Tabriz University of Medical Sciences

Research center for EBM

Urodynamics & LUTs

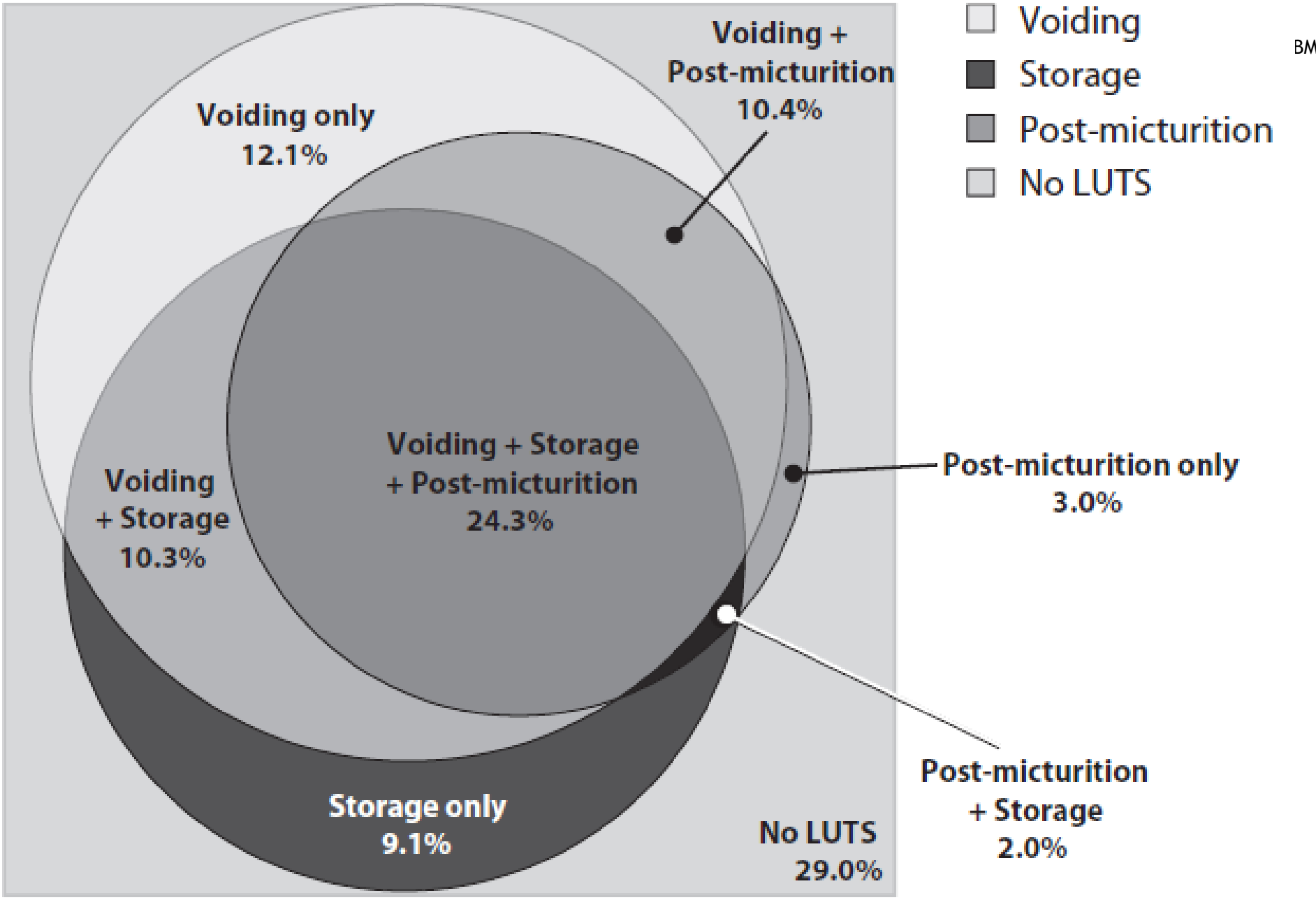
Sakineh Hajebrahimi, MD

Professor of Urology &Neurourology Department, Research center for EBM, TUMS, Tabriz, Iran

