3rd Edition of the Clinical Cases Contest related to the non-surgical clinical management of renal lithiasis

Title: Combined oral and local chemolysis through nephrostomy for the prevention of encrustation of urinary catheters

Keywords (between 3 and 6): lithiasis, acidification, encrustation, calcification

1. Summary

Objective: Case report on oral and local urinary acidification for the prevention of ureteral catheter calcification and nephrostomies.

Material and Methods: Retrospective evaluation of a female patient with double J-stents and nephrostomies, treated with Lit-Control pH Down (L-Methionine and phytate) and citric acid instillations by nephrostomies.

Result: A 57-year-old female with a medical history of total proctocolectomy due to ulcerative colitis and a carrier of bilateral double J-stent due to oncological surgery with the impossibility of extraction due to early calcification. Bilateral nephrostomies were placed to perform percutaneous surgery, initiating a process of obstruction due to early calcification. The patient began oral preventive treatment with Lit-Control pH Down and citric acid instillations through the nephrostomies, preventing their calcification and facilitating the removal of the double-J stents.

Conclusions: We consider the combined treatment (oral and local) for urine acidification, a useful preventive treatment for the calcification of urinary catheters in patients with predisposing factors.

2. Introduction

Ureteral stents are an essential tool in a urologist day-to-day. They are mainly used for decompression due to obstruction of the urinary tract, but they are also used to control and prevent ureteral stenosis after reconstructive (e.g., ureteroureterostomy) or endourological (e.g., ureterorenoscopy) procedures, to ensure that the edema following the procedure does not block urine flow[1]. However, its placement is not without complications: urinary discomfort, infections, hematuria, pain related to reflux, calcification encrustation, etc. As for the last, it is a feared complication that could cause obstruction of the lumen of the catheter, stent rupture, trauma, or even ureteral avulsion during removal, sometimes requiring multiple procedures for its removal[1].

Among the risk factors for urinary catheter encrustation are recurrent urinary tract infections, chronic kidney disease, diabetes mellitus, personal history of urolithiasis, malabsorptive syndromes, lithogenic diets, personal history of neoplasia, physical features of stents, etc.; although one of the most important factor is for how long the stent is placed [1], as the development of encrustation increases over time as shown by different studies[2,3].

As for the mechanism of encrustation of ureteral catheters, it is complex and varied. When a ureteral catheter is inserted, it is covered by a glycoprotein film (which is created by the patient's own urothelium) and coated with the content of the urine. Encrustation can occur on its own from urine with a high concentration of substances with a high mineral content (oxalate, calcium, phosphorus) or from the degradation of urea into ammonium by urease-positive microorganisms (*Klebsiella*, *Proteus*, *Pseudomona*, etc.) which raise urinary pH by forming struvite (ammonium-magnesium phosphate) crystals that precipitate on the catheters surface. The link between mineral encrustation and the formation of the bacterial biofilm that forms on the catheters is still uncertain: the bacterial biofilm could facilitate the crystallization and encrustation of the catheter, although, on the other hand, the encrustation could serve as a nest for bacterial growth and biofilms. In addition, the longer it is kept after its placement, the surface of the stent tends to change and therefore facilitate crystallization[4].

Although urine alkalization is well established for the treatment and prevention of uric acid stones, urine acidification also plays a role in the treatment of infective struvite and calcium composed stones. This can be achieved mainly by oral approach (L-methionine, acetohydroxamic acid), although it can also be achieved percutaneously, through nephrostomy[5,6] (citric acid, hemiacidrine, ethylenediaminetetraacetic acid or EDTA). In the case of the latter approach, its use is extended towards postoperative adjuvant treatment (after lithotripsy) in struvite lithiasis, having shown more limited results when proposed as a primary treatment, which is reserved only for those patients who are not candidates for surgery[5]. The local neoadjuvant treatment through nephrostomies has also been described with the objective of reducing the lithiasic load and enable the possibility of a less aggressive surgery[7], although the literature evidence is scarce. On the other hand, calcium stones are the least sensitive to chemolysis, being EDTA the most widely used, reporting moderately successful results, especially when used early at the formation of the stones[5]. In the specific case of calcium oxalate lithiasis, the citric acid solution does not dissolve stones5. Although sometimes the lithiasis or the calcifications of the urinary stents can have a mixed composition, as was the case of the incrustations of the double-J stents in our patient which had a heterogeneous composition, making their management even more difficult.

