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Medical Treatment for Renal Colic and Stone Expulsion

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Abstract

Urinary tract calculi have plagued humans since the dawn of civilization. The obstruction of the urinary tract by calculi at the narrowest anatomic areas (ureteropelvic junction, near the pelvic brim, ureterovesical junction) leads to impaired drainage, which usually eventually causes the agonizing pain of renal colic. The primary objective of the therapeutic management of urolithiasis is to provide relief of pain during an event of acute renal colic. Current evidence suggests that nonsteroidal anti-inflammatory drugs and opioids are the "traditional" choices, and some specific agents also may be effective. Adverse events of the medication administered for the management of renal colic should be considered before using these agents.

An additional aim of the urologist is to overcome the obstruction and to preserve renal function. Medical expulsion therapy for ureteral stones has been suggested as a method of conservative management of ureteral stones. The aim of this medication is to facilitate the passage of ureteral stones, an area that currently seems to be a field for continuous investigation. Current literature suggests the use of calcium-channel blockers and α-blockers for facilitating expulsion of stones, regardless of size. Nevertheless, patients with stones <10 mm could benefit from a reduced requirement for analgesics and accelerated spontaneous passage of ureteral stones.

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1. Introduction

Urinary tract calculi have plagued humans since the dawn of civilization. The clinical occurrence of urolithiasis was first described in the *Aphorisms of Hippocrates*. Incidence of urinary stones is 5–12% in white men and 6% in all women [1].

The obstruction of the urinary tract by calculi at the narrowest anatomic areas (ureteropelvic junction, near the pelvic brim, ureterovesical junction) leads to impaired drainage, which usually eventually cause pain. Two types of pain originate from the kidney: Renal colic is induced by an increase in wall tension and the stretching of the collecting system, and noncolicky renal pain is caused by the distention of the renal capsule. Clinical differentiation is very difficult and sometimes unfeasible due to the fact that these symptoms usually overlap. Rising pressure in the renal pelvis, due to the obstructive calculus, stimulates the local synthesis and release of prostaglandins, which act directly on the ureter to induce spasm of the smooth muscle [2]. An additional pathophysiologic change is renal vasodilation, which induces dieresis with subsequent increase of intrarenal pressure. Moreover, the ureteral muscular contraction induced by prostaglandins leads to disrupted peristalsis and local lactate production. The accumulation of lactate further irritates types A and C nerve fibers in the ureteral walls. These nerves send afferent signals to the

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dorsal root ganglia at T11-L1 levels of the spinal cord and eventually are interpreted as pain by the cerebral cortex.

The primary objective of the therapeutic management of urolithiasis is to provide relief of pain during an event of acute renal colic. Nevertheless, an additional aim of the urologist is to overcome the obstruction and to preserve renal function. Spontaneous passage occurs with almost all ureteral stones $\leq$2 mm but with only 1% of stones >6 mm [2]. In an attempt to treat ureteral stones conservatively, the use of various substances has been proposed. These substances facilitate the passage of ureteral stones and increase the likelihood of spontaneous stone expulsion.

Medical expulsion therapy (MET) has a long history. For centuries, high fluid intake was thought to facilitate faster expulsion of ureteral stones associated with symptoms. The increased hydrostatic pressure proximal to the stone and the high urine output inducing ureteral peristalsis are probably the mechanisms of action of high fluid intake on a ureteral stone [3]. Nevertheless, the effect of high fluid intake and diuretics in stone expulsion and pain relief has not been clearly proven in a meta-analysis [3]. Comparison of normal and high diuresis during a session of extracorporeal shock wave lithotripsy (ESWL) did not prove to be beneficial in a randomized study [4]. Moreover, the extent of ureteral obstruction and the outcome of the high fluid intake treatment can be predicted, whereas the patient's discomfort and possible complications are the motives for investigating the possible use of medication to facilitate stone expulsion. In this paper, we attempt to review current evidence in the medical treatment of renal colic and MET.

