Management of Urological Emergencies Caused by Urinary Calculi

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Introduction

Urinary calculus is a common clinical condition in daily clinical practice. A recent survey showed that 10% of the Hong Kong population has a history of renal colic attack either on themselves or their close family members1. Most people in our society would know somebody who has suffered from renal colic attacks. Proven and suspected cases of urinary calculi contribute a significant amount of workload in public and private urology practice. A large proportion of these patients become aware of their stones only when the stones cause acute problems.

Emergencies caused by upper urinary tract calculi include renal colic, acute pyelonephritis with obstruction and renal pelvic rupture. Lower urinary tract calculi may cause acute urethral obstruction and retention of urine. This article is not an exhaustive description and discussion but rather a brief overview of some common clinical conditions in terms of diagnosis and management.

Renal Colic

Renal colic is a common urological emergency. When the urinary system, usually the ureter, intends to expulse a stone by peristalsis, the intraluminal pressure generated will hit back into the kidney and the renal capsule. Together with urine excretion, this blows up the upper urinary tract and stimulates nerve fibres in the submucosa and renal capsule. The result is intense pain.

The classical description of “renal colic” is persistent unilateral loin pain that maximises in 30 minutes and may last for up to 24 hours before it gradually dies down. The pain may radiate to the lower abdomen and/ or the genitalia. If the stone passes down to the ureterovesical junction (UVJ), it may cause dysuria and urinary frequency. It also commonly causes minor bleeding from the urinary mucosa and leads to the classical description of “smoky urine” and positive test of red blood cells (RBC) in urine.

Diagnosis

With the classical presentation, diagnosis can be made by plain X-ray of the kidneys, ureters and bladder (KUB) and positive test of RBC in urine. In about 10% of cases, the stone may be radiolucent or too small to be shown on plain X-ray. Ultrasonogram is free from radiation and can be done at the bedside. It can demonstrate dilatation of the collecting system caused by obstruction. Stones in the kidney and upper ureter may show up as strong echoes with shadow. However, early obstruction may not produce hydronephrosis and it can be technically demanding to detect stones lower down in the ureter.

If the clinical diagnosis is still uncertain, Helical computerised tomography (CT) scan or contrast radiological study would be necessary. Intravenous urogram (IVU), a simple and readily available study, provides useful information including diagnosis of urinary stone, differential function of kidneys and road map of the pelvi-calyceal system.

With the increase in availability of CT scan, helical CT scan without contrast is more sensitive and specific than IVU to show urinary calculi along the urinary tract and it avoids the potential complications associated with injection of intravenous contrast. In the emergency setting, helical CT also provides information on possible extrinsic causes of obstruction to the ureter, and on non-urological causes of flank pain. The examination is a very short procedure that can be completed within one breath hold. However, the radiation associated with CT scan is substantial and expertise is required to accurately interpret the scan.

CT urogram with contrast enhancement yields more information than IVU and non-contrast helical CT combined, giving good image on the renal parenchymal tissue and adjacent organs. It would be the single most definitive investigation for planning after the acute stage. The limitation would be its high radiation dose and high cost.

Clinical Management

Pain from renal colic is so intense that people often compare it with labour pain. Non-steroidal anti-inflammatory drugs (NSAID's) are commonly used to relieve renal colic pain. Study showed that it is more effective compared with opioid analgesics and it generates less nausea. Common choices include diclofenac sodium, ketorolac tromethamine and indomethacin. Intramuscular injection is an effective way to deliver adequate serum level and is commonly used. Rectal and oral route are also good alternatives. Unless the patient passes out the stone by himself, dull aching is common after the acute attack. Definitive stone treatment is necessary.

Shock wave lithotripsy (SWL) provides effective treatment to small stones in the ureter that are not obstructing. Treatment in the acute phase can decrease
the length of stay of the patient and enhance the recovery phase.4,5

For stones that have failed the shock wave lithotripsy or when the ureteric oedema is so bad that the stones cannot be passed by normal ureteric peristalsis, an intra-corporeal lithotripsy via ureteroscopy will be necessary.

Medical expulsion therapy is the latest trend. For small stones located in the lower ureter and UVJ, some studies showed that alpha-adrenergic blockers can increase the chance of spontaneous passage of the stones, although the result is not consistent.6,7 It is believed that alpha blockers can relax the UVJ which shares common adrenergic innervations with the bladder neck. The agent first tested is tamsulosin.8 Other agents include alfuzosin and terazosin are also studied.8,9 Although the result on stone passage is not consistent among different studies, alpha blockers have the potential to decrease the total amount of analgesics needed.

Acute Pyelonephritis with Stone Disease and Pyonephrosis

Acute pyelonephritis is a clinical diagnosis of fever, rigors, dysuria and ipsilateral loin pain, usually supported by features of infection in the urine. It usually represents an ascending infection of the collecting system and renal parenchyma. In some cases it may be associated with stones in the urinary tract. The collecting system is typically not obstructed. The mainstay of treatment is antibiotics. Investigation for and definitive treatment of any underlying abnormality in the urinary tract can be undertaken when the infection is controlled.

