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ORIGINAL PAPER

The role of the general practictioner in the management of urinary calculi

Domenico Prezioso [1], Gaetano Piccinocchi [2], Veronica Abate [3], Michele Ancona [2], Antonio Celia [4], Ciro De Luca [1], Riccardo Ferrari [5], Pietro Manuel Ferraro [6], Stefano Mancon [7], Giorgio Mazzon [4], Salvatore Micali [5], Giacomo Puca [1], Domenico Rendina [3], Alberto Saita [7], Salvetti Andrea [2], Andrea Spasiano [8], Elisa Tesè [2], Alberto Trinchieri [9]

[1] Dipartimento Neuroscienze, Scienze della Riproduzione ed Odontostomatologia Università Federico II, Naples, Italy;
[2] Società Italiana di Medicina Generale, Florence, Italy;
[3] Department of Clinical Medicine and Surgery, Federico II University, Naples, Italy;
[4] S.C. Urologia ULSS 7 Pedemontana, Bassano del Grappa (VI), Italy;
[5] Department of Urology, University of Modena and Reggio Emilia, Baggiovara (MO), Italy;
[6] Sezione di Nefrologia, Dipartimento di Medicina, Università degli Studi di Verona, Verona, Italy;
[7] Department of Urology, IRCCS Humanitas Research Hospital, Rozzano, Milan, Italy;
[8] Università Cattolica del Sacro Cuore, Roma, Italy;
[9] Urology School, University of Milan, Milan, Italy.

Summary *Background: The prevalence of kidney stones tends to increase worldwide due to dietary and climate changes. Disease management involves a high consumption of healthcare system resources which can be reduced with primary prevention measures and prophylaxis of recurrences. In this field, collaboration between general practitioners (GPs) and hospitals is crucial.*

Methods: a panel composed of general practitioners and academic and hospital clinicians expert in the treatment of urinary stones met with the aim of identifying the activities that require the participation of the GP in the management process of the kidney stone patient.

Results: Collaboration between GP and hospital was found crucial in the treatment of renal colic and its infectious complications, expulsive treatment of ureteral stones, chemolysis of uric acid stones, long-term follow-up after active treatment of urinary stones, prevention of recurrence and primary prevention in the general population.

Conclusions: The role of the GP is crucial in the management and prevention of urinary stones. Community hospitals which are normally led by GPs in liaison with consultants and other health professional can have a role in assisting multidisciplinary working as extended primary care.

KEY WORDS: *Urinary calculi; General practice; Renal colic; Diagnosis; Treatment; Prevention; Primary care; Recommendation.*

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INTRODUCTION

Urinary stones are a very common disease that causes patients to suffer due to its painful symptoms and the repeated surgical procedures necessary to remove stones from the urinary tract. In some cases it can cause renal failure and, albeit rarely, mortality (1). The management of urinary stones involves the use of considerable economic resources at the expense of health services and citizens (2). The cost of working days lost due to illness must be added to these costs. Hospitals can take care of the surgical treatment of the disease and the diagnosis of diseases associated with urinary stones, but they are not able to provide follow-up and secondary and primary prevention of the disease on their own. Collaboration between GPs and hospitals is crucial to achieve these objectives (3-7). For this reason, a shared guideline between the associations of GPs and clinicians of academic and hospital structures is necessary to define the methods of intervention and tasks assignment.

METHODS

A panel composed of 4 general practitioners from the *Società Italiana di Medicina Generale* (SIMG) and 8 academic and hospital clinicians expert in the treatment of urinary stones from the *Club Litiasi Urinaria* (CLU) met with the aim of identifying the activities that require the participation of the GP in the management process of the patient with kidney stones. The panel met for the first time to read the index of the guidelines for urinary stones of the *European Association of Urology* (8) with the aim of identifying the topics of greatest interest for collaboration between GPs and hospitals. Each topic was assigned to a team made up of a GP and two hospital doctors who had the task of drafting a text illustrating the role of the GP and the method of collaboration with the hospital.