Classification of LUTS

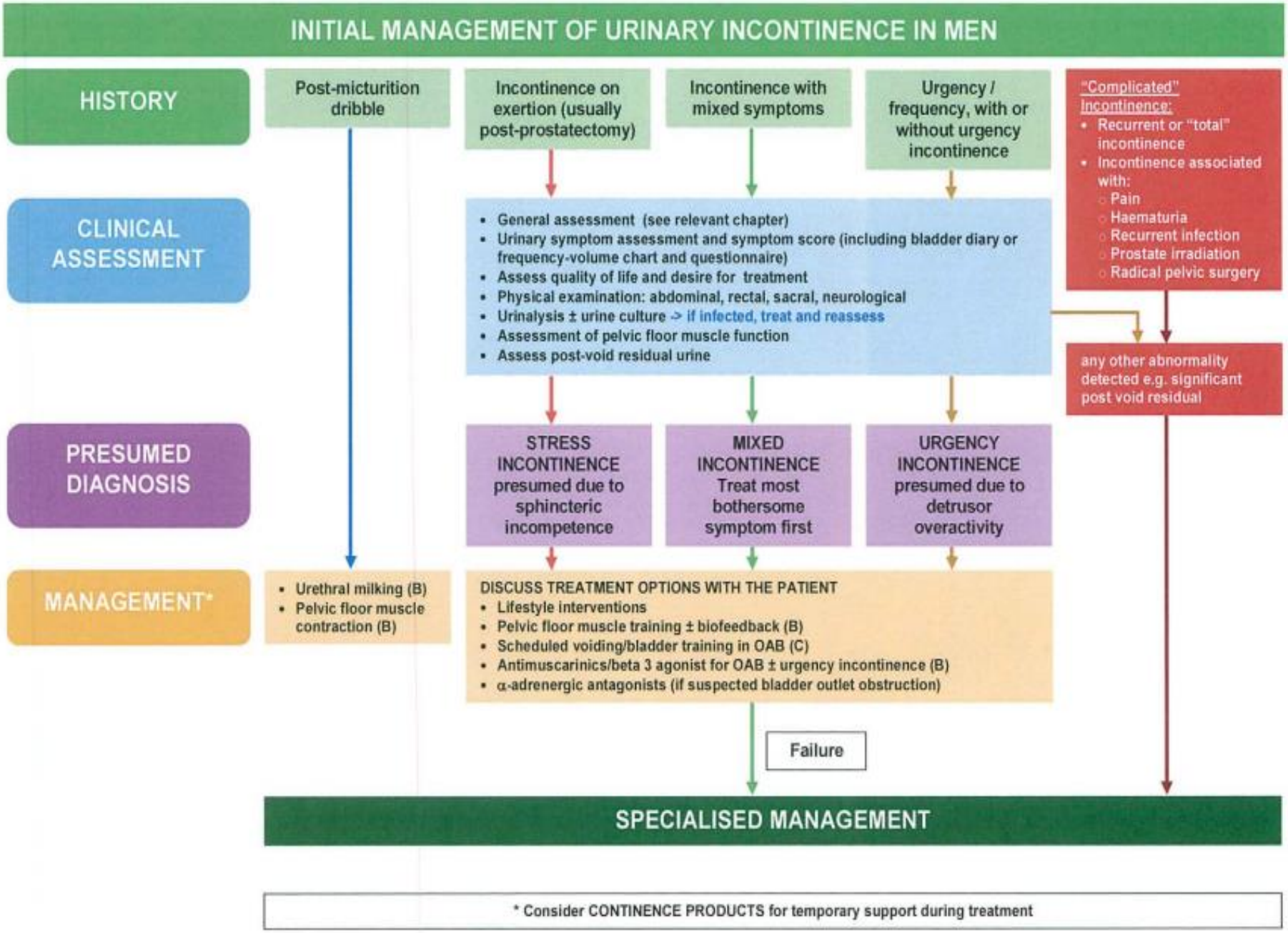
Storage	Voiding	Post-micturition
• Urgency • Urinary incontinence • Increased day-time frequency • Nocturia	• Slow stream •Splitting/spraying • Intermittency • Hesitancy • Straining • Terminal dribbling	• Post-micturition dribbling • Feeling of incomplete emptying

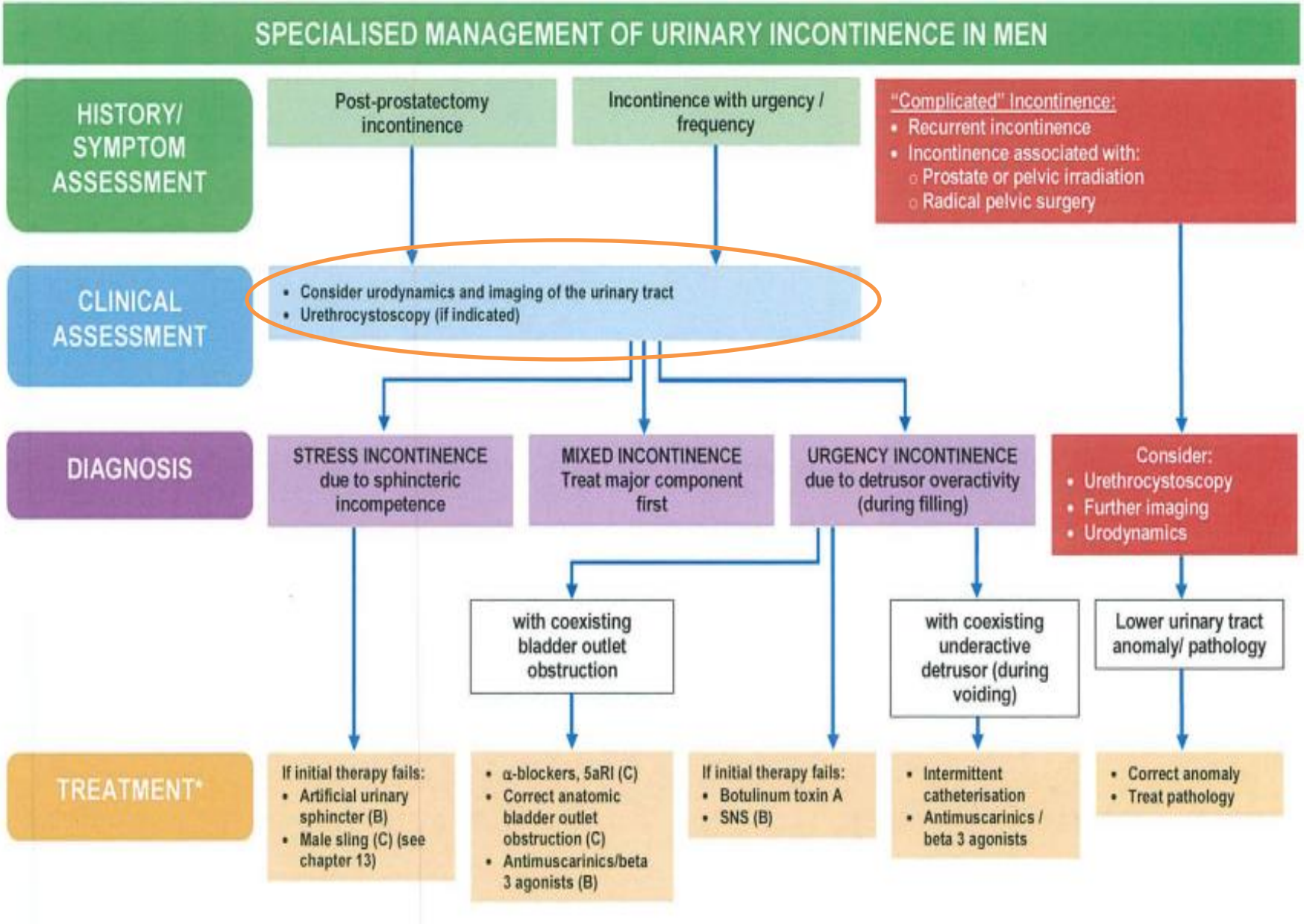
Abrams P et al. *Neurourol Urodyn* 2002;21:167–78



