

A comprehensive review on risk factors and dietary nutritional management in nephrolithiasis

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Abstract:

Kidneys are essential for life. They are major organs of excretory organs of the urinary system of the human body. All the metabolic activities of the body result in the formation of waste products and these are excreted mostly through the kidneys. Kidney stones have been associated with an increase to leads kidney failure. In a lifetime there is a chance of formation of kidney stones depending on diet and nutritional and environmental factors it may be considered as a very painful urological disorder. The kidney stone is hard deposits of acid salts and minerals developed from crystals buildup the inner surface of the kidneys. In our study, we assessed biochemical parameters efficiencies related to formation of different types of kidney stones. Nutrition plays a pivotal aspect in nephrolithiasis patients; organic and mineral analyses are carried out through the serum and plasma. It may also carry out that physiological dietary nutritional factors and daily routine habits that favor the formation of kidney stone disease. This research carried out to assess the relation between some biochemical assays and the recurring of stone formation. In which the patients were suffering from painful urination and back pain in the lower of abdomen. Under certain conditions, these stones obstruct the renal pelvis make intermittent pain. Prevention of these kidney stones requires behavioral lifestyle habits and nutritional interventions. This review represents a comprehensive study of renal stone formation and the nutritional dietary factor's role in nephrolithiasis will certainly be helpful in decrease stone formation.

Key words: Nephrolithiasis, Dietary nutritional factors, Diagnosis and Management.

Introduction:

In human's nephrolithiasis is a commonest urological disease. Nephrolithiasis also termed as kidney or renal calculi are prevalent and painful of the urinary system [1]. During 70 years of lifetime, there is 3-20% tendency to form at least one urinary stone about of the overall population of the world [2]. About 12% in the total population of India, urinary stones are reported. Among the above 12% of the population showed with severely renal damage caused in 50% of the population [3]. In India, the composition of the stone is different when compared to

Western countries. Where a predominant component of calcium oxalate, which affects the productive age group about 3% [4]. The urine biochemical investigations of stone-forming in Nephrolithiasis patients play a pivotal role, and abnormalities in the kidney may affect pathophysiology in renal stone [5]. Nephrolithiasis is a multifactorial disease, which eventually despite the crystallization of salts and minerals that favors the formation of stone [6]. A suitable metabolic evaluation on the occurrence of multiple systemic diseases complicating with Nephrolithiasis, i.e., intestinal malabsorption, bone disease, endocrine.

These metabolic investigations provide a piece of reliable information on dietary regimens.[7]. The basis for a Kidney stone that forms is a supersaturation of urine that increases the probability of salt crystals formation [8]. Prevalence of symptomatic Nephrolithiasis around the lifetime is 10% in men and 5%in women and 2 billion people spent for treatment purposes. [9]. Different kinds of factors are necessary in the formation of kidney stones like excess Ca^{+2} oxalates content, uric acid, inadequate hydration, family history of stone, lack of stone inhibitors [10]. A dietary nutritional factory administration that consumption fluid and calcium is a strong risk factor that has a very important role in formation of kidney stones [11]. This review aims to clarify the need and efficiency of nutritional dietary factors and important strategies which support clinical management of kidney stone formation patients.

DIETARY NUTRITIONAL FACTORS IN NEPHROLITHIASIS:

Protein: An elevated intake of animal protein is accountable for the increase in the formation of stone [12]. This protein makes a bridge to the contribution between uric acid and calcium stones by its physiological activity. To ignite metabolism, a balanced amount of protein and greater consumption of protein is required.[13]. The protein intake recommended for the elders is in-between 0.9 -1.0 g kilogramphysique ofmass /age [14]. Potential detrimental effects bring a probability factor in stone formation due to the high dietary intake of protein, which increases excretion of urinary calcium, and pH of urine is reduced [15]. Purines are precursors of uric acid stone; these purines are highly rich in animal protein. Amino acids such as tyr, tryp, glycine, transform into oxalates. Rise in urinary excretion of calcium and reabsorption of citrate, which leads to the formation of renal stones [16].

