

Renal Colic Disease: Overview, Management, and Prevention

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Abstract

Background: Renal colic disease is a very common condition in medicine that has causes but idiopathic causes are one important etiology. Non-contrast CT is the gold standard modality for diagnosis. Treatment varies from just lifestyle modifications to surgical interventions. **Objective:** The objective of this review is to discuss Renal Colic disease, types, presentations, management, complications, and prevention. **Method:** We searched the PubMed database looking for relevant articles to the topic using Mesh term, "Renal Colic Disease". **Conclusion:** Renal colic disease is a prevalent disease; many etiologies can contribute to that. The management will depend on the type, for that, proper history and diagnostic labs can contribute to the management plan.

Keywords: Renal Colic, Diagnosis, Management.

Introduction

Renal colic disease is a prevalent disease that affects 5-15% of the American population throughout their lives. It can cause a high morbidity and mortality rate if left untreated because of the complication and the diseases that share many features with (Heilberg and Schor, 2006). In this review paper, causes, clinical features, diagnosis, prevention, and treatment of renal stones in detail to understand the underlying causes and the best way of

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management to particular patients and what should be done in some cases are going to be discussed.

Causes:

The leading cause behind the renal colic disease is an obstruction of the urinary tract; the usual three places of these obstructions are the Vesoureteric junction –between the ureter and the urinary bladder-, mid ureter –where the ureter pass through the iliac vessels, and lastly is the pelvi-ureteric junction between the kidney pelvis and the ureter, inferior to superior respectively (Gandhi et al., 2019). These junctions that we have mentioned are usually obstructed by stones about 80% of the obstructions occurred by stones and surely there is a lot of types of these stones that are going to be mentioned in this review, other than the stones there is obstructions caused by blood clots caused by bleeding of the upper urinary tract and can be caused also by a sloughed renal papillae and it is very common with diabetic patients (Bultitude and Rees, 2012; Priyadi, et al., 2019; Khodarahmi, et al., 2020; Alshali, 2020; Moghaddam, et al., 2019).

Types of stones:

Those stones are formed due to disturbance in the balance of the formation of crystallization stones in urines which should be increased and the inhibitors growing factors of these stones, in addition to urine pH which is also important, there is a lot of materials that can be crystallized in the urine such as calcium and oxalate which constitutes 80% of the cases, calcium phosphate and uric acid stones which are usually found with patients who are suffering from the Metabolic syndrome – dyslipidemia, obesity and increase glucose level or insulin resistance (Coe et al. 2005).

Idiopathic hypercalciuria:

As the name indicates, it is an unknown cause that leads to elevation of the calcium level in the urine which exceeds 300 mg/day and 250 mg/day in men and women respectively (Coe et al. 2005). This elevation of calcium level in the urine leads to the formation of crystals in urine with unknown cause (Heilberg and Schor, 2006). In this field, a lot of researches have been conducted to looking for the cause and relationship between this increase and hormones level but they found that there is a normal level of PTH (parathyroid hormone) and vitamin D. Also, they noticed that there is no hypercalcemia but still, there is bone resorption and a decrease in bone formation (Heilberg and Schor, 2006).

Hyperuricosuria and uric acid nephrolithiasis:

Hyperuricosuria is defined as the excretion of uric acid in urine which exceeds 750 mg/day and 800 mg/day for women and men respectively (Heilberg and Schor, 2006). Uric acid is one of the metabolites that formed during the purines salvage pathway which is also increased with eating high animal proteins meal, there is a specific type of stones called uric acid stones which colored with red on orange color also decreases the urine pH, make it more acidic and so on much easier to crystallize more and more stones with this highly acidic environment and as we have mentioned above it is highly associated with patients who are suffering from metabolic syndrome and insulin resistance (Alelign and Petros, 2018).

Hypocitraturia:

Normally, the citrate binds to calcium in a soluble state to inhibit crystallization. So, when there is a low citrate level there is a high chance for the calcium to start the crystallization, we can define the hypocitraturia with a 320 mg/day level of citrate in urine or lower than this. Usually, the hypocitraturia is idiopathic, but it can also happen due to some etiologies like hypokalemia, diarrheal syndrome, or renal tubular acidosis (Heilberg and Schor, 2006).

