Managing Acute Urinary Retention

Arun Arunasalam
Definition

• Urinary retention is the inability to voluntarily empty the bladder to completion

• Acute Urinary Retention (AUR) is the sudden and often painful inability to void, despite having a full bladder
Background

• It is estimated that 10% of men in their seventies and a third in their eighties will have AUR (Curtis et al., 2001)
• AUR is rare in younger men; men in their 70s are at five times more risk of AUR than men in their 40s
• Retention is >10 times more common in men than in women
Assessing the patient with AUR

Presenting complaint

Identify cause

Rule out potentially dangerous conditions that may present as AUR

Fitness for surgical intervention

Look for complications
Presenting Complaint

- Timing & speed of onset of symptoms
- Pain intensity & sensation
- Previous episodes of AUR / known CUR
Causes of AUR

- Obstruction
- Medication
- Infectious
- Bladder Over distension
- Neurogenic
Causes of AUR

**Most common cause of AUR in men**

- Benign prostatic hyperplasia
- Prostate cancer
- Urethral stricture, bladder neck stricture
- Bladder tumour, urethral polyp, urinary meatal stenosis
- Constipation
- Women: pelvic organ prolapse, tumor eg uterine fibroids

Hesitancy, frequency, flow, stream, dribbling, urgency, straining, incomplete emptying
Constitutional symptoms, bone pain, erectile dysfunction
Family history
Bowel habits

- Medication
- Infectious
- Bladder Over distension
- Neurogenic
Causes of AUR

- Medication
  - Prostatitis
  - Urethral herpes
  - Periurethral abscess
  - UTI
- Neurogenic
- Bladder Over distension
- Obstruction

Infectious
- Fever, dysuria, discharge, genital skin lesions, sexual history
- Blood in urine/semen, pain with ejaculation, pain in perineum, groin / lower back
Causes of AUR

Obstruction

Infectious

Medication

Brain - CVA, TBI, tumours, parkinson’s
Spinal cord – Trauma, spinal stenosis, intervertebral disc dz, cauda equina synd, tumours, spinal hematoma / abscess
Autonomic / peripheral – Diabetes mellitus, autonomic neuropathy, GBS, herpes zoster virus, polio
Causes of AUR

- Bladder Over distension:
  - Recent surgery eg bladder, prostate
  - Anesthesia
  - Post op pain
  - Excessive fluid intake

- Obstruction
- Infectious
- Neurogenic

Medication
Causes of AUR

- Medication
  - Epidural
  - Opiates – eg morphine
  - Anticholinergics eg atropine
  - Sympathomimetics eg pseudoephedrine
  - Antiparkinsonian drugs eg levodopa
  - Antiarrhythmics eg quinidine
  - Hormonal agents eg testosterone
  - Antihistamines eg diphenhydramine
  - Antihypertensives – eg hydralazine
  - Muscle relaxants – eg baclofen
  - Antipsychotics – eg haloperidol
  - Antidepressants – eg amitryptiline

- Obstruction
- Infectious
- Neurogenic
- Bladder Over distension
Table 2. Pharmacologic Agents Associated with Urinary Retention

