Upper Tract Obstruction

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Common Case Presentation

A 42-year-old man with a history of hypertension presents to the emergency department with an eight-hour history of a left flank pain, nausea, and vomiting. He admits to anorexia and cannot tolerate solid or liquid food at home. He is in the emergency department for evaluation.

I. Receiving the Phone Call and Initial Thoughts

A. Patients presenting with acute onset flank or abdominal pain with or without systemic signs of infection require urgent evaluation, diagnosis and management to alleviate symptoms, control local or systemic infection and prevent loss or further deterioration of renal function.

B. **Is the patient hemodynamically stable?**
The presentation of renal and ureteral obstruction is variable, and some patients arrive to the emergency department complaining minor symptoms whereas others present floridly septic and hemodynamically unstable.

C. **Does the patient have any comorbid conditions?**
An immunocompromised state puts patients at risk for faster spread of infectious processes or electrolyte abnormalities due to poor baseline renal function. Diabetes mellitus is one of the most common conditions to cause decreased immune response. Poor control of blood sugar at baseline does impact outcomes.

D. **Does the patient have a prior history of renal calculus disease?**
The most common cause of upper tract urinary obstruction is urinary calculi. Expeditious urinary drainage may be necessary soon after initial evaluation.

E. **Is the patient able tolerate medication or fluid by mouth?**
A common need for hospital admission or more urgent intervention is a patient's inability to tolerate oral intake.

F. **Does the patient have a prior history or urologic surgery or intervention?**

A patient with a prior history of urologic surgery (such as prior nephrectomy) is at potential risk for renal deterioration or loss of renal function.

II. Differential Diagnosis

A. **Urinary lithiasis**
The most common cause of upper urinary tract obstruction is calculus disease

B. **Tumor**
Upper tract urothelial carcinoma can result in urinary obstruction. Consider in patients with risk factors of older age, smoking history, environmental exposure

C. **Trauma**
These patients present following an acute traumatic injury and have specific signs and symptoms. Genitourinary trauma is covered in the specific section in this Consults and Emergencies chapter. The comprehensive review is a separate section in the Core Curriculum.

D. **Ureteral Stricture or Obstruction** (Ureteropelvic junction obstruction, Ureterovesical junction obstruction)
This is a less common acute presentation but can be evaluated during the imaging portion of the work-up.

E. **Blood clot**
Should be suspected in a patient with a history of trauma, coagulopathy, or recent prior urologic surgery or intervention

F. **Fluid collection (urinoma, abscess)**
Typically presents after a history of trauma or recent prior urologic surgery or intervention. This is usually accompanied with fever, flank pain, and nausea or vomiting. Laboratory results and imaging help confirm the diagnosis.

G. **Retroperitoneal fibrosis**
Typically presents sub acutely in the setting of a slow deterioration of renal function. Onset of symptoms is often insidious, and patients can be severely oliguric or anuric on presentation.

H. **Pregnancy**

I. **Infectious Etiologies**
Fungus ball
GU Tuberculosis

J. **Miscellaneous Causes**
Papillary necrosis
Fibroepithelial polyp

K. **Bladder outlet obstruction**

III. Evaluation

A. **History**
The initial history should focus on characterizing the patient’s symptoms in terms of the pain

(severity, location, quality, radiation) and associated symptoms including fevers, chills, sweats, nausea, emesis, anorexia, weight loss, irritative or obstructive voiding symptoms, and hematuria. Characterizing changes in urine output over the preceding 12-24 hours is crucial. Anuria may be seen following unilateral obstruction in the functional or anatomically solitary kidney or bilateral ureteral obstruction. In addition, review of the relevant past medical history, surgical history, medications, allergies, social history including smoking, alcohol and drug consumption as well as occupation will provide useful information. Any previous history of UTIs, urolithiasis, urinary tract instrumentation and genitourinary malignancy may help narrow the differential diagnosis. A prior history of traumatic or surgical nephrectomy is important as the management of obstruction in a solitary kidney is more urgent. At all points throughout the evaluation, the clinician should keep the differential diagnosis of upper urinary tract obstruction in mind.

B. **PHYSICAL EXAMINATION**

1. **Vital Signs**
   Fever, tachycardia, hypotension, and hypoxemia are all indicative of systemic instability and a sick patient and are central to the assessment of the urological patient.
2. **General Appearance**
   Patients in distress from pain may be wincing and have trouble communicating with the clinician. Altered mental status is suggestive of sepsis and is an early sign of septic shock and end-organ damage.
3. **Abdomen/Pelvis**
   A palpable abdominal mass may be the cause for obstruction and requires correlation with the patient's clinical history of any malignancy. Surgical scars provide rapid assessment for the patient's surgical history when the clinical history is incomplete. While upper urinary tract obstruction causing collecting system dilatation is unlikely to be demonstrated on physical exam in adults, this may be more readily appreciated in the pediatric patient. Suprapubic fullness and tenderness are suggestive of a distended bladder. Signs of peritoneal inflammation including rigidity, guarding and rebound tenderness should be elicited in the acute patient as there may be an alternative cause for the patient's symptoms and delays in treatment can have profoundly negative consequences.
4. **Back**
   Costovertebral angle (CVA) tenderness can be elicited in patients with renal inflammation and may indicate underlying pyelonephritis. Obstruction related to a stone may also produce a positive CVA response.
5. **Genital**
   While external genital manifestations of upper urinary tract obstruction are less common, factors that may cause lower urinary tract obstruction with resultant upper tract obstruction may be related to meatal stenosis or a stenotic hypospadias.
6. **Rectal**

