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URETERAL CALCULI

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Abstract

Background: *Several factors must be kept in mind in to decide the best treatment for patients with renal or ureteral calculi. The factors can be categorized in 4 groups based on: stone factors (size, location, duration, composition, and presence of obstruction); clinical factors (severity of symptom, expectations of patients, associated factors as infection, obesity, hypertension and preexisting kidney disease); anatomic factors (ureteropelvic junction obstruction and renal ectopia); and technical factors (such as equipment which are available, expertise and cost).*

Methodology: *We conducted this review using a comprehensive search of MEDLINE, PubMed, and EMBASE, January 1985, through February 2017. The following search terms were used: ureteral calculi, diagnosis of urolithiasis, medical management of ureteral calculi, ureteral calculi intervention*

Aim: *Our aim in this review was to study the most effective ways of diagnosis ureteral calculi, and also study the best approach to treating it.*

Conclusion: *There is a shift away from noninvasive shock wave lithotripsy (SWL) in favor of more invasive ureteroscopic options due to the recent advances made in ureteroscopic technology, intracorporeal lithotripsy probes and extraction devices. Simultaneously, the trend in ESWL technology tends to be less expensive, with higher mobility, and more compact, however less powerful. Regardless, the best modality for management is still debatable. The best management of choice depends on factors like stone size and location, the experience of the operators', preference of patient, equipment availability, and costs.*

Keywords: *ureteral calculi, urology, urolithiasis, recent management*

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INTRODUCTION:

Several factors must be kept in mind in to decide the best treatment for patients with renal or ureteral calculi. The factors can be categorized in 4 groups based on: *stone factors* (size, location, duration, composition, and presence of obstruction); *clinical factors* (severity of symptom, expectations of patients, associated factors as infection, obesity, hypertension and preexisting kidney disease); *anatomic factors* (ureteropelvic junction obstruction and renal ectopia); and *technical factors* (such as equipment which are available, expertise and cost). When intervention is needed, the above factors must be considered in order to select the management for maximal stone clearance with least morbidity and based upon patients' preferences. Availability of equipment and technical expertise play a vital role in the decision of treatment options.

METHODOLOGY:

- **Data Sources and Search terms**

We conducted this review using a comprehensive search of MEDLINE, PubMed, and EMBASE, January 1985, through February 2017. The following search terms were used: ureteral calculi, diagnosis of urolithiasis, medical management of ureteral calculi, ureteral calculi intervention

- **Data Extraction**

Two reviewers have independently reviewed the studies, abstracted data, and disagreements were resolved by consensus. Studies were evaluated for quality and a review protocol was followed throughout.

The study was approved by the ethical board of King Abdulaziz University Hospital

Ureteric Colic

The pain of ureteric colic is because of obstruction of urinary stream, with a resulting elevation in wall tension. Rising pressure in the renal pelvis triggers the local synthesis and release of prostaglandins, and resulting vasodilatation induces a diuresis which further increases intrarenal pressure. Prostaglandins additionally act straightforwardly on the ureter to initiate spasm of the smooth muscle. Attributable to the mutual splanchnic innervation of the renal capsule and intestines, hydronephrosis and distension of the renal capsule may trigger nausea and vomiting.

DIAGNOSIS:

Besides usual history and bedside examination, investigations of individuals with suspected ureteric colic consists of plain abdominal radiography, ultrasound, intravenous urography and computed tomography.

Plain radiograph of the kidney, ureter and bladder

A plain radiograph of the kidney, ureter and bladder (KUB) has a sensitivity that spans from 45–60% in the estimation of acute flank pain. Overlaying bowel gas or stool (faecoliths) and abdominal or pelvic calcifications (phleboliths) can prove identification of ureteric stones difficult. moreover, a KUB cannot show radiolucent stones (10–20% of stones), therefore, restrict the value of plain radiography. nevertheless, a KUB can suffice for evaluating the size, shape, and locating the urinary calculi in some individuals [1].

Ultrasonography

Ultrasonography permits direct visual of urinary stones located at the PUJ, the VUJ, and in the renal pelvis or calyces. Stones contained between the PUJ and VUJ, nevertheless, are exceedingly hard to visualize with ultrasonography [2].

Intravenous urography

Back when it was initially introduced in 1923, intravenous urography (IVU) has been the common "gold standard" in assessment in ureteric colic. It offers structural and functional information, consisting site, degree and nature of obstruction. Whereas IVU has a recognition rate as great as 70–90%, it can only visualize radiopaque stones (80–90% of stones). In spite of its helpful effects, there are some unwanted aspects of IVU, consisting radiation exposure, risk of nephrotoxicity, contrast reaction and how long it takes, particularly when delayed films are needed [3].