Sexton CC et al. BJUI 2009; 103 (Suppl 3): 12-23

INITIAL MANAGEMENT OF URINARY INCONTINENCE IN MEN




SPECIALISED MANAGEMENT OF URINARY INCONTINENCE IN MEN
HISTORY/ SYMPTOM ASSESSMENT
Post-prostatectomy incontinence
Incontinence with urgency / frequency
"Complicated" Incontinence:
• Recurrent incontinence
• Incontinence associated with:
o Prostate or pelvic irradiation
o Radical pelvic surgery
CLINICAL ASSESSMENT
• Consider urodynamics and imaging of the urinary tract
• Urethrocystoscopy (if indicated)
DIAGNOSIS
STRESS INCONTINENCE due to sphincteric incompetence
MIXED INCONTINENCE Treat major component first
URGENCY INCONTINENCE due to detrusor overactivity (during filling)
Consider:
• Urethrocystoscopy
• Further imaging
• Urodynamics
with coexisting bladder outlet obstruction
with coexisting underactive detrusor (during voiding)
Lower urinary tract anomaly/ pathology
TREATMENT*
If initial therapy fails:
• Artificial urinary sphincter (B)
• Male sling (C) (see chapter 13)
• α-blockers, 5aRI (C)
• Correct anatomic bladder outlet obstruction (C)
• Antimuscarinics/beta 3 agonists (B)
If initial therapy fails:
• Botulinum toxin A
• SNS (B)
• Intermittent catheterisation
• Antimuscarinics / beta 3 agonists
• Correct anomaly
• Treat pathology

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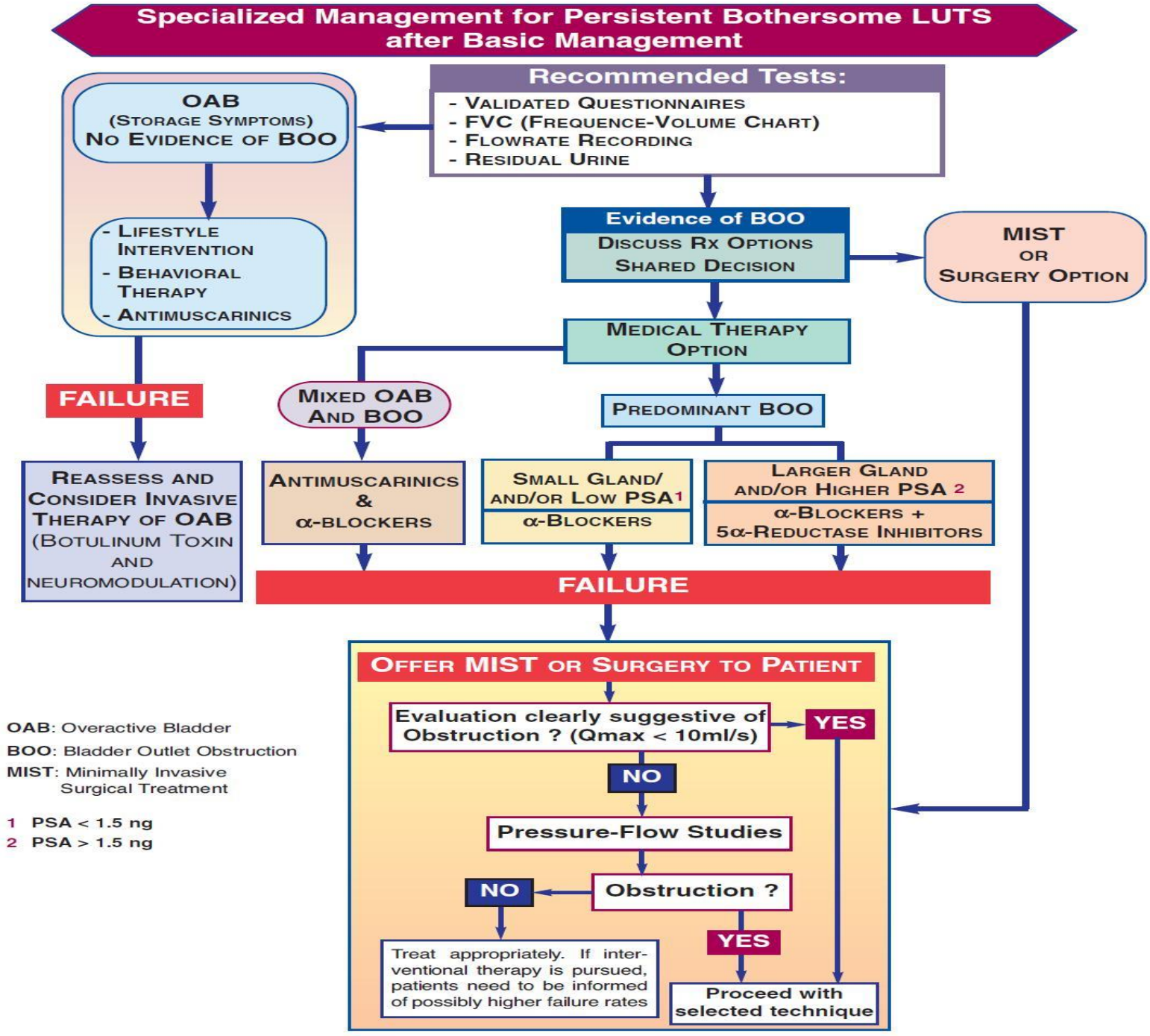