The texts were circulated for corrections and modifications. The panel met a second time to approve the final text in Italian which was published on www.simg.

Finally, a short version in English language was written to be published after approval of the panel.

Prevalence, etiology, risk of recurrence

Epidemiology of urolithiasis in Italy

The prevalence of urinary calculi has been evaluated in

some studies in Italy, ranging between 1.7 and 7.5%, depending on the population studied and the period of the study (9-13).
A study (14) based on the *Health Search/CSD Longitudinal Patient Database* (HS) compiled by 650 General Practitioners demonstrated in the Italian adult population in 2012 a prevalence of urolithiasis of 4.14% and an incidence of 0.323%. The prevalence was higher in males (4.53% *versus* 3.78%). Regional differences were demonstrated with higher prevalence in southern regions and islands (4.26-6.08%) than in central (3.75-5.35%) and northern regions (2.62-3.71%) In southern regions and islands the male to female ratio (M/F) was in favor of females while in central and northern cities it was in favor of males. Some studies have demonstrated seasonal variations in the incidence of cases of renal colic observed in the Emergency Department of hospitals in various Italian cities. In Padua (15) an association was demonstrated between the date of presentation for renal colic and higher environmental temperature and humidity, in particular higher rates of presentations for renal colic were observed when temperature was > 27°C and relative humidity > 45%. Similar observations on the relationship between environmental temperature and rate of renal colic were made in Parma, Cuneo, and Rome (16-18). In one study (19) the age of patients with renal colic in the summer period was higher than in the rest of the year, probably due to a greater number of patients with uric acid stones who tend to be older. Finally, another study carried out in Ferrara (20) on data from the period 1990-96, demonstrated that renal colic occurs with a circadian rhythm which has a peak in the early morning and a minimum in the afternoon. Other studies have shown that the epidemiological characteristics of urinary calculi in Italy have varied over time. The prevalence of urinary stones increased from 1986 to 1998 by 40% in males and by 20% in females (10). From 2001-2003 to 2016-18, the mean age of patients increased from 45.8+/- 15.4 years to 57.9+/- 14.8 years and the frequency of calcium oxalate monohydrate stones increased from 44 to 51% (21).
From 1986-1998 to 2005-2010, a change of the urinary biochemical characteristics of renal stone formers patients in Italy was observed. Patients observed in 2005-2010 showed higher urinary volume, lower urinary sodium, and lower urinary saturation for calcium oxalate and uric acid (22) than those observed in 1986-1998. In parallel, they have higher levels of physical activity and lower blood pressure levels. In conclusion, the general increase in the prevalence of stones appears to be linked to an increase of patients forming a single stone or presenting low stone recurrence in association with a lower urinary biochemical risk.
Finally, in Italy some studies have demonstrated the correlation between urinary stones and some chronic diseases such as arterial hypertension and osteoporosis. In about 700 workers of a factory in Pozzuoli, in the suburban area of Naples, the prevalence of stones was evaluated in normotensive subjects (13.4%), in untreated hypertensive patients (20.3%) and in treated hypertensive patients (32.8 %) demonstrating an independent association between arterial hypertension and the prevalence of urolithiasis (23). In a case-control study, patients with kidney stones demonstrated increased vascular stiffness and decreased bone density (24). In a study carried out in Naples in a population of over 12.000 women aged over 40 who had performed DEXA bone densitometry: incident nephrolithiasis was evaluated in the months following the examination, demonstrating an increased lithiasis risk (HR = 1.33) in patients with osteoporosis (25).
Similarly, a study of more than 7,000 ultrasound bone densitometries demonstrated that urolithiasis is an additional risk factor for osteoporosis (26).

Recurrence
Urinary calculi tend to recur. After 7 years from the first stone episode 27% of patients presented one or more recurrent episodes (27). Cystine, struvite, uric acid, brushite and apatite stones are at higher risk compared with calcium oxalate stones (28).

Classification of urinary stones
Urinary stones are classified according to:
- composition and etiology;
- site;
- size;
- radiological characteristics.