A Digital Rectal Examination (DRE) may be performed when there is a concern for prostate cancer or to evaluate for benign prostatic hyperplasia (BPH) as the cause for obstruction.

C. **LABORATORY EVALUATION**

1. **CBC with Differential**
    a. **WBC with Neutrophils**
    An elevated WBC count with evidence of left-shift raises the concern for a coinciding infection which in the setting of urinary tract obstruction represents an emergent scenario.
    b. **Hemoglobin**
    An acute reduction in hemoglobin suggests significant bleeding which in the setting of a known or suspected upper tract malignancy in the patient experiencing hematuria helps direct the urgency of treatment. A reduction in hemoglobin should be confirmed with repeat testing when invasive intervention is being considered.
    c. **Platelet count**
    Thrombocytopenia may increase the risk of persistent bleeding and may need to be addressed concomitantly. Patients with severe urinary tract obstruction and associated uremia may develop platelet dysfunction despite normal levels and raise the risk of clinically significant bleeding.
2. **Coagulation Parameters**
    a. **INR**
    Elevated INR may preclude **Percutaneous Nephrostomy Tube** placement as an option given the elevated risk of perinephric hemorrhage. Rapid correction can be achieved using clotting factor replacement with Fresh Frozen Plasma (FFP).
3. **Electrolytes**
    a. **Sodium and Potassium**
    Prolonged urinary tract obstruction with renal dysfunction may precipitate electrolyte derangement and increase the risk for complications related to electrolyte disturbances. Rapid correction is indicated to prevent the requirement for hemodialysis. Following urinary tract decompression, further derangement may occur as the result of pathologic **postobstructive diuresis (POD)**. This topic is discussed further in the corresponding chapter of this section.
    b. **Blood urea nitrogen (BUN), Creatinine, eGFR**
    The degree of renal dysfunction will dictate the urgency of management in most cases. Early, well-compensated urinary tract obstruction may not manifest with evidence of renal dysfunction and may only appear following a prolonged period of obstruction. Given variations due to age and body mass index, creatinine is not always a reliable predictor of renal function. eGFR represents a more accurate assessment and is often readily available on routine laboratory and does not typical require individual calculation.

4. **Urine Studies**
    a. **Urinalysis (UA), Urine Culture**
    UA provides a precursor analysis of the urine for the presence of blood (RBCs), infectious markers (Leukocyte Esterase, Nitrite, WBCs), bacteria and glomerular dysfunction (casts). A urine culture is required in patients with suspected infection to help identify the source, organism and to direct definitive therapy. Febrile patients require a complete sepsis workup including peripheral
5. **Blood Cultures.**

D. **RADIOLOGIC IMAGING**

1. **CT Abdomen/Pelvis (Non-Contrast)**
Computed Tomography (CT) is the most common imaging modality employed in the acute setting due to its wide availability and rapid assessment. A non-contrast-based evaluation is ideal for the assessment of urolithiasis. A contrast-based scan can obscure a subtle stone with a lower Hounsfield Unit (HU) count such as a Uric Acid stone. In addition to stone location and size, hydronephrosis, nephromegaly, perinephric fluid collections and bladder distention can be evaluated. It is important to note that some stones such as **Indinavir (HIV protease inhibitor) stones and mucoid matrix** may not be demonstrated on a CT scan. An important adjunctive imaging modality is plain-film radiography with kidney, ureter, bladder imaging to assess for stone radiopacity which allows for tracking stone movement on serial images as well as planning for shockwave lithotripsy.
2. **CT Abdomen/Pelvic (Contrast with Delayed Images)/CT Urogram**
A CT urogram is the ideal modality for patient's presenting with signs and symptoms of infection in addition to gross hematuria. The study is performed in a multi-phasic manner with non-contrast, nephrographic and delayed phases. This allows evaluation for stones, renal masses and urinary tract filling defects.
3. **MR Urogram**
MRI can be utilized in patients in whom there is concern for ionizing radiation exposure such as young children and pregnant women. MRI is less sensitive than CT for the detection of urolithiasis. Special consideration needs to be given in those with significant renal insufficiency (CrCl <30 mL/min) due to the concern of **Nephrogenic Systemic Fibrosis (NSF)** from gadolinium-based contrast exposure. Patients with a history of diabetes mellitus, hypertension and renal transplant are at an increased risk.
4. **Renal Ultrasonography**
Renal ultrasound (RUS) is widely available, cheap and lacks ionizing radiation and is an excellent preliminary study in the patient presenting with concern for upper tract obstruction due to the accurate evaluation for hydronephrosis, renal calculi and bladder distention. Accurate stone size assessment is less accurate and there is a degree of overestimation compared with CT. This test is less sensitive for the detection of stones in the distal ureter. Given the lack of ionizing radiation, RUS is the first-line imaging modality

in children and pregnant women.

