of phleboliths. Phleboliths are lower density than most stones, with a mean attenuation value of 160 HU and a range of 80 to 278 HU. The probability that a calcification represents a phlebolith is

0.03% when mean attenuation is 311 HU or more and atherosclerotic calcifications are occasionally mistaken for ureteral stones. Differentiation is made by carefully examining serial slices and determining if the calcification is in an artery or in the ureter also It is difficult to differentiate preexisting post-obstructive changes from acute obstruction. When signs of ureteral obstruction are present but no stone is evident, consider a recently passed stone, pyelonephritis, stricture or tumor, or protease inhibitor treatment-related stone, Stones passed from the ureter may be identified in the bladder or urethra or may not be seen, always look for evidence of nonurinary causes of flank pain. Unenhanced CT has been reported to be 94% accurate in the diagnosis of appendicitis.Adnexal masses are usually easily detected, and a subsequent contrast-enhanced CT scan may be needed in up to 20% of cases to provide an unequivocal diagnosis.

2.4.7 Indication Creep

The quickness and ease of obtaining non-contrast CT for renal stones has resulted in a broadening of indications by referring physicians, especially emergency department physicians.The result is many more studies that are negative for stones but positive for a wider range of other urinary and non-urinary abnormalities, Noncontrast CT has substantial limitations for the diagnosis of solid masses in the liver, pancreas, and kidneys, as well as for conditions such as visceral ischemia, infarction, and infection. Radiologists may wish to broaden their use of contrast-enhanced CT to follow a negative or equivocal renal stone CT(E. Brant et.al 2001).

2.5 Previous study:

A study conducted by (**Kluner** et.al 2006) to evaluate the diagnostic yield of multislice CT using a radiation dose equivalent to that of conventional abdominal x-ray (KUB). One hundred forty-two patients were prospectively examined with ultrasound and a radically dose-reduced CT protocol. Number and size of calculi, presence of urinary obstruction, and alternative diagnoses were recorded and confirmed by stone removal/discharge or by clinical and imaging follow-up. The mean effective whole-body dose was 0.5mSv in men and 0.7 mSv in women. The sensitivity and specificity in detecting patients with calculi was 97% and 95% for CT and 67% and 90% for ultrasound. Urinary obstruction was similarly assessed, whereas CT identified significantly more alternative diagnoses than ultrasound (P<0.001). With regard to published data for standard-dose CT, the CT protocol seems to be comparable in its diagnostic yield in assessing patients with calculi, and its radiation dose is equivalent to that of KUB.

Sommer et.al 1995, studied the value of reformatted non-contrast helical CT in patients with suspected renal colic. Thirty-four consecutive patients with signs and symptoms of renal colic were imaged with both non-contrast helical CT and a combination of plain film of the abdomen and renal sonography. Reformatting of the helical CT data was performed on a workstation to create a variety of reformatted displays. The correlative studies were interpreted by separate blinded observers. Clinical data, including the presence of hematuria and the documentation of stone passage or removal, were recorded. Findings on 18 CT examinations were interpreted as positive for the presence of ureteral calculi; 16 of these cases were determined to be true positives on the basis of later-documented passage of a calculus. Thirteen of the 16 cases proved to be positive were interpreted as positive for renal calculi using the combination of abdominal plain film and renal sonography. The most useful CT reformatting technique was curved planar reformatting of the ureters to determine whether a ureteral calculus was present. In this study, non-contrast helical CT was a rapid and accurate method for determining the presence of ureteral calculi causing renal colic. The reformatted views produced images similar in appearance to excretory urograms, aiding greatly in communicating with clinicians. Limitations on the technique include the time and equipment necessary for reformatting and the suboptimal quality of reformatted images when little retroperitoneal fat is present.

