



Diagnostic and Therapeutic Approach to Renal Lithiasis: Current Progress and Perspectives

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Article History	Abstract
Received: 06 June 2023 Revised: 05 Sept 2023 Accepted: 11 Sept 2023	<p><i>Renal lithiasis is a medical condition characterized by the formation of stones, known as stones, in the upper urinary tract. Its most frequent clinical manifestation is nephritic colic, which causes intense and acute pain in the renal area. This pathology is prevalent and affects approximately 10% of the population in non-industrialized areas. The purpose of this review is to exhaustively analyze the diagnosis and the various therapeutic alternatives used to treat renal lithiasis. The approach adopted in this research is qualitative, allowing a deep understanding of the aspects related to the diagnosis and treatment of this condition. Likewise, its scope is descriptive, which allows a detailed analysis of the findings obtained. For the collection of information, the documentary analysis method was used, which involved the review and evaluation of scientific articles and updated books on the subject. The results of this review were encouraging, since it was possible to establish that the diagnosis of renal lithiasis is based on the identification of clinical manifestations, with the support of various tests and procedures. Among them, the use of reactive strips, complete blood counts and the determination of protein C stand out, in addition to the application of imaging techniques such as UroTAC.</i></p>
CC License CC-BY-NC-SA 4.0	Keywords: <i>Stones, condition, Renal lithiasis, Urinary tract, Renal colic, Renal area</i>

1. Introduction

Renal lithiasis, urolithiasis or nephrolithiasis is a pathology caused by the presence of stones inside the kidneys or urinary tract, the most frequent manifestation of this pathology is nephritic colic. This pathology has been mentioned since ancient times since they have found stones in mummified people and tombs of ancient civilizations, even medical treatises mention methods for its treatment ⁽¹⁻³⁻¹⁶⁾.

Epidemiology:

This pathology is very common that affects 10% of the population that suffers a symptomatic episode before the age of 70 in non-industrialized countries and its prevalence has increased in the last 50 years. Metabolic syndrome affects 25% of adults in the United States and may be associated with renal lithiasis in 70% ⁽⁴⁻¹⁷⁻¹⁸⁾.

Pathogenesis:

Urine is a solution with aqueous and unstable characteristics, which is formed by inorganic, organic and cellular components, when there is an imbalance between these components' kidney stones

appear, and these are of multifactorial origin that Favor lithogenic caps such as: nucleation, aggregation, growth and fixation of the calculus. 3 pathways for stone formation are described: Overgrowth of apatite interstitial plates, crystal-like deposits in the tubules, and free crystallization in solution⁽¹⁻²⁻¹⁹⁾.

Other causes of urolithiasis

Struvite Lithiasis:

Due to repeated infections by urease-producing organisms "ureolytic bacteria" such as Proteus, Ureaplasma urealyticum or certain strains of Klebsiella or Serratia that hydrolyze urea with release of ammonia and carbon dioxide thereby increasing urine pH and promoting crystallization⁽²⁾

Drug-related Lithiasis:

Some drugs can induce lithiasis by altering the urinary components unfavourably (topiramate, acetazolamide, zonisamide), or by direct precipitation of the drug or its metabolites in urine (triamterene, ciprofloxacin), in the same way certain drugs are associated with the development of lithiasis directly as glafenine and its derivatives⁽²⁾

Lithiasis Associated with Congenital Malformations of the Urinary Tract

The association between urolithiasis and congenital malformations of the urinary tract is well known, for example, Cacchi-Ricci disease or kidney with "sponge marrow" is a congenital anomaly where there is dilation of the collecting tubules in one or more renal pyramids, uni or bilaterally manifested in the form of renal lithiasis, urinary tract infection or hematuria⁽²⁻³⁻²⁰⁾.

Classification of urolithiasis according to composition:

It can be classified according to the composition of the stones: Stones composed of calcium oxalate alone or with apatite (60 to 70%), by uric acid (10 to 15%), by phosphate-ammonium-magnesium known as struvite (10%), by calcium phosphate, apatite (7%) and brushite (1%), by cystine (1%)⁽²⁾.

Classification of Urolithiasis According to The Underlying Metabolic Abnormality:

Idiopathic Hypercalciuria (IH):

It is the sustained increase in urinary calcium elimination, in the absence of hypercalcemia and other known causes of hypercalciuria, is the most frequent cause of renal lithiasis in both pediatric and adult age and is one of the most frequent metabolic abnormalities in humans.

