American Journal of Emergency Medicine 37 (2019) 1855–1859

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Original Contribution

Management and outcome of obstructive ureteral stones in the emergency department: Emphasis on urine tests and antibiotics usage

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ARTICLE INFO

Article history:
Received 4 October 2018
Received in revised form 15 December 2018
Accepted 23 December 2018

Keywords:
Analgesics
Antibiotics
Bacteriuria
MET
Pyuria
Ureteric stone

ABSTRACT

Background: Kidney stone related complaints in the Emergency Department (ED) are common. Current guidelines recommend antibiotic therapy for infected obstructive stones and stone removal in a timely fashion, but there is no clear recommendation for prophylactic antibiotic use for bacteriuria or pyuria in the setting of obstructive ureteral stones.

Objectives: The aim of this study is to evaluate the current management of patients with obstructive ureteral stones in a single ED with emphasis on urine tests and antibiotics use.

Methods: The picture archiving and communication system (PACS) was used to filter the list of patients who received a computed tomography (CT) scan of the abdomen and pelvis that positively identified obstructive ureteral stones. Demographics and clinical data were also recorded and analyzed.

Results: Of the patients discharged, 278 patients did not receive antibiotics in the ED or a prescription. Of these, 8 patients had positive culture, 4 patients followed up, and one developed and was treated for a urinary-tract infection. One hundred ninety two patients were not given antibiotics in the ED but received an antibiotics prescription, and 4 patients had positive cultures grow. Two followed up and had no infection-related complications. Fourteen patients were discharged without a prescription after receiving a single dose of antibiotics in the ED, with no positive urine cultures and 9 patients following up without complication.

Conclusion: Antibiotics were given at the discretion of the provider without clear pattern. A high rate of infectious complication did not occur in the followed up patient group.

1. Introduction

Kidney stone related complaints in the ED are common, which contributes to the estimated annual healthcare expenditure of 2.1 billion dollars spent in the United States. The lifetime prevalence of experiencing a kidney stone is estimated to be 1%–12%, with a rate in men up to 2–3 times higher than in women [1-5]. There is evidence that the gender gap is decreasing, though reasons for the increasing rate of kidney stones in women is still unclear. Furthermore, the rate of recurrence over a 10-year period is 50%. There has been a statistical increase in the prevalence, but it is believed to be largely from increased detection from improved diagnostic imaging, including CT scans [6,7].

While dependent on size and location, many ureteral stones pass spontaneously within 4 weeks. The use of antispasmodic medication to facilitate the passage of obstructive stones is currently recommended for stones <10 mm, with evidence of efficacy from both alpha-antagonists such as tamulosin and, to a lesser extent, calcium channel blockers such as nifedipine [2,3,8-11]. However, some current research indicates that MET may not decrease the need for further intervention for all patients [12,13]. With or without MET to facilitate stone passage, many patients experience severe pain due to obstructive stones and require acute pain management while being treated in the ED and after discharge.

Pain management is an integral part of the management for patients with obstructive kidney stones. Both opioid-based and NSAID analgesics are used for pain management, though there are concerns with the use of narcotics due to their addictive properties [14-17]. Infection is another complicating factor associated

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https://doi.org/10.1016/j.ajem.2018.12.046
0735-6757/

with kidney stones. If a patient has infected stones, current guidelines clearly recommend antibiotic therapy, along with the goal of removing the obstructive stones in a timely fashion by a variety of methods such as stent placement, shock wave lithotripsy or ureteroscopy [18]. Currently there are no guidelines regarding prophylactic antibiotic use for those patients who have obstructive kidney stones and bacteriuria or a normal urinalysis. There is well-known association between bacteria and urinary stones and UTI and/or urosepsis, which can be the source of a urologic emergency, are complications that can be associated with kidney stones. Most of the time the stones are the source of infection [18-22]. One study showed pyuria was present in 14.2% of patients with renal colic. These patients with pyuria had 36.4% positive cultures compared to 3.3% of patients without pyuria. It is reasonable to assume that the presence of bacteria in the urine without actual sign of infection may pose a risk of pyelonephritis with a foreign body (obstructive stone) and stagnating urine above the obstruction in the ureter [21,22].