On the other hand, phytate also plays a role in inhibiting urinary catheters crystallization. It is a natural sourced molecule that can be found in certain foods (whole grains, legumes, nuts, etc.) and is part of the composition of Lit-Control pH Down. It is negatively charged which allows it to be incorporated into positively charged molecules such as calcium, inhibiting their conjugation with other molecules such as oxalate or, even after their union, preventing the adhesion of new calcium molecules[7,8]. It also prevents the precipitation of struvite crystals[7,8].

In addition, we consider the treatment of lithiasis as important as its prevention. For those patients who have urinary catheters, it is essential to recognize the predisposing risk factors, to establish preventive measures and treatments for their calcification when necessary and, when the stents have encrusted, perform an assessment of the location and severity of the calcification to elaborate the best strategy for their removal.

The objective of this work was, through the experience of a clinical case, to emphasize the importance of prevention of double-J stents and nephrostomies calcification through urine acidification orally and locally (through nephrostomies), to avoid complications such as obstruction or the impossibility of removal.

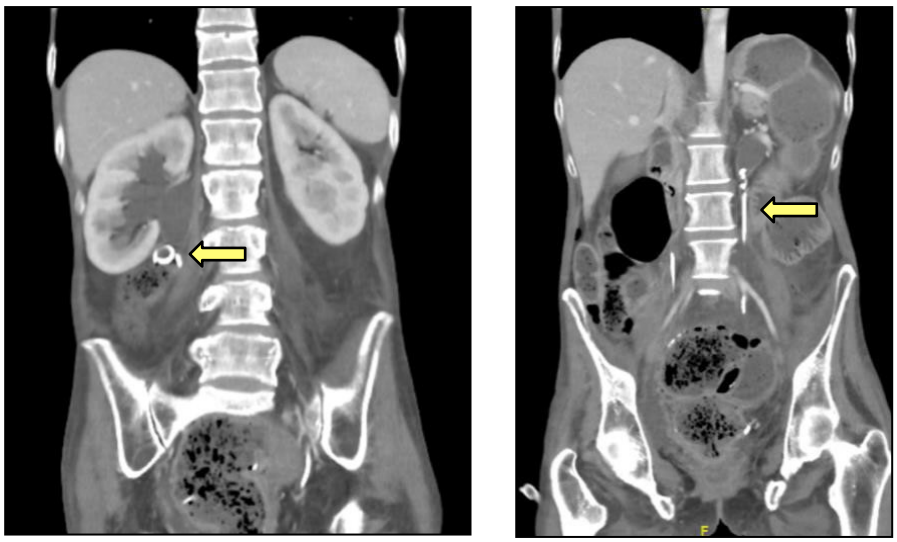
3. Description of the clinical case

a. Relevant medical history

Clinical case report of a 57-year-old female patient, who has a personal history of surgery for ulcerative colitis through a total proctocolectomy and ileal-anal pouch which was performed 30 years ago, and a surgery for endometrial adenocarcinoma where she underwent a laparoscopic hysterectomy in 2019. During follow-up for the latter, the patient was diagnosed with a pelvic tumor relapse, so it was decided to perform a laparotomy to remove said pelvic tumor in July 2022. Prior to the procedure, a bilateral double-J stent placement (6Fr, 26cm) was performed for intraoperative reference, although the right distal ureter had to be removed due to infiltration and a ureteroneocystostomy with psoas hitch was performed, along with the placement of a new ipsilateral double-J stent. In this way, the patient was left with two double-J stents placed in the postoperative period.

b. Diagnostic support studies and results

During admission, a Computerized Tomography (CT) scan was performed in which both double-J stents showed no calcifications or encrustations (Image 1a and 1b) and were both permeable.