Nephrotoxicity

The described incidence of contrast-induced renal failure is around 1%, in the other hand, the population with known renal failure and diabetes mellitus, the risk of contrast-induced nephrotoxicity is 25% [4].

Metformin is an oral agent, helps in the treatment of diabetes mellitus. Metformin is excreted unmetabolized by the renal system. It is not

nephrotoxic; nevertheless, a main concern is the potential risk of metformin-induced lactic acidosis in the individuals who exhibit contrast-induced oliguria. In this setting, metformin can accumulate, bringing about the resulting collection of lactic acid. Metformin-induced lactic acidosis is deadly in half of the affected patients; nonetheless, it is an exceptionally uncommon complication [5].

In individuals with normal renal function metformin ought to be ended at the time of the IVU and withheld for the subsequent 48 h. For individuals with abnormal renal function, metformin ought to comparatively be suspended at the time of the IVU and just be restored when renal function has been re-evaluated and observed to be normal [6].

Contrast reaction

In the overall population the incidence of contrast reaction is 5– 10%, consisting mild responses, for example, vomiting and urticaria, and in addition increasingly serious reactions, for example, bronchospasm and anaphylaxis (the danger of hypersensitivity is 157 for each 100 000). The incidence of contrast reaction can be reduced in many cases with the use of costly low osmolar contrast agents, yet it can't be totally eliminated [6].

Non-contrast enhanced computed tomography

Unenhanced computed tomography (CT) gives a highly popular alternative for assesing ureteric colic.

Advantages of CT

CT has the accompanying advantages over IVU: it has greater sensitivity and specificity for calculus detection, it does not use intravenous contrast medium, it allows alternative diagnosis, and requires a lesser examination time.

The accuracy of non-contrast CT in recognizing stone disease has been indisputable with sensitivity, specificity and positive predictive value of CT being accounted for as 96%, 100% and 100%, respectively. CT can show every single radiopaque stone, and in addition radiolucent stones, for example, uric acid and cystine calculi. when CT affirms the presence of a stone, a plain abdominal radiograph ought to be obtained to evaluate whether the stone is radiopaque. This is useful as only the KUB radiograph is required later to decide whether the stone has moved or passed. Maintaining a strategic distance from the use of intravenous contrast medium is maybe the most particular advantage of CT in this circumstance [7].

CT additionally gives a chance to recognize extra-urinary pathology amid the primary investigation of individuals in whom a definitive diagnosis is not constantly apparent. The reported incidence of extra-urinary disease with CT is 6– 12%. Those announced abnormalities consist pelvic inflammatory disease, adnexal masses, tubo-ovarian abscess, appendicitis, diverticulitis, cholecystitis, pancreatitis or unanticipated malignancy. In some cases, intravenous contrast medium will be vital for more characterization of any of the unanticipated findings [8].

Disadvantages of CT

An essential limitation of CT is the way that it doesn't allow functional assessment of the kidneys and it cannot evaluate the degree of obstruction. The presence of a stone does not really imply that the kidney is obstructed. The general absence of functional information originated from CT, compared with the renal excretory times clear amid IVU, may hinder clinical management. nevertheless, few authors have recommended that secondary features of obstruction on CT which consist hydronephrosis, hydroureter, renal enlargement and inflammatory changes of the perirenal fat, that are referred to as perinephric stranding, are a dependable parallel of postponed excretion on IVU [9].

Another great disadvantage of CT is the greater radiation exposure of the individual compared with KUB or IVU. CT in this setting requires no less than three times the radiation exposure of IVU and 10 times that of abdominal radiography and presents an extra lifetime risk of malignancy of 1 in 4000.13 Newer protocols including diminished radiation exposure without compromising efficacy are on the process of development and are probably going to lessen further the radiation exposure from CT. Low-dose and ultra-low-dose CT diminished radiation exposure by about 50% and 95%, respectively, compared with standard-dose CT, with comparable detection rates of calculi and non-stone-associated anomalies [10].

One other disadvantage is that CT services are not worldwide available for 24 h period and a radiologist may be needed for the precise interpretation of the films. lastly, in the current healthcare climate, cost and availability will commonly be central features deciding the use of CT in the acute setting. A common criticism of CT is that it is more expensive than IVU. nevertheless, when taking into account the usefulness of decreased expenditure in terms of time and manpower for CT, it is advised that indirect costs

are way lesser for CT scans [11].