Another study conducted by Eray et.al 2001, to assess the diagnostic value of urinalysis and plain films in patients with suspected renal colic presenting to an emergency department (ED). Over a 1-year period, 138 patients presented to the ED during the daytime with suspected renal colic, but for technical reasons the diagnostic modalities used in the study could be completed for only 99 patients, and 34 patients were lost to follow-up. A urinalysis; kidney, ureter, and bladder film; and spiral computed tomography (CT) were performed on each patient. The presence of urinary tract stones was determined by their definite presence on helical CT and/or passage of a stone on clinical follow-up (average follow-up = 3 months). A urinary stone was visualized on spiral CT or passed in the urine in 54 of the patients. Using helical CT findings or passage of a stone as the gold standard, plain radiography had a sensitivity of 69% and specificity of 82%. Urinalysis had a sensitivity of 69% and specificity of 27%. The sensitivity increased to 89% if either test was positive, but the specificity remained low at 27%. The sensitivity and specificity of CT in the diagnosis of urinary stones was 91%. Urinalysis and plain films are much less accurate than helical CT for confirming the diagnosis of acute urolithiasis.

Poletti et.al 2007**,** compared a low-dose abdominal CT protocol, delivering a dose of radiation close to the dose delivered by abdominal radiography, with standard-dose unenhanced CT in patients with suspected renal colic. One hundred twenty-five patients (87 men, 38 women; mean age, 45 years) who were admitted with suspected renal colic underwent both abdominal low-dose CT (30 mAs) and standard-dose CT (180 mAs). Low-dose CT and standard-dose CT were independently reviewed, in a delayed fashion, by two radiologists for the characterization of renal and ureteral calculi (location, size) and for indirect signs of renal colic (renal enlargement, pyeloureteral dilatation, periureteral or renal stranding). Results reported for low-dose CT, with regard to the patients' body mass indexes (BMIs), were compared with those obtained with standard-dose CT (reference standard). The presence of non-urinary tract-related .In patients with a BMI < 30, low-dose CT achieved 96% sensitivity and 100% specificity for the detection of indirect signs of renal colic and a sensitivity of 95% and a specificity of 97% for detecting ureteral calculi. In patients with a BMI < 30, low-dose CT was 86% sensitive for detecting ureteral calculi < 3 mm and 100% sensitive for detecting calculi > 3 mm. Low-dose CT was 100% sensitive and specific for depicting non-urinary tract-related disorders (*n* =6).

The accuracy of NCCT in estimating ureteral stone size compared with plain abdominal (KUB) films was assessed by (Appledorn *et.al 2003)*. Forty-eight patients were identified who ureteral stones had seen on NCCT and KUB films performed on the same day. The number of consecutive images on which a ureteral stone was visible on NCCT was multiplied by the reconstruction interval of 5 mm to create a size estimate, which was compared with the measurements of the same stone seen on the KUB film. They found that, the NCCT overestimated stone size by approximately 30% to 50% compared with KUB.

Dundee et al in 2006, their study was aimed to assess the accuracy of stone size measured on NCCT compared with KUB films. The NCCT and KUB studies obtained from 24 patients (27 stones) presenting to the emergency department at a major metropolitan hospital were analyzed randomly and independently by two urologists and one uroradiologist. The NCCT scans were assessed separately from the KUB films. Only size in greatest dimension and stone location were recorded. The stone size was 2 to 38 mm on NCCT scans and 2 to 46 mm on KUB films. The mean stone size was 6.773 ± 6.146 mm and 7.747 ± 7.866 mm, respectively (P = 0.0398; Student's t-test). Almost three fourths (70%) of the stones were larger on KUB films than they were on NCCT scans, with a mean difference −0.974 mm (95% confidence interval −5.652, 3.703) for NCCT. Spiral CT underestimates stone size by approximately 12% compared with KUB films.

Chen et.al 1999 conducted a study to assess whether clinicians had broadened the indications and changed the yield and findings of unenhanced helical CT. One hundred consecutive patients with suspected renal colic or flank pain referred for unenhanced helical CT were selected for this study. They reviewed the original radiographic reports for each patient and recorded the presence of ureteral calculi. Other urinary abnormalities and extra-urinary lesions were also recorded and compared with the results of the previous study. In this study a 56% of the patients who underwent unenhanced helical CT had symptoms of urinary colic, and 44% of patients had unspecified flank pain, compared with 100% of patients with symptoms of urinary colic 1 year earlier. The sensitivity and specificity of unenhanced helical CT in detecting ureteral calculi were 96% and 99%, respectively. Ureteral calculi were identified in only 28% of the patients versus 49% of patients ($p < .01$) 1 year earlier. Extraurinary lesions were identified in 45% of the patients versus 16% ($p < .01$) 1 year before.As clinicians developed familiarity with this technique, the indications for performance of unenhanced helical CT were expanded with a consequent reduction in the rate of detection of stone disease and identification of an increased number of extraurinary lesions, which suggests a demand for emergency abdominal CT studies.