Urodynamic Studies

Evidence summary	LE
Frequency volume charts of 3-7 days duration are a reliable tool for the objective measurement of mean voided volume, daytime and night-time frequency and incontinence episode frequency.	2b
Frequency volume charts are sensitive to change and are a reliable measure of outcome.	2b

Recommendations	GR
Use a frequency volume chart to evaluate co-existing storage and voiding dysfunction in patients with urinary incontinence.	A
Use a diary duration of between 3 and 7 days.	B

Types of voiding diaries

- ***Micturition time chart:*** records only the times of micturitions, D&N, ≥ 24 hrs.
- ***Frequency volume chart (FVC):*** this records the volume and time of each micturition, D&N, ≥ 24 hrs.
- ***Bladder diary:*** records the times of micturitions and voided volumes, incontinence episodes, pad usage and other information e.g. fluid intake, degree of urgency, degree of incontinence.

ثبت روزانه فعالیت مثانه

لطفا برای سه روز مقدار نوشیدنی خود و هنگامیکه دفع ادرار دارید، مقدار ادراری که تولید کرده اید ونیز اینکه آیا نیاز فوری برای دفع ادرار داشتید و تعداد دفعات رخ دادن بی اختیاری را ثبت کنید. از همکاری شما متشکریم.

	زمان حجم روزانه	ساعت خواب	شبانه	اتفاقات
روز اول				
روز دوم				
روز سوم				

مثال:

روز اول	6:30 8 9:30 1 لیوان 1/2 1/4	12	2 3:30 5 1 1/4 1/2	2 بار بی اختیاری ادرار در روز

BLADDER DIARY

NAME:_____

Please complete this **3 day** bladder diary. Enter the following in each column against the time. You can change the specified times if you need to.

1. Drinks
Write the amount you had to drink and the type of drink you had.

2. Urine output
Enter the amount of urine you passed in millilitres (mls) in the urine output column, day and night. Any measuring jug will do. If you passed urine but couldn't measure it, put a tick in the urine output column.
If you leaked urine at any time write **LEAK** in the urine output column.

3. Bladder sensation
Write a description of how your bladder felt when you went to the toilet using the codes listed at the bottom of the page.

4. Write **BED** when you went to bed and **WOKE** when you woke up in the time column.

Here is an example of how to complete the diary:

Time	Drinks		Urine Output (mls)	Bladder sensation
	Amount	Type		
6am WOKE			350ml	2
7am	Cup	Tea		
8am			✓	
9am				
10am	300ml	Water	Leak	
11am			Leak	3

DAY 1 DATE: ____/____/_____

Time	Drinks		Urine Output (mls)	Bladder sensation
	Amount	Type		
6am				
7am				
8am				
9am				
10am				
11am				
Midday				
1pm				
2pm				
3pm				
4pm				
5pm				
6pm				
7pm				
8pm				
9pm				
10pm				
11pm				
Midnight				
1am				
2am				
3am				
4am				
5am				

DAY 2 DATE: ____/____/_____

Time	Drinks		Urine Output (mls)	Bladder sensation
	Amount	Type		
6am				
7am				
8am				
9am				
10am				
11am				
Midday				
1pm				
2pm				
3pm				
4pm				
5pm				
6pm				
7pm				
8pm				
9pm				
10pm				
11pm				
Midnight				
1am				
2am				
3am				
4am				
5am				

DAY 3 DATE: ____/____/_____

Time	Drinks		Urine output (mls)	Bladder sensation
	Amount	Type		
6am				
7am				
8am				
9am				
10am				
11am				
Midday				
1pm				
2pm				
3pm				
4pm				
5pm				
6pm				
7pm				
8pm				
9pm				
10pm				
11pm				
Midnight				
1am				
2am				
3am				
4am				
5am				

Bladder sensation codes

0 - if you had no sensation of needing to pass urine, but passed urine for "social reasons", for example, just before going out, or unsure where the next toilet is.
1 - if you had a normal desire to pass urine and no urgency. Urgency is different from normal bladder feelings and is the sudden compelling desire to pass urine which is difficult to defer, or a sudden feeling that you need to pass urine and if you don't you will have an accident.
2 - if you had urgency but it passed away before you had to visit the toilet.
3 - if you had urgency but managed to get to the toilet, still with urgency but did not leak urine.
4 - if you had urgency and could not get to the toilet in time so you leaked urine.

0 - did not need to go, went just in case
1 – normal desire to pass urine
2 – had urgency but it passed away
3 – had urgency but got to the toilet before leaking
4 – had urgency and leaked

EBM

Introduction

- Urodynamics is the general term for the study of the storage and voiding function/dysfunction of the lower urinary tract.
- It is crucial that the UDS reproduce the patient's presenting symptoms.

UDS Armamentarium

- ***Noninvasive UDS:***
  - Uroflowmetry
  - Post-void residuals (PVR)
- ***Invasive UDS:***
  - Filling Cystometry
  - Pressure-flow micturition studies
  - Electrophysiological studies
  - Urethral pressure studies
  - Video-urodynamic studies

Uroflowmetry

- Non invasive study
- An estimate of effectiveness of the act of voiding along with PVR.
- Influenced by
  - effectiveness of detrusor contraction
  - completeness of sphincteric relaxation
  - patency of the urethra

Uroflowmetry(cont.)