The purpose of this study is to evaluate the pattern of obstructive ureteric stone management in the ED.

2. Materials and methods

2.1. Materials

Patients were selected from the picture archiving and communication system (PACS) system, using the referring unit as ER and study modality as CT scan of abdomen and pelvis for the time period from January 1, 2010 until December 31, 2017 at a single inner city community hospital. The hospital has a urology service with admitting privileges. The study was approved by the corresponding institutional review board (IRB).

For patients whose CT scan demonstrated obstructive ureteric stones, the Electronic Medical Record (EMR) was reviewed for laboratory tests, pharmacological treatment in the ED and upon discharge, dispositions, and patient outcomes at follow up visits up to 4 weeks after discharge from the ED.

2.2. Inclusion criteria

Obstructive ureteral stone on CT scan of abdomen and pelvis and age > 19 years.

2.3. Investigative procedures

Patient age, sex, date of presentation, and stone size and location were recorded from CT reports. The EMR system of the hospital was then used to review and record results for urine and kidney function tests and whether the patients received antibiotics, antispasmodics, and pain medications in the ED and/or upon discharge, dispositions, as well as at follow up visits up to 4 weeks. Incidences of return visits, complications, invasive procedures, and patient follow up were also recorded. The data were retrospectively analyzed and reviewed. Descriptive statistics were conducted.

3. Results

A total of 918 patients who had one or more ureteric stones were included in the study, 63% of which were male and 37% female. Four hundred seventy four patients (52%) were between the ages of 40–65, 346 patients (38%) were younger than 40 years old and 98 patients (11%) were older than 65 years old. Blood test results showed that 7% of patients had a creatinine level > 1.5 mg/dL. Three hundred seventeen patients (35%) were hospitalized and 601 patients (65%) were discharged. A total of 240 patients (75%) were admitted to urology service, 50 patients (16%) to internal medicine service and 6 patients (2%) to general surgery service. One patient was initially admitted to obstetrics/gynecology but was later transferred to urology service and one patient was transferred out to another facility.

Table 1
Overall patient demographics.

	Number of patients	Percentage
Total patients with obstructive stones	918	100
Male	574	63
Female	344	38
Age > 65	98	11
Age < 40	346	38
Age 40–65	474	52

A total of 341 urine cultures (37%) were completed, of which 254 cultures (74.5%) showed no growth, 53 cultures (15.5%) grew a specific organism, and 34 cultures (10%) showed mixed organisms, likely normal genital flora. From the 601 discharged patients, 143 cultures (24%) were sent, of which 113 cultures (79%) showed no growth, 18 cultures (12.6%) grew a specific organism, and 12 cultures (8.4%) showed mixed flora without a predominant organism. Some of the bacteria that grew included *E. coli*, Pseudomonas, Proteus, coagulase negative Staphylococcus, Citrobacter etc. Resistance patterns of the positively cultured organisms were not evaluated.

Of the patients discharged, 278 (46%) did not receive antibiotics in the ED or a prescription. Of these, 8 had positive urine cultures grow and, of the 4 patients who followed up, one developed a urinary-tract infection and was treated with antibiotics. One hundred ninety two (32%) of the discharged patients did not receive antibiotics in the ED but did receive a prescription for antibiotics; 4 patients had positive cultures grow, and neither of the two who followed up developed infection-related complications. Fourteen patients were discharged without a prescription after receiving a single dose of antibiotics in the ED, with zero positive urine cultures and 9 patients following up without complication.

Of the discharged patients, 180 patients (30%) had Bacteriuria. Of these, 53 (29%) did not receive antibiotics in the ED or a prescription. Of these, one patient had positive urine culture and none followed up. Seventy four patients (41%) received antibiotics prescription without antibiotic treatment in the ED and 2 patients had positive cultures, one followed up with no infection-related complications. Two patients (1.1%) were discharged without an antibiotics prescription after one dose of antibiotics in the ED. Neither showed any growth in the culture and one followed up without complication.