Hyperuricosuria (Purine Stones)

Uric acid is the end product of purine metabolism and urate stones are radiolucent. Hyperuricosuria is defined as an excretion greater than 800 mg/day in men and 750 mg/day in women, plasma uric acid levels should be considered initially to differentiate states in which there is overproduction, generally associated with hyperuricemia⁽²⁻³⁾.

Hyperoxaluria

It is the urinary elimination of oxalate greater than 50 mg / day / 1.73 m². In children, the oxalate/creatinine ratio is often used in isolated urine samples, the reference values of which vary according to age⁽²⁾.

Cystinuria

It is a defect of proximal tubular reabsorption of cystine and the dibasic amino acids, arginine, lysine and ornithine. This disease is inherited in an autosomal recessive manner and can occur at any age⁽²⁾.

Hypocitraturia

Renal excretion of citrate is modulated primarily by acid-base balance, so intracellular acidosis increases citrate reabsorption and alkalosis potentiates citrate production and excretion in the proximal tubule. Citrate inhibits the spontaneous nucleation of calcium oxalate and slows the agglomeration of its preformed crystals⁽²⁻³⁻²¹⁾.

Hypomagnesuria

Hypomagnesuria is defined as urinary elimination of magnesium less than 50 mg/day, magnesium forms complexes with oxalate and reduces calcium oxalate supersaturation, hypomagnesuria has been

described in patients with chronic diarrhea, intestinal malabsorption, inflammatory bowel disease and intestinal resection ⁽²⁾.

Clinical manifestations:

It can present with quite intense acute episodes with a variable clinical spectrum ranging from asymptomatic to those that are a danger to the patient's life, including: Analytical findings (microhematuria, leukocyturia), low back pain, nephritic colic (very common), irritative voiding syndrome, urinary tract infection, pyelonephritis, sepsis of urinary origin and chronic renal failure ⁽²⁻⁴⁻²²⁾.

Nephritic colic:

The origin of nephritic colic would be in the obstruction of the upper urinary tract caused by a stone on its way from the kidney to the bladder to be eliminated to the outside, it is a painful picture that originates in the costovertebral angle of the affected side and radiates forward affecting the iliac fossa, inguinal groove and external genitalia ⁽³⁾. It is an intense and fluctuating pain, which is not relieved in any posture or algic position, it is frequently associated with a large gastrointestinal and vegetative component, with nausea, vomiting, abdominal distension, paralytic ileus, profuse sweating and even hypotension of vagal origin, it should not present fever, or if we should not think of acute pyelonephritis or added urinary infection, The typical episode occurs during the night or early morning hours with an abrupt onset ⁽²⁻⁴⁾.

The origin of nephritic colic would be in the obstruction of the upper urinary tract caused by a stone on its way from the kidney to the bladder to be eliminated to the outside. Depending on the location of the stone that causes colic, the pain is localized in different ways: if the stone is renal, the pain predominates in the lumbar fossa and the costovertebral angle of the affected side; If the lithiasis is in the proximal ureter, the pain is usually low back and radiates in broadband towards the iliac fossa, while if the stone is in the pelvic ureter, the pain is more focused on inguinal or genital areas and is usually associated with voiding irritation ⁽³⁾.

Urinary tract infection:

Urinary tract infection can also be a manifestation of urolithiasis that occurs in the form of persistent bacteriuria, i.e., urease-producing bacteria can lead to coralliform stones of magnesium ammonium phosphate that usually reach large size and fill the renal cavities ⁽²⁾.

Diagnosis

Anamnesis:

It is important to inquire about the family history of renal lithiasis, as well as about situations or diseases that cause urinary lithiasis in case of digestive diseases such as: inflammatory bowel disease, ileitis, surgery with ileum resection, etc.) ⁽⁴⁾. Similarly, oncological treatments and the use of diuretics or drugs that produce lithiasis such as triemterene, sulfonamides or indinavir should be investigated ⁽⁴⁻⁵⁻²³⁾.

Laboratory:

Test strip: Renal colic is a common clinical manifestation, so in approximately 70% of patients with this manifestation they will present with microscopic or gross hematuria by microscopic count or with a dipstick. Leukocyturia may be present due to the inflammatory reaction caused by the stone and not necessarily by an added infection, being the test strip of high sensitivity and specificity ⁽⁴⁻⁶⁾.

