1st Edition of the Clinical Cases Contest related to the non-surgical clinical management of renal lithiasis

Title: Is it possible to resolve kidney stones with medical (non-surgical) treatment?

Keywords: nephrolithiasis, uric acid, urinary pH, bicarbonate

1. Summary

Kidney stones are formed because of anatomical alterations of the urinary system or alterations of urinary parameters that favor the crystallization and formation of stones. At the time, the incidence continues to increase, which entails a great social and health expense and decreases the quality of life of patients. Nowadays there are multiple treatments for kidney stones and the objective of this study is to show the utility of medical treatment in resolving them. To do this, we based on a clinical case of a 75-year-old female patient with bilateral uric acid stones that after receiving treatment with sodium bicarbonate, her right kidney stone disappeared and the left one decreased in size. It is shown, therefore, that with basic and non-invasive approaches, surgical interventions can be avoided in patients with the comorbidity that surgery entails.

2. Introduction

Kidney stones are formed because of anatomical alterations of the urinary system or alterations of urinary parameters that favor the crystallization and formation of stones.

The prevalence of kidney stones is currently on the rise. In Spain, the incidence among patients aged between 40 and 65 years currently reaches up to 16.3%. In addition, it has a high recurrence rate since, without preventive measures, up to 50% of patients experience a new renal colic within 5-10 years of the first episode (1). This greatly affects the quality of life of the patients, but it also entails a great social-sanitary expense.

The causes of the formation of kidney stones can be classified into two groups: those that cause occasional stones that rarely recur, compared to conditions that favor the appearance of recurrent

stone episodes. Among the first we can include, for example, dietary transgressions; while the second includes pathophysiological alterations that favor crystallization, causing bilateral and multiple lithiasis. It is especially in these latter patients that urinary pH becomes one of the determining parameters for the formation of kidney stones. It is usually considered that a pH lower than 5.5 increases the risk of uric acid stones formation, and a pH above 6 increases the risk of calcium stones formation. (2)

For the diagnosis of kidney stones, we will rely on the patient's symptoms and complementary tests. The symptoms may vary, from asymptomatic patients to recurrent infections or recurrent renal colic. If based on the symptoms there is a suspicion of nephrolithiasis, imaging tests should be performed to confirm the diagnosis and rule out signs of urinary obstruction (such as hydronephrosis). For this, abdominal X-ray, ultrasound and computed axial tomography scan (CT/CAT scan) could be used. The latter two provide a better image of kidneys, ureters, and the bladder. In addition, the CT scan offers the advantage of being able to approximate both the density and the appearance of stone, which allows us to predict their mineral composition, translating into a better targeted subsequent treatment. (3)

Once the diagnosis of nephrolithiasis is stablished, and after resolving the acute episode, we must consider which definitive treatment is the most appropriate. This treatment can be non-surgical, such as dietary modifications and extracorporeal shock wave lithotripsy, surgical options are also available such as percutaneous nephrolithotomy and ureterorenoscopy.

The objective of this case presentation is to demonstrate the validity of medical treatment in renal lithiasis.

3. Description of the clinical case

Clinical case presentation of a 75-year-old female patient with a past medical history of hypertension, dyslipidemia, and type II diabetes mellitus (DM-II), who visits the Emergency Department for a case of colic-type pain that lasts for hours, which does not subside despite analgesia, with no other concomitant symptoms. The patient referred to previous episodes of bilateral renal colic, which on another occasion had required urgent left urinary diversion with a double-J stent.

During her stay in the emergency room, a blood test was requested in which leukocytosis of 15.36 x 10^3 µl is highlighted (reference value in our hospital: 3.5 - 12.0 x 10^3 µl) at the expense of neutrophilia, along with impaired renal function with creatinine levels of 1.50 mg/dl being in previous tests around 1, with a glomerular filtration rate

(according to MDRD4) of 36 ml/min/1.73m^2 and urea of 55 mg/dl (reference value: 17 –49 mg/dl). The rest of the analysis showed no significant findings. As for the urine tests, a pH 5 with slight hematuria, isolated leukocytes and bacteria, and the presence of yeasts were highlighted.

An abdominal X-ray was requested, in which no image suggestive of lithiasis was visible (image 1) and a renal ultrasound was requested where bilateral pelvic dilation could be observed showing no evidence of an obstructive cause. Given these findings, an abdominal CT scan was requested, where a 1cm renal lithiasis (550 Hounsfield – UH-Units) was observed in the right ureteropelvic junction, with perirenal fluid and a 1.5 cm renal lithiasis (560UH) in the left lower calyceal group (images 2 and 3). Once the patient was diagnosed with a complicated renal colic, an urgent urinary diversion was performed, placing a right double-J stent, with no incidents. Consequently, the patient remained hospitalized in charge of Urology showing clinical and test results improvement, she is later discharged with bicarbonate 1 gram every 8 hours as a treatment for stones, given the suspicion of uric acid lithiasis, due to the presence of acidic urinary pH and not visualizing the lithiasis on abdominal X-ray, as well as the density of 550 UH determined using the CT scan.