- Recorded variables during uroflowmetry study:

-flow pattern

-voided volume

-maximum flow rate(Q max)

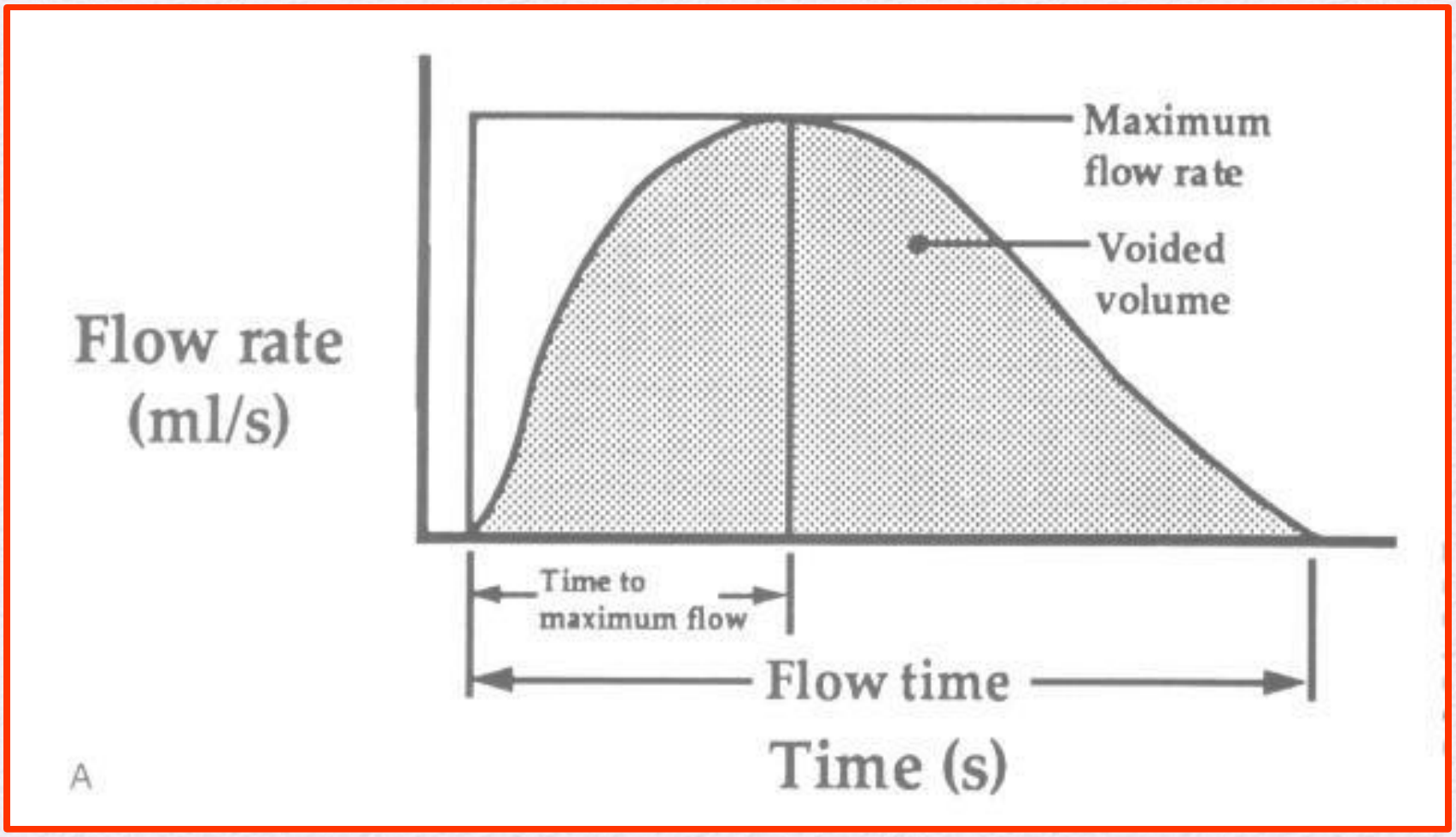
-flow time

-average flow rate(Q mean)

-time to maximum flow

-voiding time

-hesitancy


Maximum
flow rate
Voided
volume
Flow rate
(ml/s)
Time to
maximum flow
Flow time
Time (s)
A

Uroflowmetry(cont.)

- Optimal voids 200 to 400cc
- voids < 150cc are difficult to interpret.
- Pt should be well hydrated with full bladder, but not overly distended bladder.
- study should be performed in privacy and pt encouraged to void in his normal fashion.
- voided volume, pt's position, method of bladder filling, and type of fluid should be recorded.

Figure 1.
Model flow.