Blood count and C-reactive protein: The presence of nitrites is indicative of bacterial infection, but cannot be detected with the dipstick but rather with a blood count and C-reactive protein ⁽⁵⁾.

Creatinineemia: It is important to evaluate renal function with plasma creatininemia, especially in monorenes, bilateral renal colic and in case of imaging with contrast medium ^(4,5).

Prothrombin time and thromboplastin: In case of planning percutaneous, laparoscopic or open surgery, it is important to consider whether the patient is on any anticoagulant treatment and evaluate the prothrombin time/INR and partial thromboplastin time (TTPK) ^(4,5).

Imaging:

The images help us to know the location, size, relationship with other organs and hardness of the lithiasis ⁽⁶⁾.

Simple radiography: Although plain radiography can help us identify radiopaque lithiasis prior to extracorporeal lithotripsy, it is not able to identify radio-lucid lithiasis and the superposition of other structures, so they can be confused with other radiopaque structures such as sandflies ⁽⁵⁻⁷⁾.

Ultrasound or ultrasound: It is a non-invasive, fast method without exposure to ionizing radiation that informs us about the degree of obstruction of the urinary tract and can identify radiolucent lithiasis especially in the kidney and bladder (6). It has a sensitivity of 45% and specificity of 94% in ureteral lithiasis. The recommendation of the European Guidelines for Urolithiasis 2017, in a patient with renal colic, is the use in the first instance of renal and pelvic ultrasound, but the diagnosis should be confirmed with a PIELO CT ^(6,7).

PIELO TAC: This test has replaced the aforementioned tests and is capable of detecting almost all types of lithiasis including lucid radii with a specificity and sensitivity greater than 95% ⁽⁸⁾.

Figure 1. Ultrasound: Renal lithiasis with acoustic shade, arrow shows renal lithiasis



Source: Susaeta R, 2018

Figure 2. Simple renal and bladder radiography: The arrow shows radiopaque renal lithiasis.



Source: Susaeta R, 2018

Figure 3. Abdominal Computed Axial Tomography without contrast medium. The arrow shows lithiasis in the left renal pelvis.



Source: Susaeta R, 2018

Figure 4. UROTAC: Late phase sample with removal of contrast medium in upper urinary tract (Arrow)



Source: Susaeta R, 2018

Treatment

Pharmacological treatment

The symptomatology is the main precursor to give us a therapeutic approach in the use of drugs, a conservative approach is a good way to start, as long as there is no presence of signs of infection because the evolution and complementary tests gives us the initiative for a proper medication prescription ⁽¹²⁾.

There are drugs that can increase the incidence of crystal deposits increasing the prevalence of nephrolithiasis, when this situation happens, we can establish 3 positions; the suspension of the drug, fluid therapy and control of increased diuresis, and be able to achieve an alkaline state of the pH of the urine. ⁽¹³⁾

Among the medications that can generate lithiasis we have; antibiotics such as (Sulfonamides, aminopenicillins, quinolones and cephalosporins), protease inhibitors, non-nucleoside inhibitors, antivirals and other medications. The suspension of these medications will help him control renal function and improvement of picture that no longer presents images suggestive of stones in ultrasound. ⁽¹²⁾

A good pharmacological treatment is also accompanied by various activities that help us to a better clinical evolution such as a low-sodium diet plus control with several tests such as a 24-hour urinalysis, kidney function and electrolytes. ⁽¹²⁻¹³⁾

Non-surgical treatment

The first line treatment commonly used is extracorporeal lithotripsy that through the use of shock waves the objective is to break stones lodged in the kidney. The obstructive stones as a method of choice we have the percutaneous nephrolithotomy taking as reference calculations with a diameter of 2 cm that can promote hemorrhages and infections. ⁽¹⁴⁻¹⁵⁾ We have some surgical or interventional procedures to remove kidney stones of a considerable diameter in this case.

Flexible ureterorenoscopy:

Procedure currently used to use cameras or flexible visual systems that helps us to implement more clothing for the realization of less invasive techniques in urology. ⁽¹⁴⁾

Semi-rigid ureteroscopy:

This procedure is based on achieving good management, taking great care of the urinary tract since the objective is to dilate the ureter for which the due analysis must be performed and focusing on the anatomy for the use of invasive implements such as the use of Foley probe, in case of complications such as access resistance you should have a second option such as the use of a Stent for a better procedure. ⁽¹⁴⁾

Holmium yag laser lithotripsy:

It is the Gold Standard in the treatment of urological lithiasis, the positive thing is the great accessibility, causing the rupture of the stones improving the clinical picture. ⁽¹⁴⁾

Non-pharmacological treatment

Phytotherapy is mainly based on the use of plant drugs that have diuretic, anti-inflammatory and anti-infective actions ^(9,11).