Sourtzis et.al 1999, was aimed to compare unenhanced helical CT and excretory urography in the assessment of patients with renal colic. Fifty-three of 70 consecutive patients with acute signs of renal colic were prospectively examined with unenhanced helical CT, which was followed immediately by excretory urography. Two radiologists who were unaware of the findings independently interpreted these examinations to determine the presence or absence of ureteral obstruction. On all CT scans that had positive findings for ureteral stones or obstruction, they looked for secondary signs of obstruction (perinephric or periureteral fat stranding, ureteral wall edema, ureteral dilatation, and blurring of renal sinus fat).A stone was recovered in 45 of the 53 patients, nine before and 36 after imaging. The latter 36 patients had their stones identified on CT, whereas only 24 patients had their stones identified on excretory urography. Eight patients without stone disease had normal ureters on both CT and excretory urography. Of the 45 patients who had stone disease, 26 had ureteral dilatation on both CT and excretory urography, and 36 patients who recovered a stone after CT had secondary signs of obstruction. Of the nine patients who recovered a stone before CT, three had secondary signs of obstruction. Two patients had periureteral fat stranding, ureteral wall edema, and renal sinus fat blurring. One patient had only ureteral wall edema.Compared with excretory urography, unenhanced helical CT is better for identifying ureteral stones in patients with acute ureterolithiasis. Secondary CT signs of obstruction, including renal sinus fat blurring, were frequently present even when the stone was eliminated before imaging.

M. Patlas et.al 2014, they aimed to compare the accuracy of non-contrast spiral CT with ultrasound (US) for the diagnosis of ureteral calculi in the evaluation of patients with acute flank pain. 62 consecutive patients with flank pain were examined with both CT and US over a period of 9 months. All patients were prospectively defined as either positive or negative for ureterolithiasis, based on follow-up evaluation. 43 of the 62 patients were confirmed as having ureteral calculi based on stone recovery or urological interventions. US showed 93% sensitivity and 95% specificity in the diagnosis of ureterolithiasis; CT showed 91% and 95%, respectively. Pathology unrelated to urinary stone disease was demonstrated in six patients. Although both modalities were excellent for detecting ureteral stones, consideration of cost and radiation lead us to suggest that US be employed first and CT be reserved for when US is unavailable or non-diagnostic.

M .Kalorin et al 2008, they proposed that younger children are less likely to pass renal calculi spontaneously, and that children younger than 10 years are more likely to have an identifiable metabolic abnormality and subsequently a higher risk of recurrence. We report our clinical outcomes in children with urinary calculi, specifically examining these factors. He performed a retrospective review of all pediatric patients diagnosed with renal or ureteral calculi at our institution between 2000 and 2007. Of 150 patients evaluated and treated during this period 80 (86 stones) had sufficient follow-up data to be included. Patients were divided into 2 groups according to age, namely 10 years or younger and older than 10 years. There were 39 patients in the younger group and 41 patients in the older group. Their main result was; of the younger cohort stones were ureteral in 43% and renal in 57%. The opposite trend was seen in older patients, with 69% having ureteral and 31% having renal stones ($p = 0.02$). Mean stone size (greatest dimension) did not differ significantly between the older and younger groups (6.9 mm vs 5.5 mm, p = 0.17). Overall stone passage rate was 34% for younger and 29% for older patients (p = 0.65). No significant mean size differences in passed stones existed between the groups (3.2 mm vs 2.5 mm, p = 0.31). Overall younger vs. older ureteral stone passage rate was 37% vs 41% (p = 0.58), and for renal stones it was 32% vs 0%. Stones recurred in 7 younger and 6 older patients. Younger children were more likely to present with renal stones, while older children had more ureteral stones. Overall children 10 years old or younger are as likely to pass stones as older children. Renal stones are more likely to be successfully managed expectantly in younger children. Metabolic abnormalities and stone recurrences are observed at similar rates between younger and older children

Chapter three

3. Materials and Methods

3.1. Material:

3.1.1Subject:

100 patients were enrolled in the study; they were scanned with MDCTA. Patients with contraindications to iodinated contrast agent were .