Hyperoxalouria:

This condition can be caused by enzymatic disturbances in the oxalate biosynthesis pathway and also can be due to a rare genetic disorder. It is the prevailing type of these conditions called primary hyperoxaluria. Secondary hyperoxaluria can be either due to an increased level of substrate availability like ascorbic acid –vitamin C- ethylene, or decreasing the level of oxalate degradation done by intestinal bacteria in addition to hyperabsorption of oxalate in the intestine (McConnell et al., 2002). One of the most explanatory theories for this condition is the fat and bile acid malabsorption since the not absorbed bile and fat are binding to the free calcium and so the calcium will not bind to oxalate and the oxalate will not be excreted. Instead, it will be absorbed and cause the enteric hyperoxaluria state (McConnell et al., 2002).

Distal renal tubular acidosis:

This condition causes an increase in the urine pH or alkaline fasting urine with metabolic acidosis associated with hypocitraturia, hyperoxaluria, and higher chances of crystallization due to the alkaline urine (Rodríguez Soriano, 2002). This condition can occur by toxins, drugs, or autoimmune diseases such as Sjogren syndrome (Rodríguez Soriano, 2002). Also, it could be inherited and can lead to nephrocalcinosis (Cheidde et al., 2003)

Infection stones:

It is usually associated with upper UTI (urinary tract infection), with urease producing bacteria. This type of bacteria hydrolyzes the urea producing ammonia and hydroxide increasing the pH of the urine in addition to the phosphate-binding to magnesium

forming a triple crystal or called struvite, which is composed of ammonium, phosphate, and magnesium. This stone usually has a description of the stag-horn stone. (Figure 1) (Barbas et al., 2002). The most common organisms that can lead to this kind of stones are *Proteus mirabilis*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Enterobacter* (Alelign and Petros, 2018).

Cystinuria:

Is an autosomal recessive disorder characterized by decrease renal tubular absorption of the cystine amino acids like cysteine, ornithine, lysine, and arginine, increase excretion of these substances will lead to the formation of stones due to its low solubility in normal pH urine (Ahmed et al., 2006).

Clinical Manifestation:

The pain is acute in the flank and intermittent it is localized in the lumbar region radiating to the groin and scrotums the pain occurs due to movement of the ureters or kidney capsule distension, this pain should be differentiated from pyelonephritis also a tender kidney will present (Gandhi et al., 2019). In the elderly, we should rule out diverticulosis (on the left side) and also aortic aneurism rupture. If the patient is young appendicitis (on the right side) should be ruled out (Bultitude and Rees, 2012). Also, in case of a women any ovarian problems like torsion or rupture in addition to the ectopic pregnancy must be suspect, in some patients we can notice a positive costovertebral angle or tenderness in the lower abdomen (Gandhi et al., 2019). If there are fever, tachycardia, and hypotension we should suspect sepsis and this considered one of the most dangerous emergencies which required a direct referral to the urology unit and fast intervention to avoid organ failures all these complications happen only by infectious stones (Bultitude and Rees, 2012).

Investigation:

The workup for renal stones can be divided into radiological and non-radiological which is urine and blood tests.

Radiological:

It has been approved by the British Association of urological surgeons and the European association of urology that the non-contrast-enhanced CT is the gold standard for the radiological investigation because of the high level of sensitivity and specificity (Rodger et al., 2018). In some conditions, we might go to use the ultrasound procedure when the radiation is better to be avoided radiation like in pregnancy. But, it is not recommended in diagnosing renal colic because of its low sensitivity although it shows a good result in diagnosing intramural and bladder canalliculi (Gandhi et al., 2019).

Non-radiological:

It is important to do the urine dipstick test to rule out any Urinary tract infections (UTI) in addition to the urine analysis which can reveal the type and structure of the stones that are found in the urine

sample and so we can expect the cause or decreasing the field of search (Tsiotras et al., 2017). It is also recommended to do a full blood count, C - reactive protein, serum electrolytes, and calcium level (Gandhi et al., 2019).