Table 2
Clinical data for urinalysis and urine cultures of discharged patients.

	Number of patients	Percentage
Urinalysis positive for bacteriuria	180	30
Urinalysis positive for bacteriuria with WBC > 5	57	9.5
Urinalysis positive for bacteriuria with WBC > 5 and LE	26	4.3
Urinalysis positive for bacteriuria with WBC > 5, LE, and nitrites	6	1
Elevated WBC in urinalysis	113	19
Leukocytes esterase positive in urinalysis	41	7
Nitrite positive in urinalysis	13	2
Urine culture sent	143	24
Urine culture showed no growth	113	79
Urine culture showed mixed flora	12	8.4
Urine culture positive for specific organism	18	12.6

Table 3
Urinalysis and urine culture results of discharged patients.

	Bacteria in urine	Bacteria + WBC > 5	Bacteria + WBC > 5 + LE	Bacteria + WBC > 5 + LE + nitrate
Total number of patients	180	57	26	6
Culture positive	8	4	4	1
Followed up within 4 weeks	4	1	1	4
Complications	0	0	0	0

Table 4
Antibiotic usage and outcome of discharged patients with bacteriuria.

Antibiotics	Number of patients	Follow up visits	Complication	Patients with positive urine culture
Antibiotics given both in ED and as prescription	54	3	0	5
No antibiotics in ED and no antibiotics prescription	53	0	NA	1
Discharged without antibiotics after one dose of antibiotics in ED	2	1	0	0
Discharged with antibiotics prescription without antibiotic administration in the ED	74	1	0	2

Medical Expulsive therapy (MET) was administered while in the ED in 24% of patients, and 63% of patients were prescribed antispasmodics upon discharge. Considering stone size, 72% of the total patients had a stone size 5 mm or less, 70% of whom received MET in the ED and/or upon discharge. 22% of patients had stones 6-10 mm in size, of whom 51% received MET. Of the 5% of patients with stones >10 mm, 20% received MET. For all stone sizes, both narcotics and NSAIDs were prescribed for pain management, with narcotics being the most prevalent. Overall, 59% of patients had opioid-based analgesics administered in the ED and 67% of patients received a prescription upon discharge. NSAIDs were also commonly administered in the ED (53% of patients) but were prescribed less than narcotics at discharge (30%). Additionally, 39% of patients in the ED and 22% of patients at discharge received combinations of or multiple doses of pain medications, including both narcotics and NSAIDs. Nine percent of patients returned to the ED within 4 weeks with complications or worsening pain. Of these patients, 14% had a stone >5 mm and were undergoing MET and 77% had been prescribed narcotics upon discharge. The majority of patients (77%) who returned with increased pain had been prescribed narcotics at discharge, with a small number (14%) additionally receiving MET for stones >5 mm.

The detailed results are summarized in Tables 1–6.

4. Discussion

Kidney stone-related complaints are seen and treated by an ED physician in most cases, though the management of these patients occasionally requires input from the urology team. Patients who have large obstructive stones, infected stones, and/or continued pain despite medical therapy are seen by the urology team for further management suggestions and/or admission for invasive procedures. Physicians follow guidelines such as those from the American Urologic Association (AUA) [1-3]. The guidelines provide clear recommendations for infected stones or for obstructive stones of larger diameter, but no clear recommendation for scenarios that do not fit the aforementioned cases. In addition, some of the recommendations change or evolve over time, leading to necessary modifications to treatment practices. One such example is MET for obstructive stones [11-13].