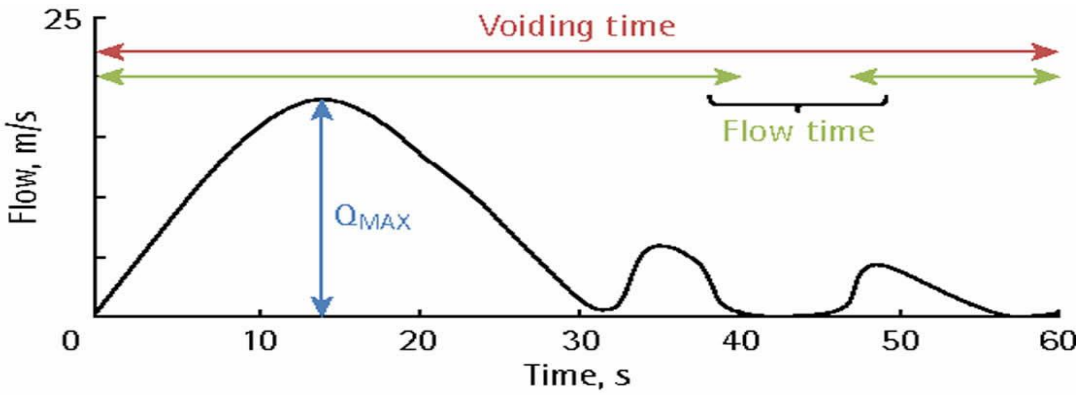
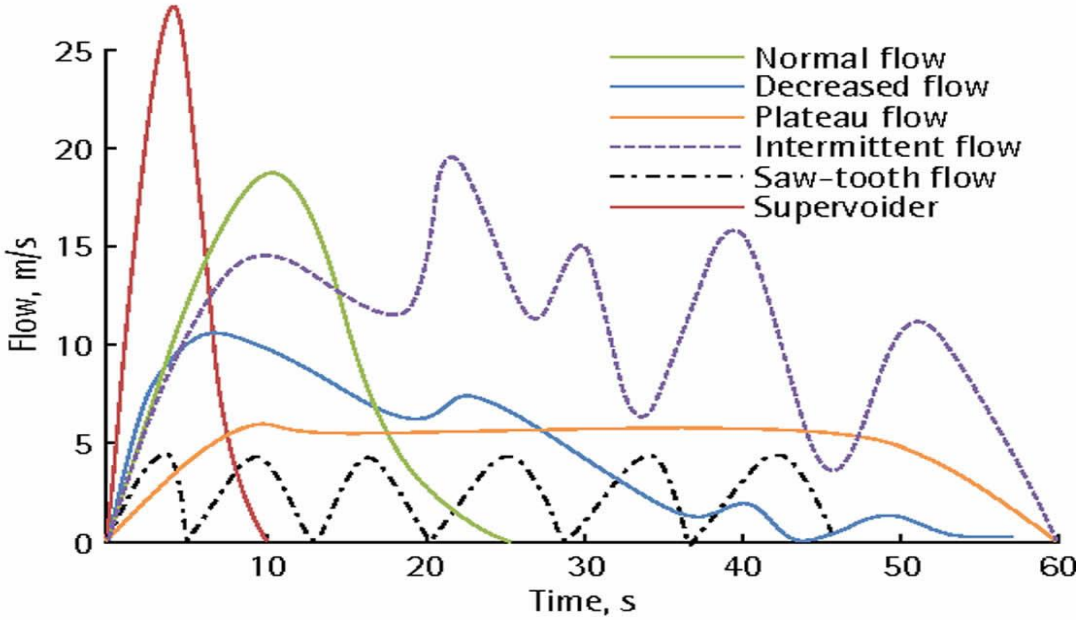


Figure 2.
Common flow patterns.



Flow rate (Q): Volume of fluid expelled via the urethra per unit time (mL/s).
Voided volume (V_{void}): Total volume expelled via the urethra (mL).

Uroflowmetry(cont.)

- Max flow rate and shape of the curve are more reliable indicators of BOO.
- Q max is the most reliable variable in detecting abnormal voiding, and influenced by several factors:

  -age & sex: decreases with age in men.

  -chance: multiple trials increases accuracy.

  -volume of voided urine: 150 cc or more.

Uroflowmetry(cont.)

- Uroflow and BOO:

- In general the test alone is insufficient to diagnose BOO.

- Qmax < 12cc/s…a good indicator for obstruction.