<table>
<thead>
<tr>
<th>Class</th>
<th>Drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiarrhythmics</td>
<td>Disopyramide (Norpace); procainamide (Pronestyl); quinidine</td>
</tr>
<tr>
<td>Anticholinergics (selected)</td>
<td>Atropine (Atreza); belladonna alkaloids; dicyclomine (Bentyl); flavoxate (Urispas); glycopyrrolate (Robinul); hyoscyamine (Levsin); oxybutynin ( Ditropan); propantheline (Pro-Banthine*); scopolamine (Transderm Scop)</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>Amitriptyline (Elavil*); amoxapine; doxepin (Sinequan*); imipramine (Tofranil); maprotiline (Ludiomil*); nor triptyline (Pamelor)</td>
</tr>
<tr>
<td>Antihistamines (selected)</td>
<td>Brompheniramine (Brovex); chlorpheniramine (Chlor-Tri meton); cyproheptadine (Periactin*); diphenhydramine (Benadryl); hydroxyzine (Atarax*)</td>
</tr>
<tr>
<td>Antihypertensives</td>
<td>Hydralazine; nifedipine (Procardia)</td>
</tr>
<tr>
<td>Antiparkinsonian agents</td>
<td>Amantadine (Sym metrel); benztropine (Cogentin); bromocriptine (Parlodel); levodopa (Larodopa*†); trihexyphenidyl (Artane*)</td>
</tr>
<tr>
<td>Antipsychotics</td>
<td>Chlorpromazine (Thorazine*); fluphenazine (Prolixin*); haloperidol (Haldol); prochlorperazine ( Compazine*); thioridazine (Mellaril*); thiothixene (Navane)</td>
</tr>
<tr>
<td>Hormonal agents</td>
<td>Estrogen; progesterone; testosterone</td>
</tr>
<tr>
<td>Muscle relaxants</td>
<td>Baclofen (Lioresal); cyclobenzaprine (Flexeril); diazepam (Valium)</td>
</tr>
<tr>
<td>Sympathomimetics (alpha-adrenergic agents)</td>
<td>Ephedrine; phenylephrine (Neo-Synephrine); phenylpropanolamine‡; pseudoephedrine (Sudafed)</td>
</tr>
<tr>
<td>Sympathomimetics (beta-adrenergic agents)</td>
<td>Isoproterenol (Isuprel); metaproterenol (Alupent); terbutaline (Bre thine*)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Amphetamines; carbamazepine (Tegretol); dopamine (Intropin*); mercurial diuretics; nonsteroidal anti-inflammatory drugs (e.g., indomethacin [Indocin]); opioid analgesics (e.g., morphine [Duramorph]); vincristine (Vincasar PFS)</td>
</tr>
</tbody>
</table>

*—Brand not available in the United States.
†—Levodopa is only available in combination drug products (e.g., carbidopa/levodopa [Sinemet]).
‡—Drug not available in the United States.

Examination

• Physical examination should include:
  1. **Abdominal examination of the bladder:**
     – may be visible and is tender
     – percussion: should be dull, may be percussible if it contains 150mL or more of urine
     – palpation: may be palpable with more than 200mL
     – may be difficult in the obese
  2. **Digital rectal examination** (DRE) after catheterisation, to note:
     – size and texture of the prostate
     – prostate nodules
     – anal tone
     – faecal impaction
     – presence or absence of constipation
  3. Focused **neurological** examination
## Possible Etiology...

**Male ...**

<table>
<thead>
<tr>
<th></th>
<th>History</th>
<th>Examination</th>
<th>Possible Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prev history of urinary retention</td>
<td>Enlarged, firm, non tender, non nodular prostate</td>
<td>BPH</td>
</tr>
<tr>
<td>2</td>
<td>Fever, dysuria, back, perineal&amp;rectal pain, tender</td>
<td>Warm boggy prostate, possible penile discharge</td>
<td>Acute prostatitis</td>
</tr>
<tr>
<td>3</td>
<td>Weight loss, constitutional symptoms</td>
<td>Enlarged nodular prostate</td>
<td>Prostate Ca</td>
</tr>
<tr>
<td>4</td>
<td>Pain, swelling of foreskin or penis,</td>
<td>Edema of penis with non retractable foreskin, externally applied penile devices</td>
<td>Phimosis, paraphimosis / edema from externally placed constricting device</td>
</tr>
</tbody>
</table>
## Possible Etiology

### Female ...

<table>
<thead>
<tr>
<th>No</th>
<th>History</th>
<th>Examination</th>
<th>Possible Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pelvic pressure, protrusion of pelvic organ frm vagina</td>
<td>Prolapse of bladder, rectum / uterus on pelvic exam</td>
<td>Cystocele, rectocele, uterine prolapse</td>
</tr>
<tr>
<td>2</td>
<td>Pelvic pain, dysmenorrhea, lower abdominal discomfort, bloating</td>
<td>Enlarged uterus, ovaries / adnexae</td>
<td>Pelvic mass, uterine fibroid, gynae malignancy</td>
</tr>
<tr>
<td>3</td>
<td>Vaginal discharge, dysuria, vaginal itching</td>
<td>Inflammed vulva &amp; vagina, vaginal discharge</td>
<td>Vulvovaginitis</td>
</tr>
</tbody>
</table>