3.1.2Machine used:

GE device

60 slice

Multi detector

Figure (3.1) CT scan machine show gantry and couch

3.2. Method

3.2.1 Protocol:

Patients were placed in the supine position; Patients were also instructed to breathe normal and to drink amuch more fluid before the examination and not to urinate in order to see the full bladder volume and to clearly visualize the associated pathology. CT technical parameters included: matrix 512 X 512, field of view (FOV) 20 cm; tube current 685 mAs at 120kV; table feed 10mm/rotation, pitch 10/40mm. Axial images were analyzed, contrast injector (Medrao Toshiba) for flush contrast media to the patient and VITREA SYSTEMand K-PACS system for diagnosis images and reconstruction and volume rendered purposes in addition to the density data measurement and stone type estimations were used. For patient's preparation, patient instructed not to eat 24 hours before the examination time and a cretin light food was identified to the patient such as foods not having oily component also milk component in order to evacuate the large intestine from the fecal masses and the abdominal gases that may interfere with stone and affect the image quality, a 3-5 mm cuts was performed from the level just below the diaphragm to the symphysis pubic in order to visualize the kidneys, ureter, and bladder and its associated morbidity.

3.2.1. Study area:

This study was conducted at Khartoum state, Antalya Diagnostic Center.

3.2.2. Study duration:

This study was carried out from March august 2015 to October 2015

3.2.5. Inclusion criteria:

The study will include all patients with flank pain at age between (20-70 years), female or male.

3.2.6. Exclusion criteria:

All patients with Allergy to contrast agent, Pregnancy, Renal insufficiency, was excluded from this study.

3.2.7. Statistical analysis:

All data were presented as mean ± SD values. Data were analyzed by an independent t-test and by correlation analysis with the use of the SPSS (IBM SPSS version 21.0). A value of $P^{<}0.05$ was considered significant.

3.2.8. Method of data collection:

The data were collect on master data sheet from the diagnostic stations which include all parameters need for evaluations.

3.2.9. Variables of the study:

Patient gender, Age, History of disease and Sign and symptoms,

3.2.10. Ethical issues:

- There was official written permission to Khartoum state diagnostic centers to take the data.

- No patient data were published also the data was kept in personal computer with personal password.

Chapter Four

Results .4

Table (4-1) gender distribution					
Cumulative Percent	Valid Percent	Percent	Frequency		
59.0	59.0	59.0	59	Male	Valid
100.0	41.0	41.0	41	Female	
	100.0	100.0	100	Total	

Figure (4-1) gender distribution

Table(4-2) Stone sidedistribution					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Right	41	41.0	41.0	41.0
	left	41	41.0	41.0	82.0
	Bilateral	18	18.0	18.0	100.0
	Total	100	100.0	100.0	

Figure (4-2) stone side distrubtion

Table (4-3)number of stone distrubtion

Cumulative Percent	Valid Percent	Percent	Frequency		
71.0	71.0	71.0	71	One Stone	Valid
96.0	25.0	25.0	25	Two Stones	
100.0	4.0	4.0	4	Three Stones	
	100.0	100.0	100	Total	

Figure(4-3) number of stone distrubtion

Table(4-4)stone loctiondistrution					
Cumulative Percent	Valid Percent	Percent	Frequency		
2.0	2.0	2.0	2	Upper	
14.0	12.0	12.0	12	Middle	
35.0	21.0	21.0	21	Upper Pole	
43.0	8.0	8.0	8	Upper Ureter	
50.0	7.0	7.0	7	Middle Ureter	
66.0	16.0	16.0	16	Lower Ureter	

73.0	7.0	7.0	7	PUJ	
95.0	22.0	22.0	22	Pelvic	
100.0	5.0	5.0	5	VUJ	
	100.0	100.0	100	Total	