Horsetail (*Equisetum arvense* L):

As a therapy of lavage of the urinary tract, in case of mild urinary affections, mainly in renal lithiasis. Infusion 1-4 g of the crushed vegetable substance in 150 mL of boiling water as an infusion or decoction (5-15 min), 3-4 times a day. Daily dose: 3-12 g⁽⁹⁾.

Grass of the boticas *Elymus repens* (L.) Gould:

It is used for the stimulation of diuresis, irritable bladder, kidney stones, gout and rheumatic disorders, among other conditions. According to the ESCOP for the treatment of irritable bladder and other urinary disorders. According to Commission E1: urinary tract infections and prevention of urinary lithiasis. Infusion or decoction 5-10 g/day (in infusion)^(9,11).

Herniaria (*Herniaria glabra*):

The EMA recommends it as a diuretic, to increase urine flow in case of mild urinary conditions. Its traditional use is as a diuretic in cystitis, urethritis, bladder tenesmus and urinary lithiasis (stone breaker). The EMA recommends, for adults and the elderly, 1.5-3 g in 150 mL of water, in infusion or decoction, 3-5 times a day (maximum daily dose: 10 g)^(9,10).

Elderberry (*Sambucus nigra*):

Both the flower and the fruit have traditionally been used as diuretics and to treat catarrhal conditions. Flower infusion: 2-5 g of drug in 150 mL of water, 3 times a day, or 3-6 g in 200 mL, divided into 2 doses. Fruit infusion: 2-10 g per cup, take hot, several times a day^(9,10).

Recommendations for patients with renal lithiasis

Water:

- It is recommended to drink 2.5 L of water a day
- Consume fruit infusions, herbs, etc.

Diet:

- Reduce salt intake
- Avoid eating fast and precooked foods
- It is recommended to consume foods rich in calcium such as: milk, fresh cheese, yogurt.

Habits:

- Decrease the consumption of animal proteins such as meats at least 4-5 times per week, and increase the consumption of fruits and vegetables.
- Avoid sugary, salty or fatty products.
- Avoid energy supplements.

2. Materials And Methods

The approach with which the research was carried out is qualitative, which is justified by the methodology used, which consisted of a rigorous review of documents and medical literature. Through this approach, it seeks to obtain a deep and detailed understanding of Renal Lithiasis, thus allowing a thorough characterization of this pathology.

As for the scope of the research, this has been defined as descriptive, since it aims to provide a complete and detailed view of various aspects related to Renal Lithiasis. In this sense, topics such as epidemiology, etiopathogenesis, classification, clinical manifestations, diagnosis and treatment of the disease are covered, offering a global perspective of it.

The inclusion criteria have been carefully established to ensure the relevance and relevance of the information collected. Crucial elements related to Renal Lithiasis have been considered, thus ensuring that the data collected are adequate and relevant to the objectives of the research. On the other hand, exclusion criteria have been defined to avoid including information on complications, focusing attention on the fundamental aspects of the disease.

The method of document analysis, which has been the central pillar of the research, has been based on an exhaustive search for scientific articles and updated books. Digital platforms such as Google Scholar have been used to identify relevant and quality information, as well as databases and indexed journals such as Elsevier, Redalyc, Scopus and Latindex. This ensures that the information obtained is from reliable sources and supported by the scientific community.

In summary, this study aims to obtain a detailed and comprehensive view of Renal Lithiasis through an exhaustive review of documents and reliable medical literature. The qualitative and descriptive methodology used, as well as the careful selection of inclusion and exclusion criteria, allow the results obtained to be solid and useful for the understanding and proper management of this pathology.

3. Results and Discussion

research carried out provides us with a comprehensive and updated vision of the diagnostic and therapeutic approach to renal lithiasis. Technological and scientific advances have allowed a better understanding and treatment of this pathology, which has led to a more personalized and effective approach to improve the quality of life of patients with renal lithiasis. The importance of continued research in this field to continue improving diagnostic and treatment strategies is emphasized.

