• 40% of patient visits to a pediatric urologist.
• It affects 15% of 6-year-old children
• Most children present with incontinence (daytime, or nocturnal, or both)
• Some present with recurrent UTI, hematuria, and pain.
• Voiding dysfunction could be an isolated problem or part of a wider neurological disorder.
Background & Epidemiology

• Voiding Dysfunction is the recommended term for various functional lower urinary tract symptoms in children without a neurogenic or anatomic abnormality.
• Incontinence, raises important psychosocial concerns in school-aged children.
• High-pressure voiding may lead to long-term detriment of kidney function.
Bladder function

• Storage
  – Bladder stretches easily as it fills with urine and serves as a low pressure reservoir. It does not contract or increase in pressure as it fills.

• Voiding
  – Bladder (and urethra) provides efficient evacuation mechanism at socially acceptable/convenient intervals.
  – As the bladder contracts during voiding, the external urethral sphincter should completely relax.
Background: Attaining Urinary Control

- Infantile voiding: Reflexive, 20x/day
- Age 6 months: Increased volumes, decreased frequency
- Age 1-2 years: Unconsciously voiding, inhibition
- Age 2-3 years: Awareness of bladder fullness, voluntary voiding/ inhibition
Background: Attaining Urinary Control

• Daytime continence achieved
  - 26% by 24 months
  - 85% by 30 months
  - 98% by 36 months

• Median age of
  - Daytime continence 3.5 years & Night time 4 years
  - Age 5 yrs. 20% bedwet monthly
  - Age 6 yrs. 10% bedwet monthly
  - Age 15 yrs. 1-2% bedwet monthly

• Bedwetting children are mostly male.
Sequence of achieving bladder and bowel control

Nocturnal Bowel Control → Daytime Bowel Control → Daytime Voiding Control → Nighttime Voiding Control
Standardization of terminology
International Children’s Continence Society

• Daytime frequency: Normal 3–7 times daily.
• Relevant in all age groups
  – Straining: external pressure applied on the abdominal wall to initiate and maintain voiding.
  – Weak stream: observed ejection of urine with weak force.
  – Intermittency – Voiding in discrete spurts (considered physiological if not with straining).
• Children >5 years or any age after achieving bladder control
  – Urgency: sudden unexpected experience of an immediate need to void
  – Hesitancy: difficulty initiating a void.
  – Squatting with heel pressed to perineum.
  – Post-micturition dribble: Urine leakage immediately after voiding.
• Holding maneuvers like standing tiptoe, forcibly crossing legs, or squatting.
Diagnostic evaluation

- History
- Physical Examination
- Bladder Diary
- Laboratory Studies
- Imaging
- Urine Flow Measurements
- Urodynamic Evaluation
Diagnostic evaluation: History

• Majority of diagnostic evaluation is careful history
  – Onset, pattern, severity
  – Circumstances in which incontinence occurs
  – Interview parent and child

• Voiding history
  – Wet day and night?
    • Daytime wetting only during naps?
  – Daytime:
    • Wet before or after using toilet?
    • Wet without effort to use toilet?
    • Child aware of wetting?
    • Dribble immediately post-void?
    • Truly always wet?
    • Use of toilet at school/away from home?
    • Rush to use toilet? Dance/squirm? Vincent’s curtsey?
    • Void with unusual frequency?
Diagnostic evaluation: History

• Storage symptoms
  – Frequency, incontinence, urgency, nocturia

• Voiding Symptoms
  – Hesitancy, straining, weak stream, intermittency

• Other symptoms
  – Holding maneuvers, incomplete emptying, PM dribble, genital and lower urinary tract pain, history of UTI

• Bowel history
  – Constipated until proven otherwise

• Psychosocial history
  – Possibility of sexual abuse

• Family history
## Elimination Diary - Record Volume or Description

<table>
<thead>
<tr>
<th>Day of week:</th>
<th>Day of week:</th>
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<tbody>
<tr>
<td>Time</td>
<td>Drink</td>
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<tr>
<td>5 am</td>
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<td>10 pm</td>
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</tbody>
</table>

Pee accidents: ☐ Yes ☐ No

Poop accidents: ☐ Yes ☐ No

Dry Night: ☐ Yes ☐ No

Any pee dance/running to bathroom?: ☐ Yes ☐ No

---

Please mark stool consistency based on Bristol Stool Chart (see reverse side)