Composition and etiology
According to etiology they can be divided into stones from infectious causes, stones from non-infectious causes, stones from genetic defects, and drug-related stones (Table 1).
Calcium oxalate stones are the most common. The main metabolic abnormalities associated with calcium oxalate stones are hypercalciuria (30-60%) and hyperoxaluria (26-67%), followed by hyperuricosuria (15-46%), hypomagnesiuria (7-23%) and hypocitraturia (5-29%) (29).
Calcium phosphate stones can present as carbonate apatite which can be associated with *urinary tract infections* (UTI) or brushite which crystallizes in the presence of high concentrations of calcium and phosphate, regardless of UTI. Possible causes of calcium phosphate stones include hyperparathyroidism, renal tubular acidosis, and UTIs.
Calcium stones can be secondary to some specific pathologies including primary hyperparathyroidism, sarcoidosis, primary hyperoxaluria, enteric hyperoxaluria, distal renal tubular acidosis.

Table 1.
Classification according to etiology and stone composition.

From non-infectious causes	Calcium oxalate Calcium phosphate Uric acid
From infectious causes	Ammonium magnesium phosphate Carbonate apatite Ammonium urate
Genetic causes	Cystine Xanthine 2.8-di-hydroxyadenine
Drug-related	

Primary hyperparathyroidism (HPT) causes approximately 5% of urinary calcium (calcium oxalate and/or calcium phosphate) stones. In fact, the increase in *parathormone* (PTH) induces hypercalcaemia, hypercalciuria, hypophosphatemia and renal phosphate loss. The laboratory diagnosis is implemented by ultrasound of the neck and scintigraphy of the parathyroid glands, and by computerized bone densitometry to assess the presence of osteoporosis. Primary hyperparathyroidism complicated by kidney stones or osteoporosis may require surgical treatment (30).
Granulomatous diseases, such as sarcoidosis, may be complicated by hypercalcemia and hypercalciuria because of overproduction of calcitriol with increased intestinal calcium absorption and PTH suppression (31).
Primary hyperoxaluria (PH) is a rare hereditary genetic disease with increased endogenous production of oxalate, renal stone formation and nephrocalcinosis which can lead to end stage renal failure requiring kidney-liver transplantation (32). Enteric hyperoxaluria occurs in patients with intestinal fat malabsorption, such as in cases of intestinal resection, bariatric surgery, Crohn's disease, or pancreatic insufficiency. Increased fatty acids link to calcium in the intestinal lumen reducing availability of calcium to form insoluble complexes with oxalate and causing intestinal hyperabsorption of free oxalate (33).
Renal tubular acidosis occurs due to impaired tubular reabsorption of protons (type 1) or bicarbonates (type 2) in the nephron. It can be acquired (e.g. in the case of recurrent pyelonephritis, acute tubular necrosis, autoimmune diseases, drugs, etc.) or hereditary. Especially in the type 1 form, where urine pH is always > 5.8, there is a high probability of calcium phosphate stone formation (34, 35).
Uric acid stones account for 10% of kidney stones and have a high risk of recurrence (36). They are mainly caused by undue low urinary pH, decreased excretion of ammonia in the urine (e.g. gout), increased endogenous production of acids (e.g. metabolic syndrome) or increased loss of bases (diarrhoea). Another risk factor is hyperuricosuria, secondary to dietary excess (high dietary intake of animal proteins), excessive endogenous production, myeloproliferative disorders, gout, drug intake (in particular chemotherapy, thiazides and loop diuretics) and tumor cell lysis or catabolic processes.
Ammonium urate stones are rare, accounting for less than 1% of all forms of kidney stones, and are associated with urinary tract infection or intestinal malabsorption, hypokalemia, and malnutrition.
Finally, some drugs can promote the formation of kidney stones by various mechanisms: drug crystallization in the urinary tract as a consequence of overdosage and/or dehydration (allopurinol, ceftriaxone, quinolones, sulfonamides, etc.); alteration of metabolism with increased risk of urinary saturation (acetazolamide, topiramate, furosemide, laxatives, excess of vitamin D or calcium supplements between meals, etc.) (37, 38).