Images 1a and 1b: CT (coronal sections). Right double-J stent is observed descended to some extent, but both catheters have no signs of calcification or encrustation.

c. Diagnosis

Two months after the surgery, the patient was scheduled for outpatient appointments to remove the stents, which was unsuccessful, therefore surgery by ureterorenoscopy and laser lithotripsy of the stents, is proposed.

d. Treatment

Fifteen days before the surgery, oral treatment with Lit-Control pH Down (L-Methionine, calcium magnesium phytate, zinc gluconate and vitamin A) was prescribed at a dose of 3 capsules of 500 mg every 8 hr., as an attempt to acidify the urine to avoid further calcification of the stents. However, the attempt of lithotripsy performed 2 weeks later by retrograde semi-rigid ureteroscopy was unsuccessful due to intense calcification of both proximal Jos, with large lithiatic casts that were observed by intraoperative fluoroscopy, therefore, it was decided to place bilateral nephrostomies to schedule a new combined (both antegrade and retrograde approaches) surgery.

Until the second surgery (20 days), the patient attended appointments on two opportunities for obstruction of the left nephrostomy due to early calcification, which was cleared by the passage of a Teflon-coated wire guide.

Therefore, it was decided to continue oral treatment with Lit-Control pH Down as well as instruct the patient to instill 20cc of citric acid solution through the nephrostomies once a day for 1h with the nephrostomies closed, in order to avoid further calcification and obstruction of both the latter and the double-J catheters and thus facilitate their removal.

e. Progress and monitoring

After 4 days of local treatment for nephrostomies, a second surgery was performed, this time combining retrograde (semi-rigid) and anterograde (flexible) ureterorenoscopy, achieving the removal of the left double-J. Due to excessively prolonged surgical time, it was decided to postpone the removal of the right double-J stent, keeping both nephrostomies permeable.

Until its removal (14 days later) the patient continued instillations through both nephrostomies with citric acid, and oral treatment with Lit-Control pH Down, avoiding calcification and obstruction. The right double-J stent was successfully removed in a third combined surgery, removing both nephrostomies on the second postoperative day due to the absence of colic or fever after being closed for 24 hr.

f. Clinical results

During the outpatient check-ups, the patient has remained free of lithiasis, without episodes of colic and with spontaneous diuresis without difficulty.

4. Discussion

We present a case in which oral chemolytic treatment is combined with local treatment through nephrostomies to achieve urinary acidification.

In this case, the calcification of the double-J stents was fast, from when they were placed to the time of removal (2 months). After the need to place the nephrostomies, during the time that passed until the stone fragmentation surgery was performed (just 20 days), the patient had to visit the outpatient consultation twice due to obstruction caused by early calcification of the left nephrostomy, which was solved by passing a guidewire through it. This motivated an initiative-taking prevention approach on our part by using the combined urine acidification, locally through nephrostomies and orally, with the aim of avoiding obstruction and being able to facilitate the combined surgery (antegrade and retrograde) with less lithiasis, or at least with a stable volume.

Some risk factors for catheter/stent calcification which were identified in our patient are: her personal history of intestinal resection due to ulcerative colitis, as well as her underlying neoplastic disease, which are conditions described in the literature as pro-encrustating[1]. Although the ideal situation would have been to establish preventive measures for the calcification of the double-J stents since their placement, we did so after the placement of the nephrostomies to avoid their obstruction and calcification.