When bacterial infection comes into an obstructed urinary system, infected urine stays in the pelvi-calyceal system and forms pus. This condition, known as pyonephrosis, is a life threatening condition. Patients usually develop sepsis and may progress to septicemic shock. With infection and obstruction, long-term renal damage is very likely.

Diagnosis

Patients usually present with high swinging fever and unilateral loin pain. It is not uncommon that patients present right away in septicemic shock without going through the usual picture of loin pain and fever. When an infected kidney is partially treated with antibiotics, the patient may present with uncontrolled swinging fever and dull loin pain.

Ipsilateral dilation of the pelvi-calyceal system in such patients will point to the diagnosis of pyonephrosis unless proven otherwise. However, in the very early stage, the system may be dilated only minimally or not at all.

Clinical Management

Treatment of bacterial infection with adequate hydration and antimicrobial agents should be instituted without delay. Empirical choice of antibiotics is required should culture results be not yet available. Drainage is the critical measure to reverse this adverse clinical course. External drainage by percutaneous nephrostomy is the orthodox approach. The pelvi-calyceal system is punctured by a nephrostomy needle under ultrasonic guidance. This is then followed by insertion of the percutaneous nephrostomy tube with or without fluoroscopic guidance, which depends on the extent of upper urinary tract dilatation. Successful drainage will be quickly followed by improvement of the clinical condition. Definitive treatment of urinary calculi will then follow when the patient’s condition is stabilised.

Internal drainage with double J catheter inserted in a retrograde fashion through cystoscopy can also provide effective measures to alleviate the pressure in the obstructed system in the upper urinary tract.10 With the development of hydrophilic guide wire and improvements in endoscopic expertise, the upper urinary tract can be effectively drained via its natural orifice with minimal traumatisation. Urethral catheter draining the urinary bladder after double J catheter insertion can provide effective dependent external drainage like that through a nephrostomy.

It should be noted that neither of these two drainage methods has been demonstrated to be consistently superior to the other. Retrograde ureteric internal drainage could be safely performed in patients with minimally dilated systems, with bleeding tendency or in pregnant patients. Percutaneous nephrostomy would be useful if retrograde drainage failed due to an impacted stone. The two methods are therefore complementary to each other.

Renal Pelvic Rupture

When the ureteric peristalsis to overcome urinary calculi obstruction is very intense, the intraluminal pressure may be so high that it may cause rupture of the pelvi-calyceal system. There will be persistent pain and radiological study will show extravasation of contrast. If the leakage is severe, a collection of urine outside the urinary system, known as an urinoma, will form. This is a rare situation but it shows up in case reports from time to time.11,12

Diagnosis

With renal pelvic rupture, the pain is extraordinarily intense compared with normal renal colic. Ultrasound may show the urinoma as a cystic collection of fluid in close proximity to the renal pelvis. Intravenous contrast study will show leakage of urine in the delay film.

Clinical Management

Management in this scenario varies according to its severity. For small perforations, the condition improves with conservative management. Although drainage with internal stenting by a double J catheter will provide a better environment for healing and less chance for progression of urinoma, manipulation with guide wire may change a minor perforation to a major one. Urinomas of a significant size will need to be drained. Operative repair may be necessary for major rupture. Definitive treatment will depend on the underlying stone disease.
Urinary Retention Caused by Lower Urinary Tract Stones

Upper urinary tract stones that have managed to pass down through the UVJ into the bladder usually can travel through the urethral lumen with little difficulty. In case of urethral stricture, or if the stone grows in the urinary bladder, lower urinary tract calculi can cause acute urinary retention when they are stuck in the urethra. Common sites where stones stop include the prostatic urethra, membranous urethra, and navicular part of the urethra that is just proximal to the external urethral meatus.

Diagnosis

The classical symptoms of sudden interruption of the normal urinary stream followed by retention of urine speak for itself. For stones lodged in the distal part of the urethra, they can be palpated over the perineum or the penis. Plan X-ray will show opacities in the pelvic view along the course of the urethra.

Clinical Management

In the emergency management of acute retention of urine, urethral catheterisation is usually necessary. Stones in the proximal part of the urethra can sometimes be pushed back into the bladder by the catheter. If transurethral catheterisation fails, the supra-pubic route is the alternative.

To provide definitive treatment, rigid urethrocystoscopy is performed. Stones in the proximal part of the urethra can be pushed back into bladder for lithotripsy. For stones in the distal part of the urethra, they can be removed after dilatation of the navicular part of the urethra. Flexible endoscopy and lithotripsy are feasible but would be more time consuming.

Conclusion

Urological emergencies due to calculi are common clinical conditions that most clinicians of different specialties will encounter from time to time. Being familiar with this clinical problem can facilitate early diagnosis and referral for specialist care.