Stone size
Size of urinary stones is crucial for treatment planning. It is usually expressed according to the largest diameter and stratified in the following groups: up to 5 mm, 5-10, 10-20 and larger than 20 mm. The size of the stones should be considered in association with stone location, presence and degree of hydronephrosis, clinical symptoms and signs.

Stone location
Stones can be classified according to their anatomical location as kidney, ureteral and bladder stones. Renal stones can be further divided as upper, middle or lower caliceal stones and renal pelvic stones; ureteral stones as proximal, mid or distal ureteral stones. Different locations, in association with the other characteristics of urinary stones, require different therapeutic approaches.
Stone location is associated with specific clinical presentation requiring a differential diagnosis.

Radiological characteristics
Urinary stones can also be classified according to their radiodensity at plain abdomen *X-ray* (Rx) as radiopaque or radiolucent (39). Radiolucent are not demonstrated on X-ray.
Non-enhanced *computed tomography* (CT) can be also used to classify stones according to their density, measured in *Hounsfield units* (HU) (40).
Weakly radio-opaque and radio-lucent stones at X-ray can be well demonstrated on non-enhanced CT.

Table 2.
Classification of urinary stones by their radiodensity.

Radio-opaque	Weakly radio-opaque	Radio-lucent
Calcium oxalate monohydrate (COM)	Ammonium magnesium phosphate (Struvite)	Uric acid
Calcium oxalate dihydrate (COD)	Cystine	
Calcium phosphate		

Clinical presentation
Urinary stones can present with different symptoms and signs.
Renal colic is a characterized by acute flank pain, often radiating to the groin, and associated with hematuria and dysuria.
Microhematuria and episodes of urinary tract infection associated with chronic low back pain and/or evening fever can also be associated with kidney stones.
Asymptomatic urinary stones can be diagnosed during investigations for other pathologies.
GP and hospital should collaborate in the diagnosis and treatment of patients with renal colic according to shared protocols (7, 8, 41, 42).

Statement 1 - The role of GP
The GP has a role in initial diagnosis and monitoring of patients with renal colic, management of analgesic therapy and prevention of obstructive and infectious complications.
The patient with symptoms of renal colic often firstly refers to the GP, who has an important role in the emergency management. Clinical evaluation is crucial for differential diagnosis between renal colic and acute low back pain of other causes. When office ultrasound is available, diagnosis can be facilitated by demonstration of direct (urinary

stone) or indirect (urinary tract dilatation/hydronephrosis) signs.
The initial step is pain treatment: the first choice are *non-steroidal anti-inflammatory drugs* (NSAIDs); opioids are more frequently associated with side effect as vomiting and stunning, and risk of dependence; antispasmodics are not suitable.
If pain is not controlled, the GP must advise access to the emergency room for further diagnostic investigations.
When pain is associated with fever, the GP should administer parenteral antibiotics plus antipyretics.
Respiratory rate (=/> 22), systolic blood pressure (=/< 100 mmHg) and state of consciousness must be evaluated. If these parameters are altered and sepsis is suspected, the GP must advise immediate access to the emergency room for diagnostics (ultrasonography, CT) and emergency treatment (stenting, nephrostomy).
In the suspect of urinary stones because of the presence of other symptoms, as microhematuria and episodes of urinary tract infection associated with chronic low back pain or fever, abdominal ultrasound should be performed.

Expulsive therapy
After the resolution of the acute symptomatology, the patient with ureteral calculi can be followed up with a treatment aimed at the spontaneous stone passage. In presence of risk factors (severe hydronephrosis, long-lasting hydronephrosis, large stones, infection resistant to antibiotic treatment, recurrent pain) or in case of prolonged observation without stone passage, surgical treatment for the removal of the stone must be planned (43-47).