Figure (4-4)shows stone location distrubtion

Hydronephrosistable (4-5) shows

Cumulative Percent	Valid Percent	Percent	Frequency		
40.0	40.0	40.0	40	No	Valid
57.0	17.0	17.0	17	Mild	
91.0	34.0	34.0	34	Moderate	
100.0	9.0	9.0	9	Severe	
	100.0	100.0	100	Total	

Figure (4-5) show tube of hydronephrosis

Table (4-6) show hydroureter

Cumulative Percent	Valid Percent	Percent	Frequency		
67.0	67.0	67.0	67	No	Valid
100.0	33.0	33.0	33	Yes	
	100.0	100.0	100	Total	

Figure (4-6) show hydroureter

Table (4-7) show obstruction					
Cumulative Percent	Valid Percent	Percent	Frequency		
65.0	65.0	65.0	65	No	Valid
100.0	35.0	35.0	35	Yes	
	100.0	100.0	100	Total	

Figure (4-7) obstruction

Table (4-8)shows other finding

		Frequency	Percent	Valid Percent	Cumulative Percent
	Normal	59	59.0	59.0	59.0
	Cortical Thinning	22	22.0	22.0	81.0
	Cortical Thickening	10	10.0	10.0	91.0
	Cyst	8	8.0	8.0	99.0
	Lobulation	1	1.0	1.0	100.0
	Total	100	100.0	100.0	

Figure (4-8) shows other finding

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	100	2	76	42.61	19.278
Density	100	77	1505	722.93	372.172
X- axis	100	.02	9.00	1.4451	1.31110
Y- axis	100	.02	4.00	1.1265	.75205

(Table (4-9

(Figure (4-9

5. Chapter Five

Discussion,conclusion,recommendation)

5.1 Discussion

This aim of this study was to evaluate the role of spiral computed tomography in the diagnosis of urinary tract stones in order to assess its size, site and number. 100 patients with flank pain were investigated in Nilein medical Diagnostic Center.

Urinary tract stones are common, with a lifetime incidence of up to 12% and recurrence rates of up to 50%. The patient gender was investigated and the study revealed that the most affected gender was male with frequency of (59%), and female 41 patients with (41%). This result was in line with Poletti et.al 2007 which stated that the predominant gender was male as 87 patient men and 38 women have renal stone.

The site of the stone was categorized into the right, left and bilateral; right and left kidney is same effect by stone more than bilateral with frequency (41%),left 41% (18%) respectively (table (4.2) figure (4.2))

The number of the stone was categorized into the one, two and three stone; there have one stone in all cases with frequency of one 71 (71%), two stone 25(25%) and three stone 4(4%) respectively (table (4.3) figure (4.3)). The stone location was categorized into the upper, middle and upper pole, upper ureter, middle ureter, lower ureter, PUJ and pelvis; upper pole is most stone location respectively (table (4.4) figure (4.4)).

Hydreonephrosis consist of mild, moderate, sever, have frequency mild17 (17%), moderate 34(34%), sever 9 (9%) respectively table (4.5) figure (4.5). Hydrourter consist of yes and no, have frequency 67 (67%), yes 33 (33%) respectively. table (4.6) figure (4.6).

Obstruction consists of yes and no, all cases have no obstruction related to stone may be due to the tube of stone.

Other finding ,normal cortical thining, cortical thicking, cyst, lobulatio ,have frequency normal 59(59%),cortical thining 22(22%),cortical thic also the obstructive changes strongly related to the upper ureteric stone which may be positive or negative related to the size of the stone. table (4.8) figure(4.8).

These pathological finding are strongly related to the site and the presence of the stone such as cortical thinning (renal pelvic stones), hydroureter (middle ureteric stone), hydronephrosis (renal pelvic stone), and also the obstructive changes strongly related to the upper ureteric stone which may be positive or negative related to the size of the stone.