Treatment and Management:

we usually used to do a conservative treatment which depends on managing the symptoms of renal colic and give NSAIDs (non-steroidal anti-inflammatory drugs) such as Diclofenac, to relieve pain by inhibiting the prostaglandins which are responsible to convey the pain through the central nervous system with substance P (Holdgate and Pollock, 2004). It is important to notice that NSAIDs should not be used in Asthmatic, peptic ulcer, or suspected renal impairment patients (Afshar et al., 2015). In some cases we need to invent directly and emergently because it considered life-threatening conditions for example: if there is any possibility of sepsis we should start directly our treatment and procedures to avoid systemic infection and organ failures if there is bilateral obstruction both ureters are obstructed by stones that can affect both kidneys (Bultitude and Rees, 2012). This can cause harmful damage to the kidney tissues, as well as if the obstruction of a solitary kidney is going on and lastly if the pain cannot be controlled in terms of severity and frequency (Bultitude and Rees, 2012).

This is for acute management of renal colic disease but some drugs are approved by the FDA (Food and drug administration) to treat renal colic and each drug has a specific indication and contraindication also. For example, we can give **Thiazide** which is a distal loop diuretic decreases the calcium excretion in urine and oxalate and this decreasing of supersaturation state will prevent the formation of stones, it has been approved that the effect of the thiazide on proximal tubule is more effective in this condition than its effect on the distal one and this study was surprising one (Nijenhuis et al., 2005). **Allopurinol**, this drug is a xanthine oxidase inhibitor it is used in treating chronic gout but it is still using in renal colic disease with uric acid stones because it inhibits the synthesizing of the uric acid by inhibiting the purine salvage pathway and it was very effective to treat hyperuricosuria patient (Heilberg and Schor, 2006). **Potassium Citrate** is an alkalizing urine agent that can be used in dRTA –distal renal tubule acidosis-patients and low pH urine patients. It decreases the ability of uric acid to crystallize and it is complexing the calcium and stops its crystallization (Heilberg and Schor, 2006). Antibiotics are approved to be used in cases of urinary tract infection UTI to prevent the case of sepsis (Heilberg and Schor, 2006).

Away from the pharmacological treatment we also have some procedure choices to do with some patients especially if it needs a direct and emergent intervention (Bultitude and Rees, 2012). We have extracorporeal shockwave lithotripsy this is a noninvasive procedure it works by destroying the stones by some waves are conducted above the skin directly to the location of the stones and without damaging the body tissues and then the stones are passing spontaneously (Bultitude and Rees, 2012).. Ureterorenoscopy, this procedure is done by inserting an endoscope from the bladder to the ureter and can allow fragmentation and extraction of stones but it needs systemic analgesia and hospitalization (Pickard et al.,

2015). Percutaneous nephrolithotomy, it is usually indicated if the above procedures are not suitable and for large stones more than 20 mm, it is contraindicated in pregnancy or uncontrolled UTI (Preminger et al., 2005).

Prevention:

Prevention mainly depends on the diet, hence, to reduce the susceptibility of stone formation patients should follow some advice in the diet field like increasing water uptake to maintain a normal urine volume which prevents supersaturation (Heilberg and Schor, 2006). Also, the patient should restrict high animal protein meals because it increases the level of uric acid in the body (Heilberg and Schor, 2006). It is worth mentioning that, patients should not go into a calcium restricted diet because it has been approved that the low calcium diet will lead to increase oxalate absorption in the intestine and increasing oxalate saturation so on Curhan et al., 1993). It is also advised to increase the intake of fruits and vegetables since they have a high amount of potassium (Ahmad et al., 2006).

Conclusion:

Renal colic disease is very common in a population because of the big problems in the diet we have so it is so important for ourselves to know how to manage those patients when to invent when to conserve when to use medication, also we should have a screening population like metabolic syndrome patients and kidney disease patients and do not forget to use the golden standard for diagnosing which is non-contracted enhanced computed tomography.



Figure 1: Stag-Horn stone on X-Ray.

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