UKHealthCare
Kentucky Children’s Hospital
Types 1 and 2 indicate constipation

Types 3 and 4 are the easiest to pass

Types 5-6 may indicate diarrhea
Diagnostic evaluation: physical exam

• Abdominal exam
  – Distended bladder
• Genital exam
  – Epispadias/bifid clitoris
  – Vaginal pooling of urine
  – Labial adhesions/erythema
  – Skin excoriation
  – Signs of abuse
• Back exam
• Rectal exam
  – Asymmetric gluteal fold
• Neurologic exam
  – DTRs, LE strength/sensation, gait
Diagnostic evaluation: Laboratory

• UA microscopy and culture
• Consider
  – Renal functions
  – Urinary Ca:Cr
  – 24 hour urine
Diagnostic evaluation: Imaging
Diagnostic evaluation: Imaging

- Other imaging studies
  - Spine sonogram (infants only)
  - Spine MRI
  - Brain MRI
  - Nuclear renogram
    - DMSA
    - MAG3
Diagnostic evaluation

**Uroflow + EMG**

**Urodynamics**
INCONTINENCE DURING FILLING
Overactive Bladder

- Most common disorder in children
- Peak 5 – 7 years
- Slightly higher in girls

- Delay in cortical inhibition of detrusor contractions perceived by child as urgency
- Prompts pelvic floor contraction & holding maneuvers (leg crossing, ext. urethral compression)
- Detrusor contraction against sphincter leads to hypertrophy perpetuating OAB
- Small functional bladder capacity

- Symptoms
  - Frequency, urgency, small voids, nocturnal enuresis
  - Constipation and fecal retention
  - Predisposition for UTI, acquired VUR

- Therapy
  - Pharmacologic (Oxybutynin, Tolterodine)
  - Voiding regimen
  - Bowel management
  - Biofeedback/Neuromodulation
Giggle Incontinence (Enuresis Risoria)

- Unknown etiology
  - Cataplexy: Laughter induced hypotonia
  - Overactivity component
  - Centrally mediated: spontaneous activation of pontine micturition center

- Urodynamics may show uninhibited contractions

- Anticholinergics and sympathomimetics

- Methylphenidate (80% complete resolution)

- Massive unexpected detrusor contraction
- Complete bladder emptying: cannot stop once flow starts.
- Normal urinalysis
- Upper urinary tracts unaffected

Normal urinalysis
Upper urinary tracts unaffected
Stress Incontinence

• Sphincteric incontinence (similar to adult women) induced by jumping, running.

• Affected
  – adolescents usually athletes
  – Also girls with obesity or with
  – Cystic fibrosis and respiratory conditions

• Volume is usually minimal
• Normal urinalysis
• Upper tracts & bladder normal by imaging and urodynamics

• Managed by
  – Timely voiding prior to activity
  – Occasionally improved with sympathomimetics
  – Possible surgery including bulking agents or suspensions (adults)
Post Micturition

Dribbling

Vaginal Voiding

- Post void incontinence
- Few drops to moderate volumes within 10 minutes after voiding
- Typically in girls
  - short stature,
  - obesity,
  - hypospadiac meatus,
  - labial adhesions

- Often misdiagnosed as vulvovaginitis
- Careful history
- PE: labiovulvar erythema or leukorrhea
  - Burning, itching, skin excoriation can mimic dysuria
- Suspicion for UTI mandates catheterized urine
- Treated by correction of voiding posture
  - Spread-leg voiding
  - Reverse-leg voiding
Extraordinary Daytime Urinary Frequency

- Sudden onset of daytime urgency and frequency
- NO dysuria
- NO incontinence
- NO enuresis

- Diagnosed by history
- Urinalysis normal
- Imaging not indicated

- Self-limited
- May recur (3%)

- Treatment
  - Anticholinergics ineffective
  - Dietary irritants management
  - Reassurance is the mainstay of treatment
Introduced by Koff in 1998, including infrequent and inefficient voiding, detrusor overactivity, constipation, and recurrent UTIs

DYSFUNCTIONAL ELIMINATION SYNDROMES
Dysfunctional Voiding

• Abnormal voiding pattern due to contraction of the urethral sphincter during voiding.

• *Dysfunctional voiding should not be used interchangeably with voiding dysfunction*

• A consequence of a lack of coordination between the detrusor and external sphincter.

• OAB and dysfunctional voiding are somewhat artificial distinction, often combined and difficult to separate.

• It is a learned response to a long-standing history of detrusor overactivity, during which the child has developed the ability to control urge by reinforcement of external sphincter and pelvic floor musculature.

• Uroflowmetry: stacatto pattern (w EMG activation)

• Urodynamic confirmation
• Incomplete bladder emptying $\rightarrow$ post-micturition residues $\rightarrow$ urinary stasis and infections $\rightarrow$ inflammatory changes in the bladder wall $\rightarrow$ exacerbate detrusor overactivity.