# Possible Etiology

**Male / Female ...**

<table>
<thead>
<tr>
<th></th>
<th>History</th>
<th>Examination</th>
<th>Possible Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dysuria, hematuria, fever, back pain, urethral discharge, genital rash, recent sexual activity</td>
<td>Suprapubic tenderness, costovertebral angle tenderness, urethral discharge, genital vesicles</td>
<td>Cystitis, urethritis, UTI, STD, herpes infection</td>
</tr>
<tr>
<td>2</td>
<td>Painless hematuria</td>
<td>Gross hematuria with clots</td>
<td>Bladder tumour</td>
</tr>
<tr>
<td>3</td>
<td>Constipation</td>
<td>Abdominal distention, dilated rectum, retained stool in vault</td>
<td>Fecal impaction</td>
</tr>
<tr>
<td>4</td>
<td>Existing / newly diagnosed neurologic dz, parkinson’s dz, diabetes mellitus, stroke, overflow incontinence</td>
<td>Generalized / focal neurologic deficits</td>
<td>Neurogenic bladder</td>
</tr>
</tbody>
</table>
Differential Diagnosis

1. Chronic urinary retention (CUR) –
   – usually painless (although acute-on-chronic retention may be painful and should be managed as AUR)
   – AUR is usually not more than 1L, whereas CUR is substantially more

2. Acute renal failure
The following are potentially more serious conditions that can be referred into hospital as AUR:

1. Diverticulitis or a diverticular abscess
2. Perforated or ischaemic bowel
3. Abdominal aortic aneurysm
Investigations

- **Catheterize** & collect urine sample
  - Note amount of urine drained (AUR vs CUR)
- **Lab**
  - Urinalysis – Infection, hematuria, proteinuria, glycosuria
  - Renal function & electrolytes – Renal failure, lower urinary tract obstruction
  - Sr Blood glucose – Undiagnosed / uncontrolled diabetes mellitus
  - Prostate specific antigen – invariably raised in AUR
- **Imaging**
  - Ultrasound KUB – Measure PVR urine, stones, hydronephrosis, upper urinary tract disease
  - CT abdomen & pelvis – Suspected pelvic, abdominal / retroperitoneal mass / malignancy
  - MRI / CT brain – Intracranial lesions (If clinically indicated)
  - MRI spine – lumbosacral disc herniation, cauda equina syndrome, spinal tumours, spinal cord compression (if clinically indicated)
- **Cystoscopy, retrograde cystourethrography**
  - Tumour, stones, strictures
- **Urodynamic studies**
  - Bladder function (detrusor muscle & sphincter) in patients with neurogenic bladder
  - Large PVR volumes (eg 350mL) may indicate bladder dysfunction & predict a less favourable response to treatment
- **Proceed with management while awaiting results of the investigations**
Management

• Urgent catheterization to relieve obstruction & drain bladder

• Subsequent management depends on cause of AUR
Acute urinary retention (AUR)

**Catheterization** 1-3 days

**Causative factors**

- **Drugs**
  - Discontinue if possible
  - TWOC

- **Diabetes**
  - Control DM
  - TWOC
  - Fail trial of void
  - Instruct on IC

- **Neurological disturbance**
  - TWOC
  - Fail trial of void
  - Instruct on IC

- **Urethral stricture**
  - TWOC
  - IPSS
  - Surgical intervention

- **BPH**
  - IPSS
  - TWOC

- **Surgery**
  - TWOC
  - Instruct on IC

- **Chronic constipation**
  - TWOC
  - Treat constipation

- **Infection**
  - TWOC
  - Treat infection

- **Previous AUR**
  - Instruct on IC

**Potential placement of SP tube**

- **Urethral stricture**
  - TWOC
  - IPSS
  - Surgical intervention

**IPSS**

- Mild 0-7
  - TWOC
  - WW
  - Reassess In 12m

- **Mod** 8-19
  - Med Rx
  - TWOC
  - Reassess 3-6m

- **Severe** >20
  - Med Rx
  - TWOC
  - Fail
  - Surgical intervention / instruct on IC

**Med Rx**

- Instruct on IC
Acute urinary retention (AUR)

Catheterization
1-3 days

Urethral vs Suprapublic?

