Obstructive uropathy: structural impedance to the flow of urine anywhere along that tract
Obstructive nephropathy: damage to the renal parenchyma that results from an obstruction to the flow of urine anywhere along the urinary tract
Hydronephrosis: presence of dilatation of the pelvis and calyces and not to the etiology of that dilatation.
\[ \therefore \text{Obstructive uropathy } \neq \text{hydronephrosis} \]

**Patient Presentation**

- Symptoms: wide range, from asymptomatic (incidentally discovered) to classic picture of renal colic; varies according to:
  1. the time interval over which the obstruction occurs: acute or chronic
  2. the obstruction is unilateral or bilateral
  3. the etiology of the obstruction: intrinsic or extrinsic
  4. the obstruction is complete or partial

  - **Acute obstruction**: flank pain may radiate into the groin &/or the ipsilateral thigh.
    - nausea, vomiting; fever; chill if infection occurs.
  - **Bilateral & chronic obstruction** or **Unilateral obstruction in solitary kidney**
    - uremic symptoms: malaise, anorexia, ankle edema, weight gain, fatigue, mental status changes, tremor, GI bleeding
  - **Unilateral & chronic obstruction**: intermittent flank pain during periods of forced diuresis
  - **Extrinsic obstruction**: more insidious & hence symptom-free presentation
  - **Lower tract obstruction**: weak & intermittent urine stream, urgency, nocturia, urge/overflow incontinence
Clinical signs & Biochemical finding

Clinical signs: abdominal mass, volume overload - bipedal edema, pulmonary congestion, & hypertension

Laboratory data: hematuria, proteinuria, crystalluria, pyuria & urinary casts.

Chronic obstruction - ↑ urine Na⁺, ↓ urine osmolality, ↓ urine/plasma Cr ratio.
- ↑ BUN, Cr, hyperkalemia & acidosis

Diagnosis

Excretory Urography: gold standard for the detection of ureteral obstruction in pt.
who - have normal renal function
- have no allergies to contrast media
- not pregnant

provide both functional & anatomic details of the obstruction

Acute obstruction - obstructive nephrogram
- delay in filling of the collecting system with contrast material
- dilatation of the collecting system
- possible fornix rupture with urinary extravasation

Chronic obstruction - ureteral dilatation, tortuosity & standing column of contrast material in the ureter to the point of obstruction
- marked renal parenchymal thinning, calyceal crescents & soap-bubble nephrogram

Ultrasonography: good starting point for evaluating the renal units of patients who IVP could not be done & pediatric age group

advantage - obtain information about both renal parenchyma & collecting system
- no exposure to radiation or contrast material - induced nephrotoxicity or anaphylaxis

Hydronephrosis in U/S: dilated collecting system separating the normally echogenic renal sinus → anechoic central area surrounded by parenchyma
Echoes Within the collecting system = Pyonephrosis, hemorrhage or lesion of the transitional mucosa

Thicknesst of renal parenchyma = indicator of the duration of obstruction

False negative in - acute onset of obstruction, intrarenal collecting system, dehydration & the misinterpretation of caliectasis for renal cortical cyst.

U/S may be useful for evaluation of hydronephrosis in the chronically obstructed kidney.

False positive in - capacious extrarenal pelvis, parapelvic cysts, vesicoureteral reflux & high urine flow state

Diuretic Renography: noninvasive measure of the relative renal function & has the ability (Figure 1) to wash out the radiopharmaceutic agent from the dilated collecting system.

radiopharmaceutic agent of choice = $^{99m}$ Tc-mercaptoacetyltriglycine (MAG 3) measure $T_{1/2}$ for the clearance of the tracer from the collecting system.

$T_{1/2}$ diuretic response < 15 minutes = normal

15 - 20 minutes = equivocal

> 20 minutes = obstruction

CT & MRI

CT = an alternative to IVP for patients - allergy to contrast media

- ↑ serum BUN & / or Cr

- non-contrast-enhanced CT is more sensitive than IVU in the detection of ureteric stones in acute flank pain

- provide information about extrinsic cause of ureteral obstruction

MRI - for visualization of the entire urinary tract. The use of IV contrast material or ionizing radiation

- disadvantages = inability to identify the ureteral calculus, use long time for images & high cost