Oxalates: Plant foods are mainly composed of dietary oxalates which are estimates of

oxalate, depending on the intake of dietary rich oxalate foods. In dietary therapy is important in knowing the detailed knowledge about oxalate foods for kidney stone patients [17]. The metabolism of vitamin C and the dietary oxalate both cause oxalates [18]. Some studies suggest consuming more oxalates in kidney stone formers compared to healthy individuals and renal stone formation the oxalate quantity is not the only reason it depends on other nutritional factors [19]. Urinary oxalate concentration increases the urinary supersaturation which is regarded as a possibility factor in formation of stones (calcium oxalate) [20].

Sodium and Potassium: In India, the periodic salty food diet is most common reason for the formation of stones in the kidneys. Sodium and potassium also increase PH, volume leads to cystine lithiasis [21]. Sodium shows a great effect on the excretion of urinary calcium, increases in urinary sodium 25mmol/day can cause to increase the 0.6mmol/day in urinary calcium. Some studies have shown excretion of calcium & sodium in urine are commonly correlated, in the body value of urinary calcium is also regulated by potassium. Some studies suggest that the Healthy subject's diet it was reported that dietary potassium deprivation, with normal sodium quantity an increase excretion of urinary calcium [22].

Calcium: In patients outside of meals Taking calcium supplements is a possible factor in result formation of nephrolithiasis [23]. In India, some main ingredients of calcium-rich foods such as soybean, rajma, ragi, and some dairy products are considered regular diets [24]. Some studies suggest lower calcium intake leads to the formation of stones when compared to higher calcium intake [25].

Carbohydrate: Fructose is used as a sweetener as a replacement for glucose or sucrose. over the last decades' consumption of fructose, a systematic review noted the relation between intake of fructose and risk

of formation of stone [26]. Some studies suggest that idiopathic hypercalciuria patients play a significant role in formation of calcium stones with a metabolic diet concluded with calcium [27].

Fat: The various complex mechanism of dietary fatty acids suggests that extremely the ratio of n-6: n-3 PUFA acids may affect the formation of calcium oxalate stones. The administration of fish oil carried out the management of the formation of stone. In healthy subjects reduce excretion of oxalate was found with supplementation of fish oil was found to and excretion of urinary calcium in most trials [28].

Beverages: The most common beverages are Tea and coffee. A review of systematic large studies concludes that preventative role of tea and coffee consumption formation against a stone. The beneficial effect of coffee and tea, consumption of large amount caffeine primarily diuretic action which could be effect of hypercalciuric effect [29].

DIFFERENT TYPES OF STONES:

Kidney stones are manufactured by salinities from the urine that are indecipherable in urine and basic mechanism complicated indevelopment of kidney stones. The mechanism categorized by precipitation with a constituent which is non – crystal-like protein. Crystallization and then precipitation of the salinities ensues in the urine. The crystals can grow into a mass. Majority substantial components for stone configuration arises on renal papillary of calcium – phosphate nidus characteristically a Randall's plaque. The common of stones are categorized by calcium salinities which contains calcium oxalate and calcium phosphate. Residue of stone is produced by uric acid, phosphate, cysteine and magnesium ammonium stones [30].

Calcium oxalate stones: About 80-90% all the stones made up major element that is calcium. Kidney stone disease (KSD) is mostly associated with absorption of

intestinal calcium which leads a condition termed as hypercalciuria in 30-60% patients. The calcium stone main component is brushite or hydroxyapatite which is an essential integrant of bone and teeth. The frequency of the calcium content stones which account for pure calcium phosphate stone is 5% and calcium oxalate are 50% and mixture of both are 45% [30]. In kidneys stones calcium oxalate found in preparation of calcium dihydrate and calciummonohydrate both which are greater than 60%. Thermodynamically COM is more stable stone compare to COD in kidney clinical stones [31].

Calcium phosphate stones: Calcium phosphate is originated with oxalate in most of the stone as calcium phosphate stone in untainted form are unusual. These types of stones designed by the high organic crystallization pressure. This stones usually connected with renal imperfections of tubular acidification. It resulted lost the function of kidney, lower the PH of urine that forms divalent and trivalent forms of phosphate cause supersaturation of urine [32].