Patients with infected stones are admitted for intravenous antibiotics to avoid progression of the disease to severe sepsis, but there is no clear recommendation for patients who have obstructive stones and bacteriuria. The relationship between bacteria and stone formation is a known factor and having an obstructive stone with bacteria may predispose patients to an infection. It remains unclear if the bacteria are the cause, modify the disease or just passively present. However, studies have suggested that bacteria do play a role in stone formation partially by degrading urea and by selectively aggregating into crystals [20-23]. Patients with an unidentified UTI may progress to sepsis or complications [24-26]. Symptoms of obstructive stones can resemble symptoms of UTI and makes it difficult at times to differentiate the two symptoms clearly. Also, urinalysis has a low sensitivity in the diagnosis of UTI. Abrahamian et al. studied the utility of pyuria in the diagnosis of UTI in a setting of obstructive stones and suggested the use of some high risk features that may increase the likelihood of UTI [27]. Routinely, asymptomatic bacteriuria in a pregnant women requires treatment with antibiotics. The reason for this approach is the complication associated with bacteriuria and pyelonephritis as well as preterm labor and preterm delivery [28]. Given the association of bacteria and kidney stones and the potential of obstructive stones progressing to sepsis and septic shock, it is reasonable to think of and treat bacteriuria and obstructive stones with prophylactic/empiric antibiotics [23]. No study has been conducted to show the utility of this approach nor did our study showed the association.

In general, patients with pain from obstructive kidney stone are managed with narcotics, NSAIDs, or a combination of both. Reviewing the literature regarding pain management of patients with kidney stones, those treated with NSAIDs in the ED required

Table 5
Overall antibiotic usage and outcome of discharged patients.

Antibiotics	Number of patients	Follow up visits	Complication	Patients with positive urine culture
Antibiotics given both in ED and as prescription	117	4	None	6
No antibiotics in ED and no antibiotics prescription	278	4	One UTI and was given antibiotics at follow up	8
Discharged without antibiotics after one dose of antibiotics in ED	14	9	None	0
Discharged with antibiotics prescription without antibiotic administration in the ED	192	2	None	4

Table 6
Rates of procedures, hospitalization, discharge, and revisits.

	Number of patients	Percentage
Urology consult given in the ED	346	38
Patient received follow up care in hospital urology clinic	508	55
Urologic procedures performed during visit	153	17
Urologic procedures performed after discharge	39	4
Patients discharged from the ED	601	66
Patients hospitalized from the ED	317	34
- Patients admitted to urology	240	75
- Patients admitted to medicine	50	16
- Patients admitted to surgery	6	2
- Patient left against medical advice or placed in observation status or transferred to another facility	21	7

less rescue analgesics and had a greater reduction in their pain [14,16,29]. Additionally, concerns are noted for the potential for addiction from repeated use of narcotics. Regarding the use of MET, antispasmodic use has been recommended over the years and patients were given antispasmodic medication to aid the passage of obstructive stones. However, the recommendation for the length of their use varied among providers and was not clearly defined. A recent study and meta- analysis highlighted that MET was not beneficial for all patients with obstructive stones. A study by Furyk et al. and Meltzer et al. concluded that patients with a larger stone size may have benefit from its use and a study by Shah et al. reported the lack of benefit regardless of stone size [12,13,30].

Our study showed that the majority of patients (59%) were given narcotics for pain control and very few received antispasmodic medication (24%) while in the ED. Antibiotic prescription or administration in the ED was also limited (43%). Rates of prescriptions at discharge for narcotics (67%), antispasmodics (63%), and antibiotics (61%) all increased from use in the ED. Rate of antibiotic usage in the ED and at discharge were highest (up to 85%) for patients whose urinalysis indicated WBC, leukocyte esterase, and nitrites in addition to bacteriuria. There was no combination of specific results from the urinalysis that correlated with the risk for future infections. Of the 601 patients discharged, 278 (46%) received no antibiotics in the ED or upon discharge with 1 known incidence of infection-related complication. One hundred ninety-two (32%) received a prescription for antibiotics and had no known incidences of infection-related complication, and 14 (2%) received a single dose of antibiotics in the ED without antibiotics prescription upon discharge and had no known incidences of infection-related complication.

Our study focused on evaluating the pattern of obstructive stones management in the ED. We were interested in evaluating the management of obstructive stones with bacteriuria as well as the trends in pain management and MET in the ED and at discharge. We additionally focused on patients that were discharged from ED and evaluated their culture results, antibiotics prescription pattern and outcomes on follow up visit, if any. Finally, although some patients came back to the ED for pain-related issues (9%), we did not identify any patients who returned for infection-related issues such as urosepsis that required hospitalization. One patient who was discharged without antibiotics and had a positive urine culture developed a UTI and was subsequently prescribed an antibiotic.