Spiral MDCT KUB is a superior modality rather than the conventional modalities such as conventional KUB x-ray and ultrasound because it provide density data measurement for all tissue, this study also measure the amount of CT number for relative stones

5.2. Conclusion:

Single-slice and multislice spiral CT have forever changed the imaging of renal stone disease. A review of the techniques, findings, complications, and pitfalls involved is timely given that CT is now the imaging method of choice to detect renal stones and diagnose the complications of renal stone disease, acute flank pain is a common complaint of patients seeking emergency medical attention. this study was investigate the accuracy of CT KUB in detection and diagnosing of renal system stone. The general aims of this study was to evaluate the role of spiral computed tomography in the diagnosis of urinary tract stones in order to exclude the most type of stone related to its size and density measurements. 100 patients who complain of flank pain and have high risk to have renal stone, with different age and gender presented to Khartoum state diagnostic center (Anilein medical diagnostic center) to perform CT-KUB examination, in period from semtember 2015 to October 2015.

From this study we found the CT KUB has the ability to detect stones of the urinary tract accurately. And most of these stones appear in male (54.4%). Also the most affected age group is (40-49) with the number of stones that present in right side equal to those at the left side of the urinary tract. The renal pelvis showed the common site for stones 18.3%. Stones of the ureters are more likely to produce hydroureter and hydronephrosis. 50.8 % of stones are associated with hydronephrosis, 27.9% mild, 57.4% moderate and 14.7% sever, and stones of the renal pelvis showed the most common site of stones cause hydronephrosis. 29.2% of stones cause hydroureterand the most common site for stones cause hydroureter is the middle ureter 71.4%. Also 29.2 of stones are demonstrate obstructive changes and the upper ureter showed the most common sit for stones cause obstruction.

These pathological finding are strongly related to the site and the presence of thestone such as cortical thinning (renal pelvic stones), hydroureter (middle ureteric stone), hydronephrosis (renal pelvic stone), and also the obstructive changes strongly related to the upper ureteric stone which may be positive or negative rela

5.3. Recommendation:

- Prevention of urinary tract stones may include a combination of lifestyle changes and medications.
- Lifestyle changes can be Drink water throughout the day, Eat fewer oxalate-rich foods if the patient tends to form calcium oxalate stones, choose a diet low in salt and animal protein

and continue eating calcium-rich foods, but use caution with calcium supplements. Medications can control the amount of minerals and acid in the urine and may be helpful in people who form certain kinds of stones. The type of medication prescribes will depend on the kind of kidney stones.

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Appendix (A)

:Table (5.1) Master data sheet was used in data collection and analysis

Other findings	Us Findings	Clinical indication	Obstructive uropathy	hydroureter	Hydro-nephrosis	Size (cm)	Density (HU)	location	site	Stone	Gender	Age	NO
Cortical thinning	_	RT renal stone	-	-	2	.8	430	RT	1	+	F	14	1
Small LT kidne with cortex lobulation	-	-	-	+	2	.6	1152	RT	7	+	F	44	2
-	-	-	-	-	-	0.7x 0.3	471	LT	2	+	M	34	3
-	-	-	-	-	_	1.7×1	874	LT	3	+	F	56	4
-	-	-	-	+ - -	2 - -	.8 1.1 .6	409 974 379	LT LT RT	6 8 3	+	M	12	5
Cortical thinning	-	-	+	-	1	2.5×3.2	530	RT	8	+	M	37	6
Cortical thinning	-	-	-	-	2 2	2.1 1.3	563 700	RT LT	3 3	+	M	40	7
Cortical thicke	-	-	+	+	-	.5	809	LT	6	+	F	42	8

ning													
-	-	-	-	+ -	2 -	1.1 1.6	1348 1037	LT LT	6 3	+	M	42	9
Cortical thickening	-	-	-	+	2	1.7 .04	877 411	RT RT	4 8	+	M	40	10
-	-	-	-	+	2	.4	348	LT	3	+	M	33	11
RT,L T simple cysts		RT renal stone	-	-	-	1.5	264	LT	3	+	M	50	12

13	53	M	+	1 8	RT LT	998 1124	1 2.5	- 3	- -	- +	-	-	LT cortical thinning
14	48	M	+	6 9	LT RT	1016 835	1.1 1.7	2 3	+ -	+ -	-	-	LT cortical thickness
15	69	M	+	8	LT	1335	2.6	3	-	+	_		Cortical thinning ,enlarged ,prostate Rt renal cyst
16	38	M	+	5 1	RT RT	441 235	08. 06.	-	+	-	-	-	-
17	43	F	+	6	RT	1030	8.	2	-	-	-	-	Cortical thinning
18	40	M	+	2	LT LT	362	1	-	-	-	-	-	Lumber scoliosis