MANAGEMENT:

Given that most ureteric stones will progress spontaneously, conservative treatment as observation with analgesia is the favored method. Ureteric stones require radiological or surgical intervention only when the conservative management fails. The likelihood of spontaneous passage depends on various components consisting stone size, stone position, degree of impaction and degree of obstruction. The probability of spontaneous stone passage diminishes as the size of the stone increases. Most authors suggest that stone passage should not surpass 4–6 weeks due to the danger of renal damage [12].

Analgesia

The decision of analgesia utilized in the administration of acute ureteric colic is changing, with increasing use of non-steroidal anti-inflammatory drugs (NSAIDs). Most studies have demonstrated these medications to be as successful as opioids, with the latter used as rescue medications. Opioids have higher rates of nausea, vomiting, and dizziness.
Information on the impact of opiates on ureteric tone recommend that they cause an increase or no adjustment in tone. Opiate-seeking individuals may accordingly falsely present with symptoms of ureteric colic [13].

NSAIDs inhibit prostaglandin-induced effects. They also decrease local edema and inflammation, and block the stimulation of ureteric smooth muscle, which is the cause for increased peristalsis and succeeding increased ureteric pressure. Despite the fact NSAIDs decrease pain accompanied with ureteric colic, they can potentially interfere with the kidney's autoregulatory feedback to blockade by decreasing renal blood flow, and renal failure may occure with pre-existing renal disease. The choice of drug is generally based on physician preference, personal experience and institutional culture [13].

Medical expulsive therapy

The traditional treatment showed above has as of late been enhanced by the use of medicinal expulsive therapy (MET). Protocols were created dependent on the possible reasons for inability to pass a stone spontaneously, including muscle spasm, local edema, inflammation, and infection. Regimens have commonly included a corticosteroid (to diminish local edema through its anti-inflammatory activity), antibiotic medications (to prevent or treat urinary tract infection), and additionally calcium inhibitors and α-blockers (medications coordinated towards stone-induced ureteric spasm). combined treatment is given for short-term use.

- **NSAID**: NSAIDs have ureteric-relaxing effects and, accordingly, can be viewed as a type of MET; however, the main randomized, double blinded, placebo-controlled trial demonstrated no difference in augmenting stones passage among NSAIDs and placebo [14].

- **Calcium antagonists**: Ureteric smooth muscle stimulates an active calcium channel pump to contract. Calcium antagonists block the fast segment of ureteric contraction, leaving peristaltic rhythm unaltered. Thus, calcium channel blockers, which are ordinarily administered in the management of hypertension and angina, have been used to relax ureteric smooth muscle and improve stone passage [15].

- **α-Blockers**: α1-Adrenergic blockers are as of now ordinarily administered as first-line treatment in men with lower urinary tract manifestations. Both α and β adrenoreceptors have been appeared to exist inside the ureter, specifically in the lower and intramural parts. α1-Adrenergic antagonists block the basal tone, peristaltic wave frequency and the ureteric contraction in the intramural parts. Therefore, the intraureteric pressure underneath the stone decreases and elimination of the stone can be achieved [16].

Individuals managed with calcium blockers or α-blockers had a 65% more prominent probability of spontaneous stone passage than individuals not given these medications. Calcium-channel blockers and α-blockers appeared to be well tolerated [17].

Addition of corticosteroids may have a little preferred advantage, yet the advantage of medication treatment is not lost in those individuals for whom corticosteroids may be contraindicated [18].

There are extra advantages which appear to be related with MET. individuals have a dramatic lessened time to stone passage, dramatically less pain episodes, lesser analogue pain scores, and need dramtically lesser dosages of analgesics. At the point when conservative treatment comes up short, the decision

of treatment lies between shock wave lithotripsy and ureteroscopy. surgical management is beyond the scope of this article and it is not discussed over here [19].

Corticosteroids

Steroids have additionally been administered to help stone passage. The rationale for this treatment is that it lessens stone-induced oedema and henceforth enables a calculus to pass. Steroids joined with an alpha blocker demonstrated great efficacy than either a steroid or alpha blocker alone. **Porpiglia et al.** [20] compared tamsulosin; deflazacort; a joint addition of tamsulosin and deflazacort; and analgesics (taken when needed). The groups were comparable as far as age, sex, and stone size and area. The rate of removal for the four groups was 60%, 37.5%, 84.8%, and 33.3%, respectively. Shockingly, deflazacort all alone was not exceptionally adequate compared to tamsulosin or combination treatment. individuals advantage significantly from combination treatment (84.8% expulsion rate) however, in the event that steroids are contraindicated (that is, as a result of diabetes or history of peptic ulceration) then adjuvant alpha inhibitor treatment will be of advantage (60% expulsion rate).