Invasive UDS

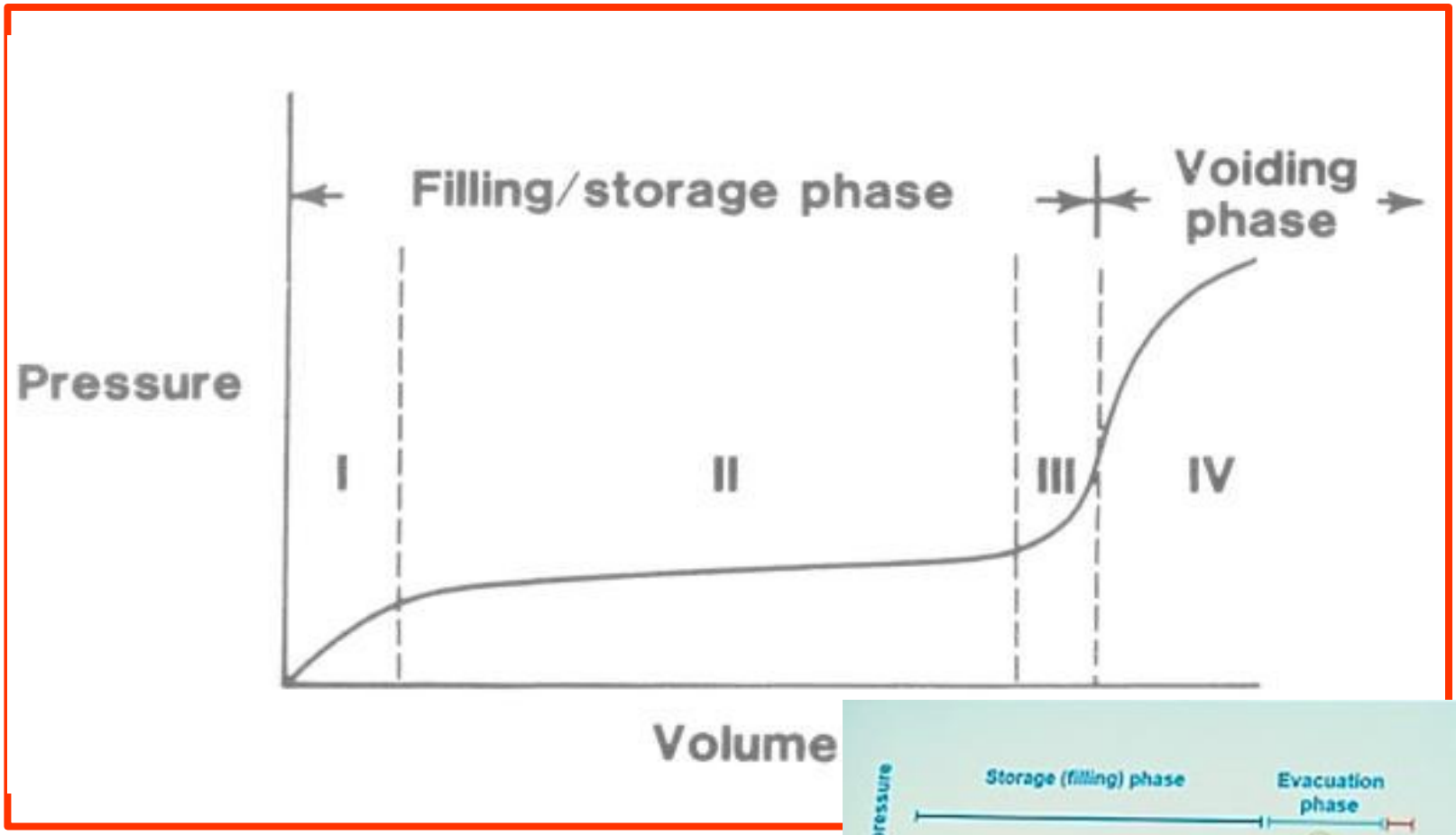
Clinical role

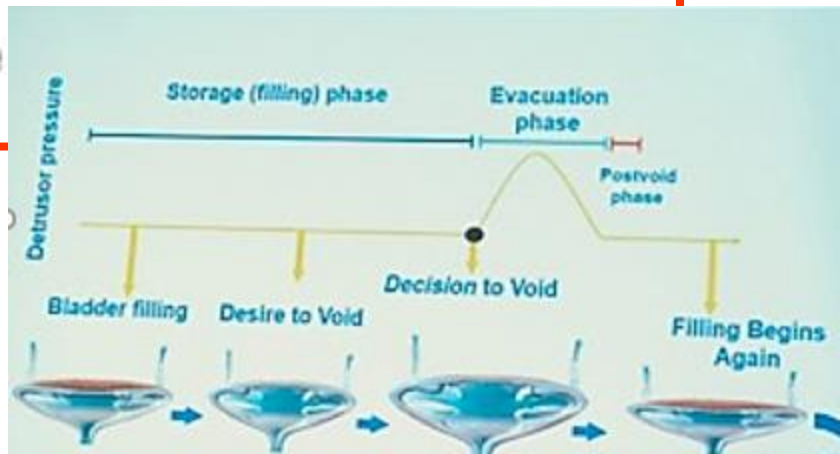
- Characterization of detrusor function
- Evaluation of bladder outlet
- Evaluation of voiding function
- Diagnosis and characterization of neuropathy.

Possible detrusor and urethral activity during storage and voiding

Storage phase				Voiding phase			
Detrusor		Urethra		Detrusor		Urethra	
Underactive	Active	Underactive	Active	Underactive	Active	Underactive	Active
Normal	Abnormal	Abnormal (incompetent)	Normal	Abnormal	Normal	Normal	Abnormal (obstructive)
Bladder relaxation to allow filling	Detrusor overactivity, often associated with OAB* and urgency incontinence	Associated with stress incontinence	Maintains continence	Hypocontractile or acontractile bladder. Associated with chronic detrusor muscle damage or abnormal neurology	Contraction allows forceful expulsion of urine	Opening of urethra allows voiding with minimal resistance from the urethra	Overactive urethral sphincter may be associated with abnormal neurology. Prostatic BOO** increases outlet resistance

Phases of cystometrogram





The 9 "C's" of Pressure-Flow Urodynamics

Filling and storage

Contractions (involuntary detrusor)

Compliance

Coarse sensation

Continence

Cystometric capacity

Emptying Contractility

Complete emptying

Coordination

Clinical obstruction

- Detrusor overactivity
  - Is a UDS observation characterized by involuntary ***detrusor*** contractions during the filling phase which may be spontaneous or provoked
- Neurogenic detrusor overactivity
  - Detrusor overactivity accompanied by a neurologic condition.
  - This term replaces detrusor hyperreflexia

Cystometry(cont.)