				3		403	7						
19	13	M	+	3	LT	291	6.	-	+	-	bilateral renal stone	-	-
20	55	M	+	3	RT	1158	1.1	-	-	-	-	-	Rt kidney compensatory hypertrophy
21	47	M	+	8 6	RT RT	775 212	2.1 4.	-	-	-	-	-	-
22	10	F	+	4	RT	1004	x 1 1.4	3	-	-	-	-	Cortical thinning
23	36	F	+	7	RT	630	1.2x0.5	-	-	-	-	-	-
24	50	M	+	4	LT	970	x 0.8 1			+	Renal stone	-	-
25	67	F	+	8	LT	619	6.6x4	2	-	+	-	-	-
26	26	M	+	8	LT	1344	2.8x2.4x1.9	1	-	-	-	-	-
27	69	M	+	2	LT	470	12x.06.	-	-	-	LT lion pain	-	Enlarged Prostate
28	40	M	+	5	RT	77	04.	1	+	-	-	RT hydro-nephrosis and -hydro Ureter	
29	55	M	+	3 7 4	RT RT LT	494 786 598	x 0.6 0.8 x 1.2 2.0 x 0.7 0.7	2 2	- +	- -	- -	-	-
30	76	M	+	4	RT	806	07x.08.	2	+	+	-	-	Enlarged Prostate
31	51	F	+	8 3	RT RT	1273 414	1.3 1.1	1	-	+	-	-	Cortical thickness

32	48	F	+	6	LT	110	4.5x1.5	2	+	-	-	-	Cortical thinning
33	62	M	+	8	RT	700	1	-	-	-		-	GB stones , RT lumber hernia
34	'42	M	+	4 3	RT RT	512 607	1.4 1.1	3	-	-	-	-	Cortical thickness
35	45	F	+	6	LT	184	03.			+			
36	64	M	+	9	RT	214	04.	2	+				Cortical scarring
37	70	M	+	8	LT	1175	2.2	2	-	+			LT cortical thinning , RT simple cyst
38	12	F	+	6	RT	130	1.8	1	+	+	-	-	RT Cortical thickness RT ovarian cyst
39	69	F	+	8	RT	664	1.5	-	-	+	-	-	Cortical thinning
40	25	F	+	3	RT	182	02.	2	-	-	-	-	Cortical thinning , ovarian cyst
41	74	M	+	3	LT	972	1.2	-	-	-	-	-	-
42	49	M	+	6	RT	125	1.6	2	-	-	-	-	-
43	40	M	+	1 3	RT LT	697 827	5. 1						Bilateral pylonephritis & cortical scarring
44	24	F	+	2	LT	1015	.17x.05	+	+	-	-	-	-
45	32	F	+	8	LT	914	05.	1	-	-	-	-	-
46	70	F	+	8	RT	478	1.5	1	-	-	-	-	-
47	43	F	+	3 3	LT RT	1449 1071	2.5x1.07.6x1. 4	- 2	- -	+ -	LT lion pain & RT renal stone	-	RT simple renal cyst Bilateral lower ureteric wall

													calcification
48	65	F	+	3	LT	435	1.4	-	-	-	-	-	Mid focal obstruction
49	45	M	+	8 3	RT LT	394 1124	07 .×9. 1.2 ×1.1	-	-		+	-	-
50	35	M	+	6 3	LT LT	418 498	9. 7.	2	+	-	-	-	-

Appendix (B)

Figures of CT KUB images showing the stone in different plane

Figure (5-1) shows RT staghorn stone and multiple LT kidney stones in [coronal plane [25

.[Figure (5-2) showed LT kidney stone insagital reconstruction plane [24

.[Figure (5-3) showed bilateral kidneys stones in axial plane [24

.[Figure (4-5) showed LT ureteric stone in coronal reconstruction plane [24

Figure (5-5) showed RT kidney stone in the scout , axial, coronal and sagital view [24].

Figure (5-6) showed RT uretero-vesicular junction stone associated with hydroureter