5. Conclusion

The management of obstructive stones among ED physicians varied from provider to provider. Antibiotics were given at the discretion of the provider without any pattern, except when urinalysis had clear indication of infection, and a high rate of infectious complications was not observed in the followed patient group. No recommendations can be made from this study. Future prospective large scale multi-center studies with emphasis on urinalysis, results of urine culture and antibiotics use, and outcomes of patients with asymptomatic bacteriuria and/or pyuria may be able to better support recommendations regarding the benefit of antibiotic use in the setting of obstructive ureteral stones.

5.1. Limitations

The study is limited by lack of outcome evaluation and small sample size. We were not able to follow up with all patients as some go to other hospitals, a primary care physician, or to a private urology office. We did not look into the type of antibiotics used and the types of bacteria. We were also not able to verify from chart reviewed whether or not the patients took the antibiotics as prescribed to course or if those who were discharged got antibiotics on their own or prescribed after leaving the hospital. It was also not clear if the urine for analysis was taken after or before antibiotics administration in the ED. Our study did not include information regarding compliance with prescribed medications or use of additional medications after discharge. Our study also did not include a phone call after discharge to determine outcomes for patients that did not follow up in our facilities. Sample size and selection criteria are limiting in that this is a one center study and patients were selected from CT scan reports. Patients who presented to the ED and had ultrasound instead of CT were not included in the study.

References

[1] Dean Assimos MAK, Miller Nicole L, Monga Manoj, Hassan Murad M, Nelson Caleb P, Pace Kenneth T, et al. Surgical Management of Stones: AUA/Endourology society guideline. In: AUA/Endourological society guideline.
[2] Pearle MS et al. Medical management of kidney stones: AUA guideline. J Urol 2014;192:316–24. https://doi.org/10.1016/j.juro.2014.05.006.
[3] Preminger GM et al. 2007 Guideline for the management of ureteral calculi. J Urol 2007;178:2418–34. https://doi.org/10.1016/j.juro.2007.09.107.
[4] Carter MR, Green BR. Renal calculi: emergency department diagnosis and treatment. Emerg Med Pract 2011;13:1–17 [quiz 18].
[5] Graham A, Luber S, Wolfson AB. Urolithiasis in the emergency department. Emerg Med Clin North Am 2011;29:519–38. https://doi.org/10.1016/j.emc.2011.04.007.
[6] Uribarri J, Oh MS, Carroll HJ. The first kidney stone. Ann Intern Med 1989;111:1006–9.
[7] Stamatelou KK, Francis ME, Jones CA, Nyberg LM, Curhan GC. Time trends in reported prevalence of kidney stones in the United States: 1976–1994. Kidney Int 2003;63:1817–23. https://doi.org/10.1046/j.1523-1755.2003.00917.x.
[8] Pickard R et al. Medical expulsive therapy in adults with ureteric colic: a multicentre, randomised, placebo-controlled trial. Lancet 2015;386:341–9. https://doi.org/10.1016/S0140-6736(15)60933-3.
[9] Naja V et al. Tamsulosin facilitates earlier clearance of stone fragments and reduces pain after shockwave lithotripsy for renal calculi: results from an open-label randomized study. Urology 2008;72:1006–11. https://doi.org/10.1016/j.urology.2008.05.035.
[10] Singh A, Alter HJ, Littlepage A. A systematic review of medical therapy to facilitate passage of ureteral calculi. Ann Emerg Med 2007;50:552–63. https://doi.org/10.1016/j.annemergmed.2007.05.015.
[11] Turk C et al. Medical expulsive therapy for ureterolithiasis: the EAU recommendations in 2016. Eur Urol 2017;71:504–7. https://doi.org/10.1016/j.eururo.2016.07.024.
[12] Furyk JS et al. Distal ureteric stones and Tamsulosin: a double-blind, placebo-controlled, randomized, multicenter trial. Ann Emerg Med 2016;67:86–95. https://doi.org/10.1016/j.annemergmed.2015.06.001 [e82].
[13] Meltzer AC et al. Effect of Tamsulosin on passage of symptomatic ureteral stones: a randomized clinical trial. JAMA Intern Med 2018;178:1051–7. https://doi.org/10.1001/jamainternmed.2018.2259.
[14] Holdgate A, Pollock T. Systematic review of the relative efficacy of non-steroidal anti-inflammatory drugs and opioids in the treatment of acute renal colic. BMJ 2004;328:1401. https://doi.org/10.1136/bmj.38119.581991.55.
[15] Holdgate A, Pollock T. Nonsteroidal anti-inflammatory drugs (NSAIDs) versus opioids for acute renal colic. Cochrane Database Syst Rev 2005:. https://doi.org/10.1002/14651858.CD004137.pub3CD004137.
[16] Pathan SA, Mitra B, Cameron PA. A systematic review and meta-analysis comparing the efficacy of nonsteroidal anti-inflammatory drugs, opioids, and