• Advantages of SPC – Less UTIs, less stricture formation, permission of TWOC without catheter removal, increased patient discomfort
• Disadvantages – More complex, requires skill, serious complications including bowel perforation & peritonitis (2.5%)
• Benefits of SPC have been shown in many studies with similar complication rates
• However, most urologists performed urethral catheterisation >80% of the time

Acute urinary retention (AUR)

Catheterization 1-3 days

Causative factors

Drugs
- Discontinue if possible
- TWOC

Diabetes
- Control DM
- TWOC
- Fail trial of void
- Instruct on IC

Neurological disturbance
- TWOC
- Fail trial of void
- Instruct on IC

Urethral stricture
- TWOC
- Surgical intervention

BPH
- IPSS
- TWOC

Chronic constipation
- Treat constipation
- TWOC

Infection
- Treat infection
- TWOC

Previous AUR
- Instruct on IC

BPH
- IPSS

Chronic constipation
- Treat constipation

Infection
- Treat infection

Prevention

IPSS
- Mild 0-7
- TWOC
- WW
- Reassess In 12m

- Mod 8-19
- Med Rx
- TWOC
- Reassess 3-6m

- Severe >20
- Med Rx
- TWOC
- Fail

Surgical intervention / instruct on IC
Acute urinary retention (AUR)

Catheterization 1-3 days

Causative factors

Drugs
Discontinue if possible

Trial without catheter
- Involves catheter removal after 1-3d
- 23-40% of patients will be able to successfully void
- Allows surgery to be delayed to an elective setting
- Higher probability of success – age <65, UTI with no prev obstructive symptoms, postvoid residual (PVR) <1000ml, prolonged catheterisation, identifiable precipitating cause (eg gross constipation, drug induced)
- High probability of failure – Age > 75, PVR > 1000ml, Prev LUTS, voiding detrusor contraction < 35cmH2O on urodynamics
- 50% of patients with initial TWOC success will experience AUR over the next year & 35% will require surgery
- ALFAUR study – most patients who required surgery after successful AUR needed it for recurrent AUR – therefore important to follow up patients with risk factors despite initial successful TWOC
Acute urinary retention (AUR)

Catheterization
1-3 days

Causative factors

Drugs
Discontinue if possible
TWOC

Diabetes
Control DM
TWOC
Fail trial of void
Instruct on IC

Neurological disturbance
TWOC
Fail trial of void
Instruct on IC

Urethral stricture
TWOC
Surgical intervention

BPH
IPSS

Surgery

Chronic constipation
Treat constipation
TWOC

Infection
Treat infection
TWOC

Previous AUR
Instruct on IC

Potential placement of SP tube

BPH
IPSS

TWOC

IPSS

Mild
0-7
TWOC
WW
Reassess In 12m

Mod
8-19
TWOC
Med Rx
Reassess 3-6m

Severe
>20
TWOC
Med Rx
Fail

Surgical intervention / instruct on IC
Acute urinary retention (AUR)

Catheterization 1-3 days

Causative factors

- Diabetes
- Control DM
- TWOC
- Fail trial of void
- Instruct on Intermittent catheterisation
Acute urinary retention (AUR)

Catheterization 1-3 days

Causative factors

**Drugs**
- Discontinue if possible
  - TWOC

**Diabetes**
- Control DM
  - TWOC
- Fail trial of void
  - TWOC
- Instruct on IC

**Neurological disturbance**
- TWOC
- Fail trial of void
- Instruct on IC
- Potential placement of SP tube

**Urethral stricture**
- TWOC
- IPSS
- Surgical intervention
- TWOC
- IPSS
- TWOC
- Treat

**BPH**
- IPSS
- TWOC

**Surgery**
- TWOC
- Treat constipation
- TWOC

**Chronic constipation**
- TWOC
- Treat infection
- TWOC

**Infection**
- TWOC
- Instruct on IC

**Previous AUR**
- TWOC
- Instruct on IC

**IPSS**
- Mild 0-7
  - TWOC
  - WW
  - Reassess In 12m

- Mod 8-19
  - TWOC
  - Med Rx
  - Reassess 3-6m

- Severe >20
  - TWOC
  - Med Rx
  - TWOC
  - Fail

**Surgical intervention / instruct on IC**
Acute urinary retention (AUR)

Catheterization 1-3 days

Causative factors

- Neurological disturbance
  -TWOC
  - Fail trial of void
  - Instruct on IC
  - Potential placement of SP tube

• After catheter removed, watchful waiting with PVR check to ensure bladder emptying well
Acute urinary retention (AUR)