• Functional bladder outlet obstruction $\rightarrow$ bladder wall hypertrophy, trabeculations $\rightarrow$ high intravesical voiding pressures.

• At a more severe stage, voiding dysfunction evolve into fractionated voiding $\rightarrow$ ineffective and unsustained detrusor contractions $\rightarrow$ progressive increase of bladder capacity $\rightarrow$ incomplete emptying
Bladder Bowel dysfunction association

• The association between bladder dysfunction and VUR remains incompletely understood.
  – In infants, one may speculate on common embryological ureteric abnormality causing high-grade reflux and bladder dysfunction.
  – In older children, it is hypothesized that VUR appears secondary to high filling pressure.

• Functional constipation and fecal incontinence are
  – 20% of children at school age.
  – Constipation causes mechanical obstruction and bladder compression inducing detrusor instability.
  – Bowel dysfunction is associated with VUR, UTIs, breakthrough infections, renal scars.
Voiding Postponement (Dysfunctional Elimination Syndrome)

- Habitual postponement of voiding
  - May delay first morning void
  - Holding maneuvers
  - May decrease fluid intake to increase voiding intervals

- Present with
  - UTI, asymptomatic bacteruria
  - Incontinence, significant urgency
  - May have psychological comorbidity or behavioral disturbances
  - Often have concomitant constipation
  - Association with VUR and its treatments

- Four-point plan
  - Strict timed voiding
  - Aggressive treatment of constipation
  - Possible psychiatric/psychologic involvement
  - Significant reinforcement required
Underactive Bladder

- Decreased desire to void. Intervals of 8-12 hours
- Frequent bladder infections
- Constipation usually present

- Poor urinary stream
- Incomplete emptying
- Large, smooth-walled, non-thickened bladder
- Upper tract dilation

- UDS demonstrates large capacity, hypotonic bladder, no outflow obstruction

- Management
  - Bowel cleanout/bowel regimen
  - Timed voiding/Double/Triple voiding
  - CIC
  - α-blockers
Myogenic Detrusor Failure

- End-stage bladder decompensation
- Seen in:
  - Neurogenic bladder
  - Hinman’s syndrome
  - Posterior Urethral Valve
- High post-void residuals
- Recurrent UTIs
- Dilated upper tracts

- Treatment
  - α-blockers,
  - CIC
NON NEUROGENIC NEUROGENIC BLADDER
Non-neurogenic neurogenic bladder

- NNNB represents the most severe end of the spectrum of bladder dysfunction.
- First reported by Beer (1915): children with bladders behaving like neurogenic bladders, without evidence for neurological disease.
- Hinman (1973) established a relationship between functional neurological bladders and psychological profile, and reported successful treatment by suggestive therapy, hypnosis, behavioral modification and sphincteric physiotherapy measures.
- Allen (1977) demonstrated evidence of acquired severe detrusor sphincter uncoordination.
Hinman’s Syndrome (non-neurogenic neurogenic bladder, occult neurogenic bladder, subclinical neurogenic bladder)

- Dyscoordinated voiding
- NO neurologic disease
- NO bladder outlet obstruction
- Acquired condition, occurring after the age of toilet training
- Mostly boys

- Day-&-night wetting
- Significant behavioural issues, with frequent anxiety, depression

- Cystogram: Christmas tree bladder
- Upper tract: hydroureteronephrosis.

- Urodynamics: overactive poorly compliant bladder, detrusor sphincter dyssynergia, weak flow rates and considerable post-void residuals.

- Treatment
  - Clean intermittent catheterization to preserve upper urinary tract/renal function
  - Bladder retraining: biofeedback
  - Botulinum-a injection
  - Neuromodulation
Behavioral therapy

• One of the mainstays of treatment
• Avoid bladder irritants like coffee or soda
• Timed voiding (every 2 h)
  – Improves 1/3 of children with overactive bladder, urge incontinence, and dysfunctional voiding.
• For MNE, behavior modification encompasses avoiding bladder irritants + wetting alarm.
  – Alarm aims to awaken child before the bladder is empty.
  – With time, child responds faster &
  – Ultimately, child responds to the full bladder.
  – To be effective, it requires at least 15 weeks of use.
Biofeedback

- Relies on creating a conscious realization of activity of pelvic floor muscles and training the child to relax these muscles during detrusor contraction.
- Real time monitoring of uroflow and EMG activity,
- Children can
  - identify dysfunctional sphincter/pelvic floor muscle contraction.
  - avoid these contractions by actively relaxing these muscles.
- Needs enthusiasm from the child.
- Sustained improvement in the long term.
Bowel management

• Bowel management should be part of any treatment strategy.
• The aim of treatment is
  – evacuate any existing impaction of stool in the colon and
  – maintain regular painless bowel movements with soft stools.
• The initial evacuation is performed by a combination of oral laxatives and rectal enemas.
• Regular soft bowel movements are achieved by diet modifications (supplemental fiber) & oral laxatives.
Pharmacotherapy

• Anticholinergics
  – Decreases detrusor overactivity & increase functional bladder capacity
  – Treats urgency and urge incontinence.
  – Can be used intravesically in children with neurogenic bladders.
  – Combination of anticholinergics and behavioral modification is more efficacious than either treatment alone.