Uric acid stone: Uric acid stones characteristics appearance is round, smooth, yellow – orange and transparent radiographically. High intake of food materials contains rich source of purine such as fish, meat result to clinical manifestations like hyperuricosuria, and resulting low urine pH and low urine volume, renal ammonium production can lead to formation of uric acid stones [33]. Elevated levels of serum uric acid and urinary uric acid concentrations can precipitate out uric acid in urine. Elevated uric acid leads hyperuricaemia disorders like GOUT, tumour lysis syndrome, myeloproliferative disorders and protein inborn error disorders result in an increased concentration in urine and serum and along that certain drug like thiazides, salicylates that enhance the uric acid stone formation [34].

Struvite Stone: When the urine is alkaline which leads to develop struvite stones along with raised Concentration of trivalent phosphate, ammonium, and urease produced by bacteria. Bacteria like *Providencia* species, *proteus* species, and *Morganella morganii* that favour produce the urease that alkaline conditions lead to crystallization of Magnesium, Ammonium Phosphate. For example, bacteria like *staphylococcus* produce 55%, *klebsiella* produce 84% and *E. coli* species that produce 1.4% of urease [35].

Cystine stones: Cystine stones are very few when compare to the other types of stones it is about 2%. These stones may be considered a genetic disorder of the cystine amino acid transport which leads to clinical manifestations of cystinuria in urinary excretions. The formation of this stone may be considered as an autosomal recessive disorder due defect in a gene known as rBAT gene located in chromosome 2. The people who are suffering for cystinuria excrete insoluble cystine more than 600 millimole per day [36].

RISK OF FACTORS IN NEPHROLITHIASIS:

Dietary nutritional factors are major key points to promote or inhibit the Nephrolithiasis. The stone formation can be occurred by other factors which include body weight, genes, environment and intake of fluids. The following factors which can associate formation kidney stones [37].

- Poor intake of fluids
- Dehydration of the body
- Cystinuria is risk of developed the cystine stones, it can also occur by genetically.
- Consumption of high animal protein, fats, sugar may increase the risk of kidney stones.
- urinary tract infections easily develop the struvite stones.
- Metabolic syndrome can associate the risk of kidney stones.

- Body mass, obesity risk of kidney stone formation.

DIAGNOSTIC STRATEGICS IN NEPHROLITHIASIS:

Symptoms associated with stones at definite location:

Renal pelvic stones
Distal ureteral stones
Proximal ureteral stones
Caliceal stones

Blood test:

To check the physiological function of kidney blood test is performed to check evaluated uric acid and calcium level in the blood.

Urine test:

To check the excretion of urinary substances and elevated levels of uric acid, urea, protein and sugar.

Imaging tests:

- Ultrasonography
- Tomography
- CT scanning
- Retrograde urography
- Intravenous urography

Management of Nephrolithiasis: There are numerous management possibilities are accessible depending upon the stoneSize and type.

Small stones: The small stones naturally their own excrete through urine not essential much treatment. Drinking plenty of water may help flush out the stones throughout urine. During the urination the movement of stone create pain. Generally, this type pain can be treated by certain medications. The doctors can recommend with alpha blockers which work as relaxation of muscles in ureters, they allow quickly pass stones through urine. Some drugs like diuretics are increase flush out the stones from kidney [38].

Large stones: Large stones are harmful for the body it can cause loss the function of nephron, internal bleeding and urinary tract infections. Due the large shape they cannot flush out easily throughout urine. Intake plenty of water, they cannot flush out from the body due to struck in urinary track. Clinical features may sign of urinary tract infections, malfunction to take oral fluids indicates of active management and hospitalization. This type of stones is fragmented into small pieces by shock wave lithotripsy, which waves creates vibrations. The vibration brake large stones into small which are flush out throughout urine. Shock wave lithotripsy treatment is common due to its congenital in nature its required minimum dose of anaesthesia and most preferable method by physicians and it is uniformly for all types of stones [39].