Catheterization 1-3 days

Causative factors

Drugs
- Discontinue if possible
- TWOC

Diabetes
- Control DM
- TWOC
- Fail trial of void
- Instruct on IC

Neurological disturbance
- TWOC
- Fail trial of void
- Instruct on IC

Urethral stricture
- TWOC

Surgical intervention
- IPSS
- TWOC
- IPSS

BPH
- TWOC

Surgery
- TWOC

Chronic constipation
- Treat constipation
- TWOC

Infection
- Treat infection
- TWOC

Previous AUR
- Instruct on IC

Urethral stricture
- Mild 0-7
- TWOC
- Potential placement of SP tube
- WW
- Reassess In 12m

Mod 8-19
- TWOC
- Med Rx
- Reassess 3-6m

Severe >20
- Med Rx
- Fail
- Surgical intervention / instruct on IC

IPSS
- TWOC
- Med Rx
- TWOC
- Fail

Instruct on IC

TWOC

Reassess

Med Rx

Reassess

Surgical intervention

Instruct on IC
Acute urinary retention (AUR)

Catheterization
1-3 days

Causative factors

Urethral stricture
TWOC
Surgical intervention

If unable to insert catheter first, will need surgical intervention then trial of void.
Acute urinary retention (AUR)

Catheterization 1-3 days

Causative factors

Drugs
- Discontinue if possible
- TWOC

Diabetes
- Control DM
- TWOC
- Fail trial of void
- Instruct on IC

Neurological disturbance
- TWOC
- Fail trial of void
- Instruct on IC

Urethral stricture
- TWOC
- IPSS

Surgical intervention

BPH
- IPSS

Surgery

Chronic constipation

Infection

Previous AUR
- Instruct on IC

Infection
- Treat infection
- TWOC

BPH
- IPSS

IPSS

Moderate
- 8-19
- Med Rx
- TWOC
- Reassess 3-6m

Severe
- >20
- Med Rx
- TWOC
- Fail

Surgical intervention / instruct on IC

Mild
- 0-7
- TWOC
- WW
- Reassess In 12m

Potential placement of SP tube

Treat constipation
- TWOC

IPSS

TWOC
Acute urinary retention (AUR)

Catheterization 1-3 days

Causative factors

BPH

IPSS

IPSS

Mild 0-7

Mod 8-19

Severe >20

TWOC

WW

Reassess In 12m

Med Rx

TWOC

Reassess 3-6m

Fail

Surgical intervention / instruct on IC

Prostatectomy

- Previously AUR was considered an absolute indication for TURP
- Associated with ↑ morbidity due to Alpha blockers
  - adding in 10mg OD x 2 fusion names doubles TWOC success
  - Delay of surgery allows bladder to recover its contractility

Watchful waiting / active surveillance

Mild 0-7

TWOC

WW

Reassess In 12m

Mod 8-19

TWOC

Reassess 3-6m

WW

Reassess In 12m

Med Rx

TWOC

Reassess 3-6m

WW

Reassess In 12m

Med Rx

TWOC

Reassess 3-6m
Acute urinary retention (AUR)

Catheterization 1-3 days

Causative factors

Drugs
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Neurological disturbance
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Urethral stricture
- TWOC
- Surgical intervention

BPH

IPSS

Surgery
- TWOC

Chronic constipation
- Treat constipation
- TWOC

Infection
- Treat infection
- TWOC

Previous AUR
- Instruct on IC

IPSS

Mild
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Mod
- 8-19
- Med Rx
- TWOC
- Reassess 3-6m

Severe
- >20
- Med Rx
- TWOC
- Fail

Surgical intervention / instruct on IC
Acute urinary retention (AUR)

Catheterization
1-3 days

Causative factors

Surgery
TWOC
Acute urinary retention (AUR)

Catheterization
1-3 days

Causative factors

Drugs
Discontinue if possible
TWOC

Diabetes
Control DM
TWOC

Neurological disturbance
TWOC

Urethral stricture
TWOC

BPH
IPSS

Surgical intervention
IPSS

Surgery
TWOC

Chronic constipation
Treat constipation
TWOC

Infection
Treat infection
TWOC

Previous AUR
Instruct on IC

Mild
0-7
TWOC

Mod
8-19
Med Rx

Severe
>20
Med Rx

Potential placement of SP tube

Fail trial of void

Instruct on IC

WW
Reassess In 12m

Reassess 3-6m

Fail
Surgical intervention / instruct on IC
Acute urinary retention (AUR)