Statement 2 - The role of GP
The GP has a role in the management of expulsive and analgesic therapy and in the prevention of obstructive and infectious complications. Obstructive and infectious complications are renal failure, pyelonephritis, and urosepsis. There is no validated protocol that defines the necessary diagnostic tests and their timing in the follow-up of patients with ureteral stones treated conservatively or with medical expulsive therapy, but only the opinion of experts and the results of some systematic reviews.
Based on these observations a moderate increase in water intake should be suggested. Observation or medical expulsive therapy should not be prolonged beyond 4 weeks. Patients should be monitored for infectious complication (white blood count, C-reactive protein, urinalysis, and urine sediment) and promptly referred to the emergency department in case of *systemic inflammatory response syndrome* (SIRS). Analgesic therapy has to be monitored in order to prevent digestive complications of NSAIDs (gastroprotection) and risk of prolonged opioids (addiction). Patients should be informed of off-label use of alpha-blockers (especially in young men and in women where use is not justified by concomitant benign prostatic hyperplasia) and of the side effects of alpha-blockers (anejaculation for tamsulosin and silodosin, syncope).

Chemolysis
Uric acid stones can be dissolved with chemolytic therapy. Pure uric acid stones can be suspected in case of age onset > 50 years, male sex, and diabetes mellitus. Uric acid composition can be predicted from stone radiodensity on CT (HU < 500) and low urine pH values (pH < 5.2). Demonstration of the stone on ultrasound in the absence of radiopaque images on the abdominal X-ray may be an alternative to CT (48).
Undersaturation of the urine with respect to uric acid causes the dissolution of uric acid stones and can be achieved by alkalizing the urine with citrate or bicarbonate, increasing urine volume and reducing the excretion of uric acid (allopurinol) (49-54).

Statement 3 - The role of GP
The oral chemolytic treatment of pure uric acid stones with oral administration of alkalizing agents can be performed on the recommendation of the urologist or nephrologist (or directly from the GP). The GP has a very important role in increasing treatment compliance and follow-up. The success of the therapy depends on the patient's compliance which can be increased with self-measurement of urine pH several times a day and weekly checks to evaluate the diary of pH values and urine volumes. Stone size should be monitored frequently (every two weeks) until the stone has dissolved. Treatment should be ended after three months if the stone has not reduced in size.

Extracorporeal and endoscopic therapy
The modern treatment of urinary stones is based on extracorporeal or endoscopic lithotripsy (8). Stone fragments are eliminated through the urinary tract or suctioned through endoscopic instruments. The choice of treatment depends on location, size and composition of the stone, morphology of the urinary tract, renal function, possible presence of urinary tract infection, any anticoagulant therapy and general conditions of the patient
The treatment is chosen by the urologist according to the aforementioned characteristics of the stone and his personal experience. At the end of the treatment, the patient is discharged with indications on the management of residual fragments and possible complications. Follow-up of actively treated patients for urinary stones should be under the responsibility of the urologist who performed the treatment.

Statement 4 - The role of GP
The GP must be aware of the complications that can arise in the post-operative period in the patient undergoing lithotripsy. The main complications are represented by infections/sepsis, obstruction of the urinary tract (hydronephrosis), and hemorrhage (for percutaneous lithotripsy). The GP must recognize the early onset of complications and send the patient to the emergency department, as these complications cannot be treated at home and require rapid management by an expert team. In the case of post-operative nephrostomy and/or ureteral stent placement, the management of these devices is demanded to urologists and hospitals.