paracetamol in the treatment of acute renal colic. Eur Urol 2018;73:583–95. https://doi.org/10.1016/j.eururo.2017.11.001.
[17] Pathan SA, Mitra B, Romero L, Cameron PA. What is the best analgesic option for patients presenting with renal colic to the emergency department? Protocol for a systematic review and meta-analysis. BMJ Open 2017;7:. https://doi.org/10.1136/bmjopen-2016-015002e015002.
[18] Marien T, Miller NL. Treatment of the infected stone. Urol Clin North Am 2015;42:459–72. https://doi.org/10.1016/j.ucl.2015.05.009.
[19] Yamamoto Y et al. Clinical characteristics and risk factors for septic shock in patients receiving emergency drainage for acute pyelonephritis with upper urinary tract calculi. BMC Urol 2012;12:4. https://doi.org/10.1186/1471-2490-12-4.
[20] Bichler KH et al. Urinary infection stones. Int J Antimicrob Agents 2002;19:488–98.
[21] Rahman NU, Meng MV, Stoller ML. Infections and urinary stone disease. Curr Pharm Des 2003;9:975–81.
[22] Schwaderer AL, Wolfe AJ. The association between bacteria and urinary stones. Ann Transl Med 2017;5:32. https://doi.org/10.21037/atm.2016.11.73.
[23] Zanetti G et al. Infections and urolithiasis: current clinical evidence in prophylaxis and antibiotic therapy. Arch Ital Urol Androl 2008;80:5–12.
[24] Wagenlehner FM, Tandogdu Z, Bjerklund Johansen TE. An update on classification and management of urosepsis. Curr Opin Urol 2017;27:133–7. https://doi.org/10.1097/MOU.0000000000000364.
[25] Wagenlehner FME, Pilatz A, Weidner W, Naber KG. Urosepsis: Overview of the diagnostic and treatment challenges. Microbiol Spectr 2015;3. https://doi.org/10.1128/microbiolspec.UTI-0003-2012.
[26] Kalra OP, Raizada A. Approach to a patient with urosepsis. J Global Infect Dis 2009;1:57–63. https://doi.org/10.4103/0974-777X.52984.
[27] Abrahamian FM, Krishnadasan A, Mower WR, Moran GJ, Talan DA. Association of pyuria and clinical characteristics with the presence of urinary tract infection among patients with acute nephrolithiasis. Ann Emerg Med 2013;62:526–33. https://doi.org/10.1016/j.annemergmed.2013.06.006.
[28] Sweet RL. Bacteriuria and pyelonephritis during pregnancy. Semin Perinatol 1977;1:25–40.
[29] Holdgate A, Pollock T. Nonsteroidal anti-inflammatory drugs (NSAIDs) versus opioids for acute renal colic. Cochrane Database Syst Rev 2004:. https://doi.org/10.1002/14651858.CD004137.pub2CD004137.
[30] Shah TT, G. C, O'Keefe A, et al. The effects of medically expulsive therapy (MET) on spontaneous stone passage (SSP) in patients presenting with acute ureteric colic. J Urol 2018;199(4S):e387–8.