Epidemiology of Renal Lithiasis:

A high prevalence of renal lithiasis was identified in the population, affecting approximately 10% of people in a non-industrialized population.

Differences were found in the incidence of renal lithiasis according to age, gender and geographical location, highlighting the importance of considering demographic factors when addressing this pathology.

Etiopathogenesis and Risk Factors:

Various risk factors associated with kidney stone formation were identified, including dehydration, diet high in sodium and protein, family history of lithiasis, obesity, metabolic disorders, and underlying medical conditions such as hyperparathyroidism.

Advances in research allowed for a better understanding of the biological mechanisms involved in kidney stone formation, providing opportunities for the development of more effective preventive strategies.

Clinical Manifestations and Diagnosis:

Nephritic colic was the most common clinical manifestation associated with renal lithiasis, characterized by severe pain in the lumbar and abdominal region.

The use of diagnostic procedures such as dipstick analysis, blood count and protein C was essential to identify the presence of renal lithiasis.

Imaging, especially uro CT, proved to be an effective diagnostic tool for visualizing kidney stones and assessing their size and location.

Pharmacological Treatment:

Analgesics, including NSAIDs and metamizole, were the most commonly used drugs to control the symptoms associated with renal lithiasis.

Advances in the development of drugs aimed at preventing the formation of kidney stones and facilitating their expulsion through the urinary tract were highlighted.

Non-pharmacological Treatment:

Phytotherapy showed promising results in the management of renal lithiasis, with the use of medicinal plants that help dissolve stones or facilitate their elimination.

The adoption of a balanced diet, rich in fluids and low in sodium, protein and oxalate, was considered essential in the prevention and treatment of renal lithiasis.

Surgical and Technological Treatments:

Extracorporeal lithotripsy and percutaneous nephrolithotomy were presented as effective options for the treatment of larger, complicated kidney stones.

Technological advances in endourological surgery, such as ureteroscopy and nephroscopy, have improved the accuracy and effectiveness of surgical procedures for the management of renal lithiasis.

The results obtained based on the development of the research, support the importance of a multidisciplinary, individualized and evidence-based approach to optimally address renal lithiasis,

which can result in a better quality of life for affected patients. However, the need for further research to further improve knowledge and therapeutic strategies in this medical area is recognized.

Table 1. Diagnosis of Renal Lithiasis

Anamnesis	Personal background	<ul style="list-style-type: none"> ● Tumors ● Treatment with diuretics or drugs that induce urolithiasis
	Family history	<ul style="list-style-type: none"> ● History of renal lithiasis ● Intestinal diseases
Laboratory	Test strip	<ul style="list-style-type: none"> ● Microscopic or macroscopic hematuria ● Leukocyturia
	Blood count and C-reactive protein	<ul style="list-style-type: none"> ● Nitrite titration
	Creatinine	<ul style="list-style-type: none"> ● Assessment of renal function
	Prothrombin time and thromboplastin	<ul style="list-style-type: none"> ● Assess treatment with anticoagulants
Imaging	Plain x-ray	<ul style="list-style-type: none"> ● Identifies radiopaque lithiasis
	Ultrasound or ultrasound	<ul style="list-style-type: none"> ● Identifies radiolucent lithiasis
	TAC LEATHER	<ul style="list-style-type: none"> ● Detects almost all types of lithiasis

Source: Valencia, A; Zúñiga G; Sailema L; Andrade D

Table 2. Pharmacological treatment

Lithiasis medicamentosa	<ul style="list-style-type: none"> ● Antibiotics <ul style="list-style-type: none"> ○ Sulfadiazine ○ Amoxicillin and Ampicillin ○ Quinolones ○ cephalosporins. ● Other antivirals <ul style="list-style-type: none"> ○ Acyclovir ● Other medicines <ul style="list-style-type: none"> ○ triamterene ○ methotrexate 	3 situations are specified: <ul style="list-style-type: none"> ● stopping the drug ● increase diuresis ● alkalize urine
Symptomatic	NSAIDs and metamizole.	The use of antispasmodics shows no benefit
Hypercalciuria or repeated nephrolithiasis.	<ul style="list-style-type: none"> ● Hydrochlorothiazide 25 mg PO BID or 50 mg PO QD. ● Indapamide 2.5 mg VO QD 	It should be supplemented with a low-sodium diet, to limit potassium loss.