Stones in pregnancy
Urinary calculi in pregnancy are a rare event which nevertheless requires careful management to avoid damage to the mother and the unborn child (55). Ultrasonography is

the first-line method of diagnostic imaging in pregnant women. *Magnetic resonance imaging* (MRI) is a second-line procedure used to define the level of the obstruction and to visualize the stones. Radiography and CT, due to the use of ionizing radiation, should be avoided. The recommended initial treatment is conservative with hydration and analgesics, if necessary, with the addition of antibiotics (56), since in 75% of cases there is a resolution of the symptoms and in 40-80% spontaneous expulsion. In symptomatic cases refractory to medical therapy or in the presence of infection or persistent obstruction, it is advisable to place a double J stent or alternatively a nephrostomy, under local anesthesia and if possible, under ultrasound control. However, both the stent and the nephrostomy are a potential risk of infection, and require periodic replacements, especially if the placement is performed in the first or second trimester of pregnancy. Therefore, some authors suggest performing a first-line rigid or flexible ureteroscopy as an effective procedure not burdened by obstetric complications. Despite the studies performed on some cell lines, the effects of shock waves on the fetus are not fully known at present and therefore *shock wave lithotripsy* (SWL) is not indicated during pregnancy and the reported cases generally refer to accidental treatments.

Statement 5 - The role of GP
The GP has a role in patient monitoring, in the prevention of obstructive and infectious complications and in the management of analgesic therapy. The choice of analgesic therapy must be careful, avoiding NSAIDs, which are associated with pulmonary hypertension and premature closure of the ductus arteriosus, and codeine. Paracetamol is an option (category B according to the FDA) for analgesic and antipyretic treatment. Morphine must be used in low doses and for limited periods of time (category C).
Beta-lactam antibiotics and fosfomycin are generally considered safe and effective in pregnancy. The use of fluoroquinolones and tetracyclines is not recommended.
In the event that the pain symptomatology is refractory to medical therapy or pain symptomatology is associated with hyperpyrexia or in the suspicion of urosepsis, the GP must advise immediate access to the emergency department.

Stones in the renal transplant recipient
Kidney transplant recipients may suffer from calculi both due to the presence of calculi in the kidney already at the time of transplantation, and due to the greater risk of de novo lithiasis due to various risk factors: recurrent urinary tract infections due to immunosuppressive therapy, tendency to alkalize the urine, hyperfiltration, renal tubular acidosis, serum hypercalcaemia due to tertiary hyperparathyroidism (57).

Statement 6 - The role of GP
The GP must be aware of the greater risk of stones in patients with renal transplants, must contribute to an early diagnosis by means of abdominal ultrasound (and possibly non-enhanced CT) and guide the patient towards an adequate therapeutic procedure, reserving conservative treatment under close follow up to only asymptomatic and highly compliant patients with small stones.

General advice for the prevention of recurrence
All patients with kidney stones should follow general prophylaxis measures in order to reduce the risk of recurrence. General measures can be associated with a targeted pharmacological treatment based on the chemical-physical analysis of the stone in patients classified as high risk (7).

Statement 7 - The role of GP
The GP has an important role in advising on an adequate diet and lifestyle. A constant intake of at least 2.5-3 liters of liquids per day should be recommended to guarantee a diuresis of at least 2.5 liters of clear urine in 24 hours. The patient should prefer water intake. Consumption of soda and sugary drinks is associated with a higher risk of urinary stones, while the intake of water, coffee, tea, beer, wine and orange juice are associated with a lower risk of urinary stones.
The patient must be instructed to consume a varied and balanced diet, following the recommendations of Mediterranean diet.
Should be recommended:
- increased intake of fruit and vegetables, at least 5 servings a day (alkaline content of the vegetarian diet increases the urinary pH);
- avoiding intake of foods high in oxalate and vitamin C (especially in patients who show high oxalate excretion);
- limiting the intake of animal proteins (maximum 0.8-1 g/kg of body weight)(as they favor hypocitraturia, lowering of urinary pH, hyperoxaluria and hyperuricuria);
- not limiting calcium intake but ensuring an intake at least equal to the daily calcium requirement of 1000-1200 mg per day (to promote the formation of non-absorbable calcium-oxalate salts in the intestinal lumen and reduce intestinal absorption of oxalate);
- not exceeding 3-5 g of sodium per day (as a higher intake is associated with increased calcium excretion, reduced citrate excretion and greater risk of sodium urate crystal formation);
- limiting the intake of foods rich in purines (no more than 500 mg/day) in patients with hyperuricuric calcium oxalate and uric acid stones.