Two months later, the patient visited the outpatient consultation of the Urology Department's Lithiasis Unit with a control abdominal CT scan in which the disappearance of the right lithiasis and migration of the left lithiasis to the ureter along its size reduction can be observed (images 2 and 3). Despite the migration of the left lithiasis to the ureter, the patient remained asymptomatic, with no evidence of ipsilateral ureteropelvic dilatation on control CT scan, and she has not presented complications due to said lithiasis. Given the resolution of the right kidney stone with no evidence of hydronephrosis, it is decided to remove the right double-J stent.

It has not been possible to obtain any kidney stone to perform any study.

Currently, the patient has shown good clinical progress and has a follow-up appointment pending to assess progress and to plan follow-up and treatment approach, if necessary.

4. Discussion

In Spain, the average incidence of renal lithiasis is 0.73% (737 cases per 100,000 inhabitants/ year), with a prevalence of 5.06% (compared to 10% in Europe). (1) The frequent causes of this disease are metabolic disorders (hypercalciuria, hyperphosphaturia, hyperoxaluria, hypocitraturia, cystinuria, hyperuricosuria), anatomical alterations (such as vesicoureteral reflux, ureteropelvic stenosis...) and genetic causes. It has been observed that in up to 40% of patients with renal colic, there is family history related to the same disease. (4)

In this case, the patient does not have a family history of renal colic and the imaging tests do not reveal anatomical alterations, but hydronephrosis is diagnosed related to urinary tract obstruction, where a kidney stone observed in the CT scan was found to be the cause.

The blood tests performed upon the arrival to the Emergency Department show urea of 55 and a urinary pH of 5 which, together with the absence of radiopaque images in the abdominal X-ray and the visualization of lithiasis with a density of 550 UH in the CT scan, suggest that we are facing a uric acid lithiasis.

When the urinary pH drops below 5.5 the urate in urine, which is soluble, binds to hydrogen ions forming uric acid, which is insoluble, and which therefore precipitates triggering the formation of lithiasis (5). With the elevation of urinary pH, uric acid is transformed back to urate and the tendency to uric acid crystallization decreases and, therefore, the tendency to the formation of lithiasis decreases.

When uric acid stones form, the causes of such formation should be studied in patients to provide a targeted treatment. Among the features that should be considered are low urinary volume, hyperuricosuria, or an acidic pH.

A reduced water intake and, consequently, a low urinary volume, favors the appearance of lithiasis of any etiology. The fact of having uricosuria does not determine by itself the formation of uric acid lithiasis, although it may favor its precipitation and the lithiasis formation. However, the fact of having an acidic environment in urine will promote the conversion of soluble urate into insoluble uric acid and therefore its precipitation, thus being a determining factor in the formation of these stones.

On the other hand, it has been discovered that insulin resistance in a patient with type II diabetes mellitus is highly associated with the formation of uric acid kidney stones. Insulin resistance influences urinary pH through two mechanisms: first, through the endogenous synthesis of acids and their subsequent elimination in urine: and second, through the anomalous production of ammonium, although the exact mechanism by which the latter occurs is not entirely clear. Theories under study to explain this second phenomenon include the increase of lactic acid or the production of ketoacids, both related to insulin resistance. (6)

The treatment for this type of kidney stones is therefore based on alkalizing urine to maintain the pH >6.5, reduce purines intake, maintain diuresis above 2 liters, and even in patients who excrete more than 1000 mg of uric acid per day, it is recommended to take allopurinol if they do not respond to the mentioned therapy (7). Urine alkalization is achieved using potassium citrate or sodium bicarbonate, as well as the use of the combination of certain supplements that are currently on the market such as, for example, Lit-Control pH Up. This not only helps to prevent recurrences in this type of patients, but it even dissolves the existing stones, as is the case of our patient.

It is recommended to monitor urinary pH so that it remains between 6.1 and 7. Avoiding an excessively acidic urinary pH can prevent uric acid lithiasis, but it is also important not to exceed pH alkalinization to avoid the formation of calcium phosphate stones, which are formed very easily in alkaline urine. (8)

5. Conclusions and recommendations

The resolution of uric acid stones is possible through the alkalization of urinary pH by medical treatment and dietary measures. Therefore, it is important to emphasize that at a time when endourology is growing with the improvement of surgical techniques, we should not forget that with quite simple measures we can avoid for patients with uric acid lithiasis future, surgical interventions and reduce the comorbidities associated with them.

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