• Alpha-adrenergic antagonists
  – With increased bladder outlet resistance due to primary bladder neck dysfunction.
    • Delayed bladder neck opening.
    • Videourodynamics: incomplete bladder neck funneling, elevated PVR, and silent EMG.
  – Improved flow rates, decreased PVR and symptom relief.
Pharmacotherapy

• **Desmopressin**
  - Synthetic ADH analogue
  - Decreases the amount of urine made after intake.
  - Treatment for 3–6 months then slowly weaned to assess treatment result.
  - 25% achieved complete dryness
  - 10–90% achieved significant reduction of wet nights.
  - Relapse rates are high.
  - Combination of behavioral therapy with desmopressin improves results
  - Side effects uncommon. Behavioral changes & nightmares reported.

• **Tricyclic antidepressants**
  - Acts centrally by altering sleep cycles and possibly stimulating pituitary secretion of ADH and locally with anticholinergic effects.
  - Effective in nocturnal enuresis
  - Evidence lacking for daytime voiding dysfunction.
  - Side effects include dry mouth, insomnia, arrhythmia, and personality changes.
Management of voiding dysfunction

- **Botulinum toxin**
  - Injection into the detrusor at the bladder base or the external sphincter.
  - Improvement in detrusor overactivity, continence, PVR, and UTI.

- **Clean Intermittent Catheterization**
  - In children with high residual volumes leading to recurrent UTI.
  - CIC can assure bladder emptying, decrease UTI, and regain continence.

- **Surgical Management**
  - Children with extremes of voiding dysfunction with resultant high pressure bladder and outlet obstruction with or without upper tract reflux may require bladder augmentation with or without a bladder outflow procedure.
NOCTURNAL ENURESIS
Epidemiology

• Nocturnal enuresis affects 5–7 million American children.
• ICCS nomenclature:
  – Nocturnal enuresis may be divided into

  - **Monosymptomatic** (isolated nocturnal enuresis)
  - **Non-monosymptomatic (complicated)** 20% symptoms: frequency, urgency & daytime

  - **Primary** (80%) never dry at night
  - **Secondary** Previously dry
Abnormal rhythm of vasopressin and urinary production in PNE

Dry children

Children with enuresis

Detrusor activity in enuresis patients

* = voiding

**Dry children**

*Some enuretic children*

*Other enuretic children*
Night-time Polyuria

Night-time overactive bladder

Difficult arousal

Waking up
Prevalence of nocturnal enuresis

Severe Bedwetting is Persistent

50% of Adolescent Bedwetting are Severe Cases

Yeung et al. BJU Int 2006; 97: 1069-1073
Parental history

- 77% risk where both parents had enuresis as a child
- 43% risk where only one parent had enuresis as a child
- 15% risk where there is no parental history of enuresis
- 40% siblings also had MNE
Treatment options

• Desmopressin 0.2mg up to 0.6 (79% success)
• Anticholinergics
  – Oxybutynin
  – Tolteridine
• Bedwetting alarm
• Combination treatment
  – Desmopressin + oxybutynin (Significant better results)
  – Alarm + desmopressin
Bedwetting alarm

• Enuresis alarm
  – 13 x more chance to become dry
  – 65-70% success after 5-12 weeks
  – Drop out 0-29%
  – Recurrence 29-69%

– Conclusion: big efforts + no direct effect
Nighttime Polyuria

Nighttime overactive bladder

Difficult arousal

Waking up

Desmopressin

Anticholinergics

Full Spectrum (+ alarm)

(+ alarm)
Some “rules”

Nocturnal enuresis
Is NOT a disease
It is a condition and a symptom!

No Magic pill or quick treatment
ICI Recommendations for the Treatment of Bedwetting

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Level of evidence</th>
<th>Grade of recommendation</th>
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<tbody>
<tr>
<td><strong>Pharmacological treatments</strong></td>
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<tr>
<td>Antidiuretics (desmopressin)</td>
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<tr>
<td>Desmopressin + alarm combination</td>
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<tr>
<td>Tricyclic antidepressants</td>
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<td>No more effective than alarm treatment alone</td>
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THANK YOU