Adequate physical activity should be recommended. For adults over the age of 18, at least 150 minutes of moderate-intensity physical activity per week, especially walking, cycling, or playing a sport at a non-competitive level is recommended.
Finally, the maintenance of a normal body mass index, i.e. less than 30 kg/m^2 and correct control of blood pressure with systolic blood pressure values below 135 mm Hg and diastolic blood pressure values below 85 mm Hg must be recommended.

Metabolic evaluation
The chemical composition of the stone should always be identified, preferably by infrared spectroscopy or X-ray diffraction (7, 8). In patients at high risk of recurrence, an individualized metabolic assessment is required, including: measurements of blood levels of creatinine, sodium,

potassium, chloride, calcium (ionized or total corrected for albumin), phosphate and uric acid; measurement of urine pH and urine specific gravity; 24-hour urine collection with measurement of urine volume and concentration of calcium, oxalate, uric acid, citrate, sodium and magnesium (7, 8).
In case of hypercalcemia, determination of blood parathyroid hormone (PTH) and vitamin D levels is recommended to rule out hyperparathyroidism.
In case of struvite or ammonium urate stones, urine culture is recommended.

Pharmacological prevention
In patients at high risk of recurrence, drug therapy should be considered.
Alkaline citrates (5-12 g per day) in case of calcium oxalate or uric acid stones.
Thiazide diuretics at a dosage of between 25 and 50 mg per day in case of oxalate and/or calcium phosphate stones (monitoring blood pressure, advising the execution of a densitometric examination and of periodic dermatological visits).
Magnesium at a dosage between (200 and 400 mg per day) in case of calcium oxalate stones associated with hypomagnesiuria or enteric hyperoxaluria (taking care not to induce diarrhea).
Allopurinol (100-300 mg/day) in case of uric acid or calcium oxalate stones associated with hyperuricemia/hyperuricuria or of ammonium urate stones (alternatively febuxostat at 80-120 mg/day).
Calcium supplements (up to 2000 mg) 20 minutes before meals in case of enteric hyperoxaluria, to reduce intestinal absorption of oxalate.
Tiopronine (800 and 2000 mg per day) in case of cystine stones, to reduce the urinary excretion of cystine, in combination with alkalizing citrates to increase the solubility of cystine (as a second-line drug to reduce the excretion of cystine, captopril at a dose between 75 and 150 mg).

Primary prevention
Primary prevention is mainly entrusted to the GP and to the media (newspapers, TV, books, Internet).

Statement 8 - The role of GP
The GP should suggest measures to prevent the risk of stone formation to her/his patients who have not formed stones, particularly in those with a family history of the disease or other risk factors.
Risk factors can be highlighted by a thorough medical history:
- familiarity;
- dietary habits (energy intake, quantity and type of fluids, intake of salt, animal proteins, calcium, oxalate, carbohydrates, and potassium);
- lifestyle;
- urological pathologies: bladder diverticula, renal cysts, urethral strictures, horseshoe kidney, UPJ stenosis, ureterocele, etc.
- non-urological pathologies that can cause urinary stones: obesity, diabetes, dyslipidemia, arterial hypertension, IBD (Crohn's disease and rectocolitis), hyperparathyroidism;
- recurring urinary tract infections (UTIs);
- drugs with potential lithogenic effect: cortisone, laxatives, some antibiotics, topiramate;
- previous urological procedures.

GP should encourage to modify risky dietary habits as:
- reduced calcium intake (which can cause hyperoxaluria);
- low fruit consumption;
- reduced fluid intake.

Physical activity should be encouraged in conjunction with increased fluid intake to compensate for sweating losses.
Finally, it is useful to correct excess weight, sedentary lifestyle, arterial hypertension, and metabolic pathologies predisposing to stone formation (dyslipidemia, hyperuricemia, diabetes, etc.).