MEDICAL TREATMENT OF NEPHROLITHIASIS:

Laparoscopic Pyelolithotomy: This procedure has been programmatic effective on every aspect of urinary tract infections. This procedure is ideal for large tones in pelvis of patients. When stones are unable to remove from shock wave lithotripsy then this procedure are applied by physicians [40].

Nephrolithotomy: When large stone are appeared inside of kidney then Nephrolithotomy is surgical procedure applied by the doctors. During the surgery patient accept certain dose of general anesthesia. A thin telescopic tool contain instrument which remove more than 2 cm kidney stones. This instrument is inoffensive and operative procedure with high success rate. This procedure highly used to remove stones near the pelvic region of patients [41].

Ureteroscopy: When large stones are get struck in urinary bladder or ureter which can be removed by a clinical procedure known as Ureteroscopy. It mainly examined the upper urinary tract. This Procedure instrument at the end have a small wire with connection of

camera to visualize the location of stone. The wire is implanted into the urethra of penis and passed into urinary bladder to identification of location of stone then destroy into small pieces and remove with help of a cage connected with it. [41]

Open surgery: The patients having a high stone clearance rate with fewer interventions, hence open surgery, in spite and its more invasive nature. During the procedure an incision in patient abdomen or side of abdomen to reach the kidney to flush out the stones, then a catheter will place near the kidney to flush out urine until healing the kidneys [42].

PHARMACEUTICAL TREATMENT OF NEPHROLITHIASIS:

1. **Non-Steroidal Drugs:** opioids and non-steroidal anti-inflammatory drugs are effectively used to discharge abdominal pain in patients with nephrolithiasis [43].
2. **α – Blockers:** They increase the ejection rate of distal ureteral stones and also improve clearance of stones more than 5mm. α – blockers have a great role in Medical Exclusive Therapy and prevent hospitalization [44].
3. **Anti – Inflammatory Drugs:** Allopurinol is a type of medication, which work as reducing the production of uric acid. It is prescribed to intended the treatment of uric acid and calcium calculi [45].
4. **Thiazide Diuretics:** Is a type of drugs which lower supersaturation and reduce the calcium oxalate and calcium phosphate stones. Prevent the risk of hypercalciuria [46].
5. **Chelating Agents:** D- penicillamine act as a chelator. It has an effective role in patients suffering with alkalization and hydration it decreasing the rate of stone formation. It is used treating the cysteine stones [47].

6. **Acetohydroxamic Acid:** The action of acetohydroxamic acid as urease inhibitor. It stops the excrete of ammonia in urine. This drug used to prevent growth of urease producing organisms, which effects the urinary tract infections and recommended in struvite stones treatment [48].
7. **Thiol Agents:** Tiopronin is a thiol agent which work by eliminating additional cystine from the body. It is used to prevent severe homozygous cystinuria in nephrolithiasis patients [49].
8. **Calcium Binding Agent:** Cellulose sodium phosphate is drug used to treatment of hypercalciuria and hypercalcemia. It is extremely effective to bind intestinal calcium and inhibit calcium absorption to decrease the possibility of calcium calculi development [50].
9. **Urinary Alkalinizers:** Potassium citrate is a type of drug making urine less acidity. It is used in treatment of tubular acidosis and prevent the gout that occur with nephrolithiasis. Citrate complexes are soluble form which inhibit calcium crystals aggregation [51].

Conclusion:

The nephrolithiasis is common, morbid and highly recurrence with dietary nutritional factors. It is generally seen in the overall population of sex, race and age. The pathophysiology of formation of stone in kidney is diverse. Metabolic evaluation, preventative life style habits help to identify measures to reduce recurrence of nephrolithiasis. The treatment based on decreasing or eliminating supersaturation. The surgical treatment techniques relapse the high stones. The Pharmaceutical treatment may help in diminishing reoccurring rate of nephrolithiasis. Enhancement of analytic modalities in future this may provide a better understanding of the nephrolithiasis. The present review demonstrates several dietary

nutrition and risk factors that are chiefly have role on nephrolithiasis. Novel strategies will lead to manage nephrolithiasis in the future follow up studies.

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