2. Dealing with renal colic

2.1. Symptoms and evaluation of renal colic

Renal colic is typically characterized by the sudden onset of colicky flank pain. The severity of the pain depends on the degree of obstruction and the stone size. The position of the calculus is related not only to the location of the pain but also to pain radiation, thus various anatomic regions may be involved. When the stone is located in the ureteropelvic junction, the patient appears with severe pain of the costovertebral angle that radiates along the course of the ureter and the gonad (due to shared innervation). Another possible location for the calculi is the midureter, in which case the pain symptoms are almost the same as noted, except that the patient also reports important tenderness of the lower abdominal quadrant. Finally, stones at the distal ureter often cause pain that radiates to the groin or testicle in males and to the labia majora in females; symptoms of bladder irritability can usually occur as the stone approaches the ureterovesical junction. Furthermore, signs of peritoneal irritation are absent. The patient with acute renal colic is often writhing in distress, trying to find a comfortable position in an attempt to release the agonizing pain. In contrast, a patient with peritoneal signs lies motionless to minimize discomfort. In addition, acute renal colic is frequently associated with nausea and vomiting due to the shared splanchnic innervation of the renal capsule and the intestines. Last but not least, approximately 90% of the patients with renal colic present with gross or microscopic hematuria. In the absence of hematuria, the possibility of urinary calculi should also be considered [3]. Infection proximal to obstruction may complicate renal colic and may be a contributing factor of pain perception.

Because of the characteristically poor localization of visceral pain, paroxysmal renal colic may mimic a variety of pathologic abdominal or pelvic states. It is paramount to note that the most frequent misdiagnosis of ruptured abdominal aortic aneurysms is renal colic. Marston et al demonstrated in a retrospective, multi-institution study that 30% of referred cases of ruptured abdominal aortic aneurysms were initially diagnosed incorrectly as renal colic incidents [5].

The goal of radiologic evaluation in the setting of renal colic is not only to confirm the diagnosis and to identify the presence of the calculi but also to determine whether urgent intervention is required. For suspected stone colic, excretory urography (intravenous pyelography) has been the traditional gold standard for decades. However, in recent years, unenhanced helical computed tomography (CT) of the abdomen and pelvis has been introduced as the best imaging study and provides a contrast-free, increasingly popular alternative for depiction. According to the 2010 European Association of Urology guidelines, in randomized prospective studies of patients with acute renal colic, the sensitivity and the specificity of unenhanced helical CT was similar or superior to that obtained with urography. An alternative evaluation method of acute flank pain is the combination of plain film of the kidneys, ureters, and bladder with ultrasonography. Extensive experience shows that in a large proportion of patients, these methods are sufficient for the diagnosis of a ureteral stone [6]. Ultrasonography is the initial imaging method when colic occurs during pregnancy.

2.2. Medical treatment of renal colic

The main target of the therapeutic management of acute renal colic is to provide adequate analgesia. In addition, aggressive hydration is not recommended for the management of renal colic because the main target of the therapy is to eliminate spasms of the ureteral walls. Nevertheless, the administration of fluids should be considered only in cases of intractable vomiting. Medical analgesic treatment has gained increasing attention in an attempt to relieve patients' pain—not only to achieve reduction in pain score but also to reduce the need for repeat dosing. Two principal classes of drugs are used to relieve excruciating pain: nonsteroidal anti-inflammatory drugs (NSAIDS) and opioids. In addition, other pharmacologic agents such as cyclooxygenase (COX) 2 inhibitors, desmopressin, or a drug combination can be administered to provide pain relief. Drugs that are commonly used to treat renal colic are summarized in Table 1. Pain of different severity could be managed according to Heid and Jage, as presented in Table 2 [7]. It is important to note that when medical therapy is inadequate to provide pain relief, urinary decompression should be obtained by invasive means, usually percutaneous nephrostomy and double-J stenting.