Follow up
After treatment for urinary stones, patients without residual stones should be monitored for no less than 2 years in the case of radio-opaque stones and no less than 3 years in the case of radiolucent stones. A 5-year follow-up window allows for a greater margin of safety that can be evaluated on the basis of cost-effectiveness (58, 59).
In patients with residual stones no greater than 4mm, disease progression and need for intervention are reported in less than 40%. Stones are expelled spontaneously within the fourth year in 25-33% of cases. An instrumental follow-up window of 48 months is therefore recommended in these patients.
Residual stones greater than 4 mm in diameter should require retreatment unless there are contraindications suggesting conservative follow-up. Populations of patients diagnosed with metabolic abnormalities undergoing medical therapy require monitoring and follow-up for adverse reactions and compliance for a period of 4 years. In patients diagnosed with metabolic abnormalities not undergoing specific medical therapy, an extension of the follow-up window to at least 10 years is strongly recommended.
The reference imaging method for follow up is plain X-ray and renal ultrasound for patients with radiolucent stones.
Computed tomography should be avoided as a first-line follow-up method to minimize patient exposure to ionizing radiations.
In the presence of residual fragments, the follow-up must be extended for 4-5 years by alternating ultrasound and CT (considering the risk of exposure to ionizing radiation).

Statement 9 - The role of GP
The GP who identifies a progression in the size of the stone should refer the patient to the urologist to evaluate the need of active therapeutic intervention.
In patients with metabolic abnormalities on drug treatment, the GP should monitor any adverse reactions and help increase patient compliance with medical therapy.
The GP can intercept patients who may have missed follow-up and, conversely, discourage the use of opportunistic diagnostic procedures outside the follow-up windows, illustrating the lack of evidence of the benefit of monitoring procedures after an adequate recurrence-free period.

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Correspondence

Domenico Prezioso, MD
dprezioso@libero.it
Giacomo Puca, MD
giacomopuca40@gmail.com
Ciro De Luca, MD
cirodeluca96@libero.it
Dipartimento Neuroscienze, Scienze della Riproduzione ed Odontostomatologia, Università Federico II Napoli, Naples, Italy

Gaetano Piccinocchi, MD
Società Italiana di Medicina Generale, Florence, Italy
piccinocchi.gaetano@simg.it

Veronica Abate, MD
veronica.abate@unina.it
Domenico Rendina, MD
domenico.rendina@unina.it
Department of Clinical Medicine and Surgery, Federico II University, Naples, Italy

Michele Ancona, MD
mich.ancona@gmail.com
SIMG Regione Puglia

Antonio Celia, MD
antonio.celia@aulss7.veneto.it
Giorgio Mazzon, MD
giorgiomazzon83@gmail.com
S.C. Urologia ULSS 7 Pedemontana, Bassano del Grappa (VI). Italy

Riccardo Ferrari, MD
richiferrari91@gmail.com
Università Modena e Reggio Emilia, Modena, Italy

Pietro Manuel Ferraro, MD
pietromanuel.ferraro@univr.it
Sezione di Nefrologia, Dipartimento di Medicina, Università degli Studi di Verona, Verona, Italy

Stefano Mancon, MD
stefano.mancon@humanitas.it
Resident Humanitas University, Rozzano (Mi), Italy

Salvatore Micali, MD
salvatore.micali@unimore.it
Università Modena e Reggio Emilia, Baggiovara (Mi), Italy

Alberto Saita, MD
alberto.saita@humanitas.it
Responsabile Endourologia
Istituto Clinico Humanitas, Via Manzoni 56, 20089 Rozzano (Mi)

Andrea Salvetti, MD
dr.andreasalvetti@gmail.com
Segretario SIMG Toscana
Coordinatore AFT_Sud AUSL Sud Est Regione Toscana

Andrea Spasiano, MD
andrea.spasiano01@icatt.it
Department of Translational Medicine and Surgery, Università Cattolica del Sacro Cuore, Rome, Italy

Alberto Trinchieri, MD
alberto.trinchieri@gmail.com
Urology School, University of Milan, via Commenda 15, Milan, Italy

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