5. **Diuretic Renography**
   Nuclear medicine based renal functional scanning is helpful to determine differential renal function in the setting of a questionable renal unit if there is evidence of hydronephrosis and significant renal atrophy. As well, hydronephrosis may be present without obstruction in some cases and diuretic based (most commonly Lasix) renography to assess filtration and obstruction (most common and accurate radiopharmaceutical is **^{99m}Tc-Mercaptoacetyltriglycine-3 or ^{99m}Tc-MAG-3)** will help direct management. This technique is commonly used in the evaluation of **ureteropelvic junction obstruction (UPJO)**. This study may be repeated post-intervention to assess for improvement in renal function in a kidney with questionable baseline function based on radiologic appearance.
6. **Retrograde Ureteropyelogram/Antegrade Nephrostogram**
   For patients in which renal ultrasonography is not definitive or if cross-sectional imaging is contraindicated or unavailable, fluoroscopic examination of the upper urinary tract can be performed with catheter-based iodinated contrast injection to delineate ureteral anatomy, hydronephrosis and filling defects. The added benefit of this technique is that concomitant management with ureteral stent placement can be performed. Antegrade nephrostography is performed following percutaneous nephrostomy placement (see section on Management) to assess the collecting system when retrograde access is not possible.
7. **Whitaker Test**
   This test is a dynamic pressure perfusion study and has become less common in clinical practice but involves assessing for obstruction based on changes in collecting system pressure following the instillation of fluid into the upper collecting system via a percutaneous nephrostomy tube. A urodynamic catheter is placed within the bladder to record pressures. Elevated pressures are indicative of functional obstruction. Renal pelvic pressures of greater than 15 to 22 cm H2O are highly suggestive of obstruction.

E. **DIAGNOSIS**
   Once the diagnosis of upper urinary tract obstruction has been made, the next steps in management depend on an assessment of the acuity of the obstruction and the severity of the associated symptoms, systemic infection and/or renal dysfunction.

IV. MANAGEMENT

A. **Initial Management**
   1. Fluid Resuscitation - Fluid bolus can restore blood pressure and increase intravascular volume in volume depleted patients. A Foley catheter should be placed into the bladder, if indicated, to allow for maximal drainage and monitoring following relief of obstruction.
   2. Broad Spectrum Intravenous Antibiotics - The unstable patient with evidence of systemic

infection in the setting of obstruction requires initial resuscitation with intravenous fluids, parenteral antibiotics and emergent decompression of the upper urinary tract.

3. Preparation for drainage of the urinary obstruction - Depending on clinical circumstances drainage of the obstructed upper urinary tract can be via retrograde ureteral stent or percutaneous nephrostomy tube placement.

B. **Specific management plan**

1. Upper Urinary Tract Decompression - The cornerstone of management is urgent decompression with placement of a **Retrograde Ureteral Stent or Percutaneous Nephrostomy Tube** insertion with or with **Antegrade Ureteral Stent** placement. Both techniques are associated with rapid decompression and drainage and are equally effective. Patients on anticoagulation or with an uncorrected coagulopathy may not be candidates for urgent percutaneous management

C. **Definitive Management**

1. Following upper tract decompression and resolution in infection, renal dysfunction and patient clinical stabilization a plan at definitive management of the inciting obstruction can be made. In some cases, stent and nephrostomy tube placement may be temporary while the stone, clot, tumor or retroperitoneal process resolves. In other situations, the patient may require chronic tube placement with interval exchanges if the process is chronic. Upper tract obstruction secondary to lower urinary tract obstruction (BPH, prostate cancer, stricture) can be relieved following definitive management for the obstructive process. Definitive surgical techniques will employ endoscopic, laparoscopic, robotic-assisted or open methods

Key Takeaways

1. Upper tract obstruction is a common clinical scenario encountered by Urologists and therefore an approach to the rapid evaluation, diagnosis and management is required to quickly relieve patient suffering and prevent complications related to sepsis and renal failure.
2. A focused history and physical examination along with pertinent laboratory and radiological studies will direct the Urologist to the final diagnosis.
3. Initial management will involve decompression of the obstructed collecting system with Foley catheter placement and either ureteral stent placement or percutaneous nephrostomy tube insertion.
4. Once the acute phase has resolved, then attention can be directed towards definitive management of the etiology of the obstruction.

Videos

Nephrostomy Tube Placement for Acute Upper Urinary Tract Obstruction

Presentations

Upper Urinary Tract Obstruction Presentation 1

References

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