Catheterization
1-3 days

Causative factors

Chronic constipation
Treat constipation
TWOC
Acute urinary retention (AUR)

Catheterization 1-3 days

Causative factors

Drugs
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Neurological disturbance
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BPH
- IPSS

Surgery
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Chronic constipation
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Infection
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IPSS
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  - TWOC
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  - TWOC
  - Fail

Previous AUR
- Instruct on IC

Surgical intervention / instruct on IC

Med Rx
- Treat

Reassess 3-6m
- Fail
Acute urinary retention (AUR)

Catheterization
1-3 days

Causative factors

Infection
  Treat infection
    TWOC
Acute urinary retention (AUR)

Catheterization
1-3 days

Causative factors

Drugs
Discontinue if possible
TWOC

Diabetes
Control DM
TWOC

Neurological disturbance
TWOC
Fail trial of void
Instruct on IC

Urethral stricture
TWOC
IPSS

BPH
IPSS

Surgical intervention
TWOC

Surgery

Chronic constipation
TWO C

Infection
TWO C

Potential placement of SP tube
TWOC

Urethral stricture
TWOC

BPH

Surgical intervention

IPSS

Mild
0-7
TWOC

Mod
8-19
Med Rx

Severe
>20
Med Rx

Previous AUR

Instruct on IC

TWOC

WW

Reassess
In 12m

Reassess
3-6m

Instruct on IC

Surgical intervention / instruct on IC
Acute urinary retention (AUR)

Catheterization
1-3 days

Causative factors

Previous AUR
Instruct on IC
Prevention

• Predictive risk factors for AUR
  – Age > 70 with LUTS
  – IPSS > 7
  – Flow rate < 12ml/s and / or prostate volume > 40cm²
  – PSA > 1.4ng/ml
  – Symptoms of hesitancy
  – Rx with 5α reductase inhibitors for > 6m has been found to reduce the risk of AUR by 50%

### Table 2

Risk of Acute Urinary Retention (AUR)

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of Patients</th>
<th>History of BPH</th>
<th>Risk of AUR per 1000 PY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physicians</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Health Study*</td>
<td>15,851</td>
<td>No</td>
<td>4.5</td>
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<tr>
<td>Olmsted County</td>
<td></td>
<td></td>
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<tr>
<td>Study†</td>
<td>2115</td>
<td>No</td>
<td>6.8</td>
</tr>
<tr>
<td>PLESS‡§</td>
<td>1376</td>
<td>Yes</td>
<td>18</td>
</tr>
</tbody>
</table>

* Data from Meigs JB et al. *J Urol.* 1999;162:376–382.\(^{39}\)
† Data from Jacobsen SJ et al. *J Urol.* 1997;158:481–487.\(^{3}\)
§ Placebo arm.

BPH, benign prostatic hyperplasia; PY, person-year; PLESS, Proscar Long-Term Efficacy and Safety Study.
END
Post obstructive diuresis management
Definition

• A dramatic increase in urine output after the release of urinary tract obstruction

• Factors necessary are:
  – acc of total body water, Na+ and urea
  – impairment of tubular reabsorptive capability
  – True incidence unknown
Definition

• A high urine output exceeding >200 ml/hr
• 0.5 – 1 L/hour after the obstruction is relieved

• Seen esp in pt with edema, hypertension, weight gain and azotemia
Types

• Physiologic diuresis
• Pathologic diuresis
  – Urea diuresis (U osm > 250)
  – Sodium diuresis (U osm > 250)
  – Water diuresis (U osm <150)
Types

• **Physiologic diuresis** - self limiting – as response to the solute and water overload. Stops after return to euvolemic state.