MET has been appeared to be financially cost-effective by decreasing the quantity of ureteroscopic procedures that would be required following observation alone. Given that ureteroscopy is not very cheap and MET is not extremely expensive, or spontaneous stone passage rates are not to a great degree high (and in this way require neither MET nor ureteroscopy) or to a great degree low (and along these lines require a ureteroscopy whether treated by MET or not), MET is a financially cost-effective therapy. In the USA, this method would result in a hypothetical $1,132 cost sparing per individual over observation, a saving that is related to the staggering expense of ureteroscopy in the USA and the moderately minimal cost of tamsulosin. In fact, because of the cost differences between the two therapies, if only a single ureteroscopy per 100 treated individuals is avoided due to MET, at that point it would even still be a cost-effective treatment in the USA [21].

Extra-corporeal shockwave lithotripsy

Extra- corporeal shockwave lithotripsy has been used for a long time and is an efficient treatment method for a select group of individuals. It has been appeared to be extremely efficacious for upper ureteric stones of ≤10 mm in size. Various large series have demonstrated stone-free rates of over 80% for proximal ureteric calculi. In a series of 397 individuals with an upper ureteric stone, 91% had a calculus diameter of ≤14 mm and this cohort study had an 84.3% stone-free rate at 3 months. nevertheless, with expanding stone diameter the success rate diminishes. For the Dornier Compact Delta lithotripter, the success rate at 3 months was reported as 96% for calculi ≤10 mm and 90% for individuals of 11-20 mm in diameter [22].

Ureteroscopy

Alongside progressing advancement of safety/working wires and basket design and size, one of the key advances in ureteroscopy relates with the enhanced image quality itself, with the improvement of digital ureteroscopes with chip in the tip' innovation. Such systems can be enlightened by LEDs (light-emitting diodes) in the tip of the scope, and an outer light source may not therefore be required. Additionally, the astounding enhancement in image quality, such scopes are lighter (there is no requirement for an external camera to be connected), characteristically more secure (there is no danger of drape or individual burns from the outer light source), and perhaps increasingly solid (there are no delicate fiber-optics inside the scope since the image is transmitted digitally) [23].

It has been recommended that the impressive enhancement in image quality over conventional analogue scopes may permit the earliest phases of stone development to be better appreciated, and thus enhance our understanding of the pathogenesis of calcium oxalate stone formation [24].

Isoproterenol and ureteroscopy

Through its impact on relaxation of ureteric tone, the use of endoluminal isoproterenol in the irrigation fluid has been demonstrated to decrease pelvic pressure compared with saline irrigation without influencing heart rate or mean arterial blood pressure. dramatic increases in intra-renal pressure do happen amid ureteroscopy (particularly amid infusion of contrast) and these might be related with complications, including urinary sepsis due to pyelovenous and pyelolymphatic reflux. The decrease of intra-pelvic pressure, without related cardiovascular side effects, thus, offers a possibly valuable safety step in ureteroscopy [25].

Robotics

While not reported for the therapy of ureteric calculi up until now, the extension of robotics to ureteroscopy deserves a notice. **Desai and partners** [26] have lately described the use of a modified robotic catheter system for ureterorenoscopy that had been initially created for intra-cardiac applications.

In this feasibility study using a pig model, they could investigate 98% of calyces using a steerable guide catheter controlled remotely by means of a three-dimensional joystick. They announced that the robotic method was 'stable, effectively maneuverable, and ergonomically superior' to conventional ureterorenoscopy. Intra-renal therapeutic methods were likewise possible, including the entire fragmentation of small stones. They found that the combination of the exact positioning of the catheter tip and its consequent stability enabled the system to be 'parked' in a calyx for longer periods, enhancing the ability to target little fragments for further fragmnetation. nevertheless, they recognized noteworthy extravasation of irrigation fluid after these procedures, and have consequently decreased the size of the prototype ureterorenoscope to 7.5 F [26].

CONCLUSION:

The number of emergency department encounters, outpatient visits, and total estimated annual economical burden for patients with urolithiasis have has been increasing. α-antagonists and calcium channel blockers are used for managing spontaneous stone expulsion. Therefore, close monitoring with MET, which is a conservative approach, promises a valid option for distal ureteral stones with size up to 10 mm.

There is a shift away from noninvasive SWL in favor of more invasive ureteroscopic options due to the recent advances made in ureteroscopic technology, intracorporeal lithotripsy probes and extraction devices. Simultaneously, the trend in ESWL technology tends to be less expensive, with higher mobility, and more compact, however less powerful. Regardless, the best modality for management is still debatable. The best management of choice depends on factors like stone size and location, the experience of the operators', preference of patient, equipment availability, and costs.

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