Already in 1991, el-Faqih et al described the presence of ureteral catheters calcification according to the time that had since their placement, reporting 9% of calcified catheters removed at 6 weeks, 48% between 6 and 12 weeks, and 77% over the 12th week[1]. Later, in 2012, Kawahara et al showed remarkably similar results with the same duration[1]. Our patient calcified the double-J stents in a period of 8 weeks, while the left nephrostomy suffered an early calcification process.

since its placement (just 2-3 weeks) with one episode of obstruction that was solved in outpatient consultation.

As for the use of local chemolysis by nephrostomy, it has been described as an adjuvant treatment to a previous stone fragmentation treatment (open, endoscopic, percutaneous, or by shock waves) or, more rarely, as a primary treatment in selected cases with high surgical risk. The composition of the lithiasis usually dictates the indication and the results are variable[5]. In the case of infective or struvite lithiasis, the use of acidifying solutions adjuvant to stone fragmentation has shown satisfactory results in the various literature series regarding the free rate of lithiasis. Mulvaney reported a 77-80% free rate of infective lithiasis after shock wave treatment followed by adjuvant therapy with acidifying solutions (hemacidrin or citric acid) in 118 patients, being higher than the rate reported by shock wave alone[5].

However, the experience regarding local chemolysis by nephrostomy in a neoadjuvant manner is scarce. This is usually done with the aim of reducing or eliminating the lithiasic load prior to a stone fragmentation treatment that is expected to be very difficult[9]. Schillebeeckx et al report the case of an 86-year-old male with a high load of calcium phosphate lithiasis (in both proximal ureters and bilateral nephrolithiasis), in which they initiated neoadjuvant treatment by irrigating a citric acid solution through both nephrostomies (bilateral), achieving the dissolution of a considerable part of the stones in just 4-5 days of irrigation (50-100ml/h) and facilitating their full fragmentation through subsequent percutaneous nephrolithotomy[9].

Although in the case of our patient the citric acid solution was instilled through the nephrostomies before the interventions, the initial objective was not to reduce the lithiasic load as a neoadjuvant treatment, but it was meant as preventive treatment to the obstruction due to calcification of the nephrostomies, which had an early onset. This was achieved with a lower daily dose of citric acid than the one used in the aforementioned study (20 ml in a single daily instillation), although it is true that it is not possible to compare the two methods as the one used in the literature is continuous irrigation of maximum 120 ml/h[5,6,9] instead of instillation with posterior nephrostomy closure. In addition, the patient maintained oral chemolysis by taking Lit-Control pH Down (L-Methionine, calcium magnesium phytate, zinc gluconate and vitamin A) while performing the instillations through the nephrostomy, complementing urinary acidification orally.

In literature, the use of phytate as an inhibitor of urinary crystallization is well established[7,8]. The use of new products such as Canoxidin® (phytate, L-methionine and theobromine) have a double effect: on the one hand, it helps neutralizing the alkalinization produced by urease-positive bacteria and on the other it inhibits the crystallization of the different urinary salts. This makes it possible to reduce the removal time of urinary catheters and increase the time they stay in place[7], so it would have been an option to consider these as a preventive treatment for our patient.

Since the establishment of preventive treatment through urinary acidification with combined oral and local therapy, the patient did not experience any other episode of nephrostomies obstruction, enabling the successive combined surgical treatments by antegrade and retrograde approaches for the definitive extraction of encrusted double-J stents. After the nephrostomies were removed, there were no signs of encrustation.

As for the limitations of our work, it should be noted that this a single patient case. On the other hand, we have not obtained conclusive data on the appropriate dosage of nephrostomy chemolysis since the different studies use different doses, acidifying solutions, which also vary in duration and in the way of administration (irrigation vs instillation).

5. Conclusions and recommendations

In our experience, we consider the combined treatment (oral and local) for urine acidification, for preventing calcification and obstruction of urinary catheters, a useful option in patients with predisposing or early calcifying factors. It is essential to recognize the predisposing risk factors, to establish preventive measures and treatments when necessary and, when the catheters have already calcified, to assess the location and severity of the calcification to develop the best strategy for their removal.

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