∴ useful in patients - allergies to contrast material & renal failure
Gamma camera renograms obtained from computer-generated regions of interest with $^{131}$I-ortho-iodohippurate (OIH) demonstrate four responses. The group I renogram is normal. Because obstruction is sometimes unmasked by diuretic administration, O'Reilly and associates recommended a repeat renogram 15 minutes after diuretic administration. A second normal group I renogram rules out obstruction. Progressive accumulation (group II) despite administration of furosemide at about 20 minutes after tracer injection confirms obstruction. On the other hand, rapid emptying after diuretic administration (group IIIA) despite an initial rise in the renogram curve indicates dilatation without obstruction. Finally, an increasing curve with a partial excretory response may indicate either partial obstruction or renal dysfunction with an inability to respond to the diuretic (group IIIB). (From O'Reilly PH, Shields RA, Testa JM, eds: Nuclear Medicine in Urology and Nephrology, 2nd ed. London, Butterworths, 1986, pp 91-108.)
Voiding Cystourethrography (VCUG)
- For patients with symptoms related to the lower urinary tract dysfunction & suspected anatomic abnormalities
- Female urethra & posterior male urethra are best visualized: urethral diverticula in the male & stricture urethra in the infant or posterior urethral valve in infants

Retrograde Urethrography
= the only procedure for visualizing the anterior male urethra

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<th>Classification of Obstructive Uropathy</th>
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<td>According to</td>
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<td>- etiology (congenital, acquired)</td>
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<td>- duration (acute, chronic)</td>
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<td>- degree (partial, complete)</td>
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<td>- level (upper, lower)</td>
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Classification by etiology

**Congenital**
- meatal stenosis
- posterior urethral valve
- ectopic ureter
- ureterocele
- UVJ & UPJ obstruction
  etc.

**Acquired**
- stricture urethra
- BPH
- CA prostate
- CA bladder
- calculi
- local extension of CA cervix
- retroperitoneum fibrosis & tumor
- pregnancy

Classification by level

**Upper tract**
UPJ obstruction - stone
- adynamic segment
- crossing blood vessel
- tumor

**Lower tract**
Mechanical:
- BPH
- Stricture urethra
- CBN
- posterior urethral valve
- urethral stone
  etc.

Ureteral obstruction - intrinsic cause
- extrinsic cause

Functional:
- Neurogenic bladder
  : DSD
- Pharmacologic cause

Common cause of obstructive uropathy

**Adult men**
- calculi
- BPH
- CA prostate
- UPJ obstruction
- stricture urethra

**Adult woman**
- pregnancy
- calculi
- UPJ obstruction
- pelvic malignancy
- Surgical trauma to ureters

**Children**
- UPJ obstruction
- UVJ obstruction (ectopic Ureter)
- ureterocele
- posterior urethral valve
- calculi
Anatomic Changes of Upper Urinary Tract Obstruction

Gross changes in the kidney depend on:
- intrarenal VS extrarenal collecting system
- length & degree of obstruction
- infection

Mechanism of injury & cellular atrophy in hydronephrosis
1. compression atrophy \( \leftarrow \) ↑ Intrapelvic pressure
2. ischemic atrophy \( \leftarrow \) ↓ RBF

Microscopic Changes in the Kidney: tubule > glomeruli
- Tubule: initial \( \rightarrow \) dilatation of the lumen with flattening of the epithelium
  > 21 days \( \rightarrow \) disappear in several areas
- fibrosis: 7 days after UUO \( \rightarrow \) appearance of collagen fibers in the kidney
  32 days after UUO \( \rightarrow \) diffuse interstitial collagen in cortex & outer medulla, no change at glomerulus before 28 days of obstruction

Tools for making decisions in treating patients with obstructed kidneys.
(to relieve the obstruction, to preserve future renal function OR to remove the kidney)
1. estimate of renal Function = IVP, Diuretic renography.
2. estimate of architecture of the renal unit = U/S, IVP/RP & CT

Clinical Management of Obstructive Uropathy

1. Postobstructive diuresis

   = Marked polyuria that occurs after relief BUO or obstruction of a solitary kidney most likely presents in patients with chronic obstruction, edema, CHF, hypertension, weight gain, azotemia

   Mechanism 1. Solute diuresis \( \leftarrow \) retained urea, Na\(^+\) & water, administered glucose
2. Impaired urine concentrating ability = The earliest & most characteristic renal tubular defect found in obstructive uropathy
3. Impaired sodium reabsorption
2. Renal Colic

Standard treatment = 1. Narcotic analgesics but can exacerbate GI symptom & cause excessive sedation

2. NSAIDs → directly affecting prostaglandin-mediated pain pathway but affect renal ↓ RBP

Hydronephrosis & Hypertension

Incidence of hypertension: BUO > UUO; acute > chronic

Hypertension in UUO: relate to increasing RAAS (renin–angiotensin–aldosterone system)

BUO: relate to retention of sodium, water & urea