Source: Valencia, A; Zúñiga G; Sailema L; Andrade D

Table 3. Non-pharmacological treatment

Phytotherapy	<ul style="list-style-type: none"> ● Horsetail (<i>Equisetum arvense</i> L.) ● Grass of the boticas <i>Elymus repens</i> (L.) Gould ● Hernia ● Elder 	<ul style="list-style-type: none"> ● Urinary tract washing, renal lithiasis ● Treatment of irritable bladder, increase the amount of urine, renal lithiasis. ● Diuretic in cystitis, urethritis, bladder tenesmus and urinary lithiasis, gout and rheumatic conditions ● Diuretics and to treat catarrhal conditions
Recommendations		
Water	<ul style="list-style-type: none"> ● 2.5 L of water is recommended throughout the day 	<ul style="list-style-type: none"> ● Avoid alcohol and sugary drinks
Diet	<ul style="list-style-type: none"> ● Use fresh vegetables and fruits 	<ul style="list-style-type: none"> ● Reduce salt intake ● Avoid canned foods
Habits	<ul style="list-style-type: none"> ● Exercise 	<ul style="list-style-type: none"> ● Reduce the consumption of animal proteins

Source: Valencia, A; Zúñiga G; Sailema L; Andrade D

According to García and other authors, renal lithiasis is a pathology that may be associated with metabolic syndrome, and its etiology is broad, suggesting the influence of both organic and genetic factors on its development. We agree with the authors that the variability of the underlying causes will determine the clinical manifestations, especially the picture of pain that occurs due to stone obstruction.

In relation to pharmacological treatment, the information collected supports the initial choice of conservative treatment, focused on the relief of the patient's symptoms. We agree with the author that, although medicine has advanced considerably and there are several procedures for the disintegration and removal of kidney stones, the choice of treatment will also depend on the resolution capacity of the health institution to carry out these techniques.

According to Jurado and other authors, non-pharmacological treatment focuses mainly on the use of phytotherapy, due to the diuretic, anti-inflammatory and anti-infectious actions that certain medicinal plants have been shown to possess. We agree with the author that several studies support the use of these plants as an effective alternative for the treatment of renal lithiasis, although it is recognized that their application may be more appropriate as a therapeutic complement and not as a total solution.

In summary, this research supports the relevance of considering both organic and genetic factors in the etiology of renal lithiasis, which may influence the clinical manifestations experienced by patients. The conservative approach in pharmacological treatment and the use of phytotherapy as a non-pharmacological option are presented as valid alternatives for the management of this pathology, although it is important to recognize the limitations and scope of each therapeutic approach. Further research in this field will further improve treatment strategies and provide a comprehensive and effective approach for patients with renal lithiasis.

4. Conclusion

The accurate diagnosis of renal lithiasis is based on the meticulous identification of clinical manifestations, especially those associated with nephritic syndrome. For this purpose, procedures of diagnostic value are used, such as the use of test strips for urinary analysis, the blood count to evaluate possible signs of inflammation and the determination of protein C as a relevant marker. Likewise, imaging, in particular the Uro CT, plays an essential role in obtaining a detailed view of the stones and their location in the urinary system.

In the pharmacological field, the management of symptoms focuses on the appropriate use of analgesics, being NSAIDs (Non-Steroidal Anti-Inflammatory Drugs) and metamizole therapeutic

options commonly used to relieve pain associated with nephritic colic. However, it is essential to consider the individual characteristics of the patient to ensure the choice of the most appropriate and safe therapy.

In addition to pharmacological treatment, phytotherapy has emerged as a promising alternative in the management of kidney stones. The incorporation of medicinal plants and natural compounds in complementary treatment has proven effective in certain cases and deserves continuous attention in medical research. A multidisciplinary approach that includes a balanced diet, regular physical exercise and healthy lifestyle habits also contributes to reducing the risk of new kidney stones formation and promotes the patient's overall health.

On the other hand, in specific situations in which the size or location of the stones require more invasive treatment, surgical procedures such as lithotripsy and percutaneous nephrolithotomy are specialized options that allow the fragmentation or removal of stones with high levels of efficacy and safety.

In conclusion, the diagnostic and therapeutic approach of renal lithiasis encompasses a diverse set of medical strategies and surgical procedures that seek to provide comprehensive and optimal management for affected patients. The continuous advancement of research in this field is essential to improve the knowledge and treatment of this pathology, thus providing a better quality of life to patients who suffer from it.

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