• **Pathologic diuresis**
  – Inappropriate diuresis of water beyond euvolemic state, due to insensitivity of collecting tubule to ADH and other defects in urinary concentrating ability of the kidney and tubular reabsorption of solutes
  – Self limiting and can be managed easily
Types

• Urea diuresis

  - Is the most common

  🌷 self limiting, lasting 24-48 hours

  - Manage by monitoring fluid balance and electrolytes

  - if not otherwise contraindicated, increase fluid intake should suffice
Types

• **Sodium diuresis**
  - Is the second most common
  - Usually self limiting, lasting >72 hours
  - Manage by monitoring fluid balance and electrolytes more aggressively
Types

• Water diuresis
  - Rare
  - Usually self limiting
    - It is a temporary nephrogenic diabetes insipidus which occurs secondary to impaired renal tubular response to ADH
Pathophysiology

• Derangement of urinary conc. ability

  - Normal urine – hypertonic medullary interstitial gradient because of

    - active salt reabsorption from the thick ascending limb of Henle

    - urea back flux from the inner medullary collecting duct and

    - water permeability of the collecting duct mediated by vasopressin & aquaporin water channels
Pathophysiology

- Obstructive nephropathy can disrupt some or all of these mechanisms and lead to urinary conc.

- The onset of conc. defects may occur soon after obstruction
Evidence

- When urine flow is obstructed, upstream Na delivery to apical cell membranes slows so that the transmembrane gradient is reduced – downregulation of Na transport across the basolateral cell membrane (Ziedel 1993).

- Ischemia – proposed as a signal – reduced perfusion of the kidney with obstruction can reduce transporter expression (Kwon et al. 2000)

- Many investigators have shown that obstruction markedly increases the endogenous production of PGE2 in the medulla. This can produce natriuresis (Strandhoy et al. 1974).
Sodium excretion after release of obstruction

Absolute excretion of sodium

Day 0–Day 1  p<0.05
Day 1–Day 14  p<0.05
Day 14–3 months  N.S.
Insensitivity to ADH
Another aquaporin, **AQUAPORIN 1 (AQP1)** - renal proximal tubules, the thin descending limb of Henle, and the descending vasa recta in the kidney. It promotes urinary concentration through the countercurrent multiplier by facilitating water transport from the descending limb of Henle into the interstitium.
Evidence

- Li and coworkers (2001) demonstrated that the polyuria following release of BUO correlates with deceased expression of AQP water channels AQP1, AQP2 and AQP 3 in rats.

- Jansen et al. (2006) examined changes in water channels after bilateral ureteral obstruction in rats. POD with reduced osm was accompanied by decreased AQP1, AQP2 & AQP3 expression in rats.

- **Dysregulation of AQP water channels** in the prox tubule, thin descending loop and collecting duct contribute to the long term polyuria and impaired concentrating capacity caused by obstruction.
Fluid management

- In the first 24 hours, urine output should be checked hourly.
  - If its over 200mls/hour, then 80% of the hourly output should be replaced intravenously with 0.45% saline

- After 24 hours of persistent diuresis,
  - Total fluids infused should be about 1L less (or 75%) than the previous days output, provided the patient is hemodynamically stable.

- Once the urine output is under 3 L/ day, oral fluids should suffice
Fluid management

- If there are signs of hypovolemia, then total fluids replaced should be about 0.5 L less, instead of 1L, than the last 24 hours’ output.

- Replacement of electrolytes, eg. K and Mg, may be necessary and should be guided by the levels.
Obstruction relieved

Risk factors of POD

Abscent, mentally alert, oral fluids

No POD

POD

Discharge

Oedema, congestive heart failure, hypertension, azotemia

Mentally alert, oral fluids

RP, Na, K daily till diuresis subsides
Risk factors for POD, hypotension, poor cognition

Hypo-osmolar urine is indicative of a primary water diuresis as opposed to solute diuresis

Na, K, Mg, urine osm every 12 hours

Mentally alert
Oral fluids

Poor cognitive function

Hypovolemia, deranged electrolytes

IV below normal maintenance

ICU care

Majority self limiting
Experimental modulation

- Ureteral obstruction
  - Induces expression of COX-2 in collecting duct cells and downregulation of AQP2 receptors is mediated by COX-2.
  - COX-2 inhibitors prevented the downregulation of AQP2 and significantly diminished postobstructive diuresis in rats.
Experimental modulation

- Ureteral obstruction

  - cGMP pathway has been demonstrated in both in vitro and vivo models to allow membrane insertion of AQP2

  - Sildenafil Citrate elevated intracellular cGMP and facilitate the collecting duct accumulation of AQP2.

  - Pharmacological manipulation - beneficial or harmful - unclear
THANK YOU