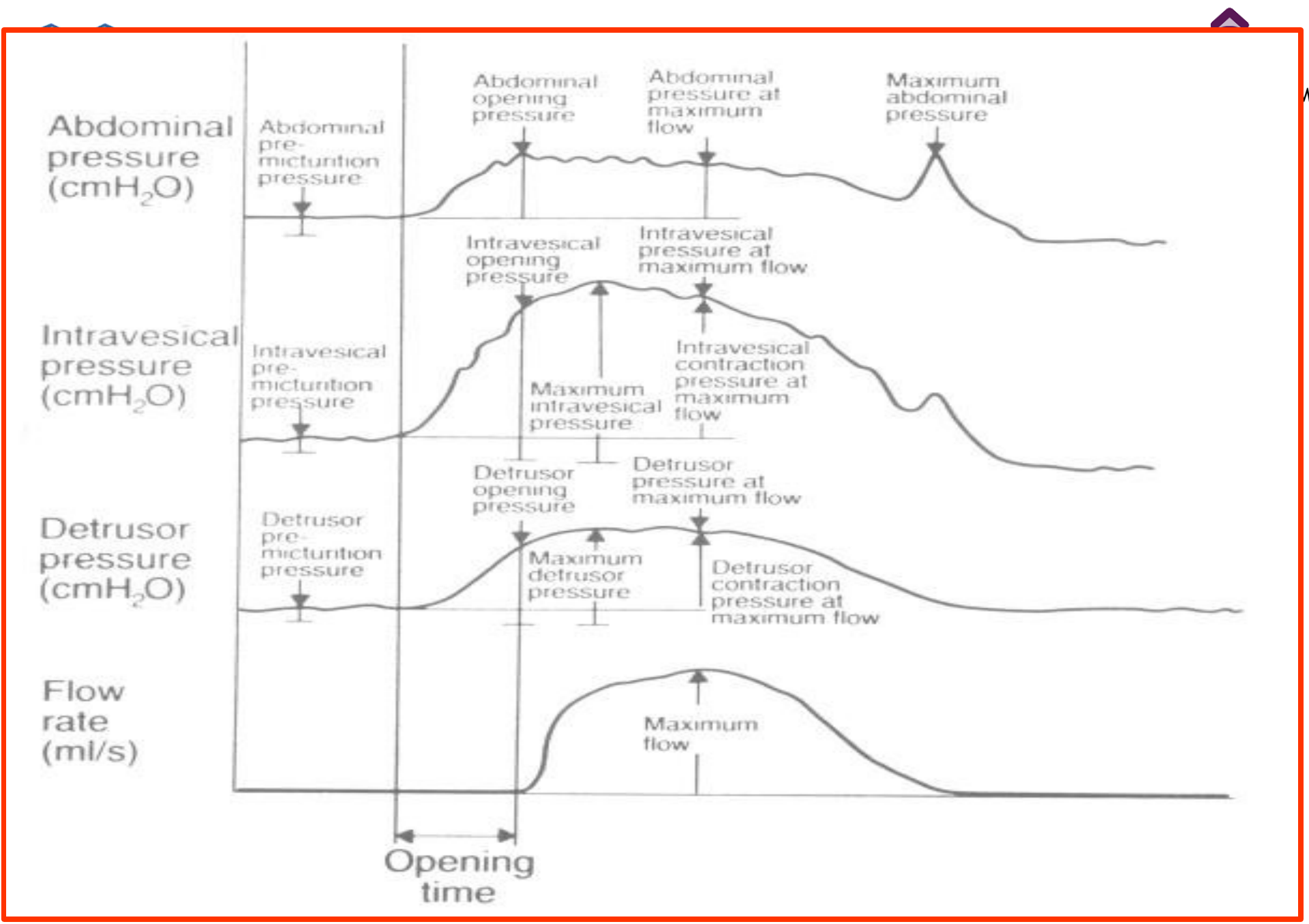
- Measurements via cystometry:
  - Bladder capacity
  - Sensation
  - Compliance
  - Detrusor stability

Pressure Flow Studies

- Simultaneous measurement of bladder pressure and flow rate throughout the micturation cycle.
- The best method of quantitatively analyzing voiding function.
- Access to bladder via transurethral or s/p.

PFS(cont.)

- Detrusor opening pressure > 80cm may indicate outflow obstruction.
- detrusor pressure at Qmax > 100cm implies outlet obstruction even if flow rate is normal.
- No consensus regarding critical value for pressure and flow that is diagnostic for obstruction.
- Pdet = Pves – Pabd
- Normal male generally voids with Pdet 40-60 cmH2O, and woman with lower pressure.
- Pdet more accurately measures bladder wall contractions.


Abdominal pressure (cmH_2O)
Abdominal pre-micturition pressure
Abdominal opening pressure
Abdominal pressure at maximum flow
Maximum abdominal pressure
Intravesical pressure (cmH_2O)
Intravesical pre-micturition pressure
Intravesical opening pressure
Maximum intravesical pressure
Intravesical pressure at maximum flow
Intravesical contraction pressure at maximum flow
Detrusor pressure (cmH_2O)
Detrusor pre-micturition pressure
Detrusor opening pressure
Maximum detrusor pressure
Detrusor pressure at maximum flow
Detrusor contraction pressure at maximum flow
Flow rate (ml/s)
Maximum flow
Opening time

PFS(cont.)

- Role of pressure-flow studies:

- to differentiate between pts. with a low Q max sec. to obstruction, from those sec. to poor contractility.

- Identify pts. with normal flow rates but high pressure obstruction.

PFS(cont.)

Indications for pressure-flowstudies:

-LUTS in pt with hx of neurologic disease (CVA, Parkinson's).

-LUTS with normal flow rates (Qmax > 15cc/min).

-younger men with LUTS.

-men in whom LUTS are suggestive of bladder instability rather than flow disorder.

- men with little endoscopic evidence of prostate occlusion.

PFS(cont.)

- Pressure-flow plots:

- Many models available.

1-Abrams-Griffiths number.

2- ICS provisional nomogram

PFS (cont.)

- Abrams-Griffiths number: BOOI:

  - Divides obstructed from equivocal from unobstructed pattern.
  - plot of $P_{det}Q_{max}$ vs. Q_{max}

    - AG number = $P_{det}Q_{max} - 2 \times Q_{max}$
    - Can grade the degree of obstruction before and after treatment.

    - BOOI > 40 = obstructed;
    - BOOI 20–40 = equivocal; and
    - BOOI < 20 = unobstructed

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Bladder Contractility Index: BCI

- Schaefer described the formula for BCI:
- BCI= Pdet @ Qmax + 5 (Qmax) .
- strong contractility is a BCI of >150,
- normal contractility —BCI of 100–150
- weak contractility — BCI of < 100.

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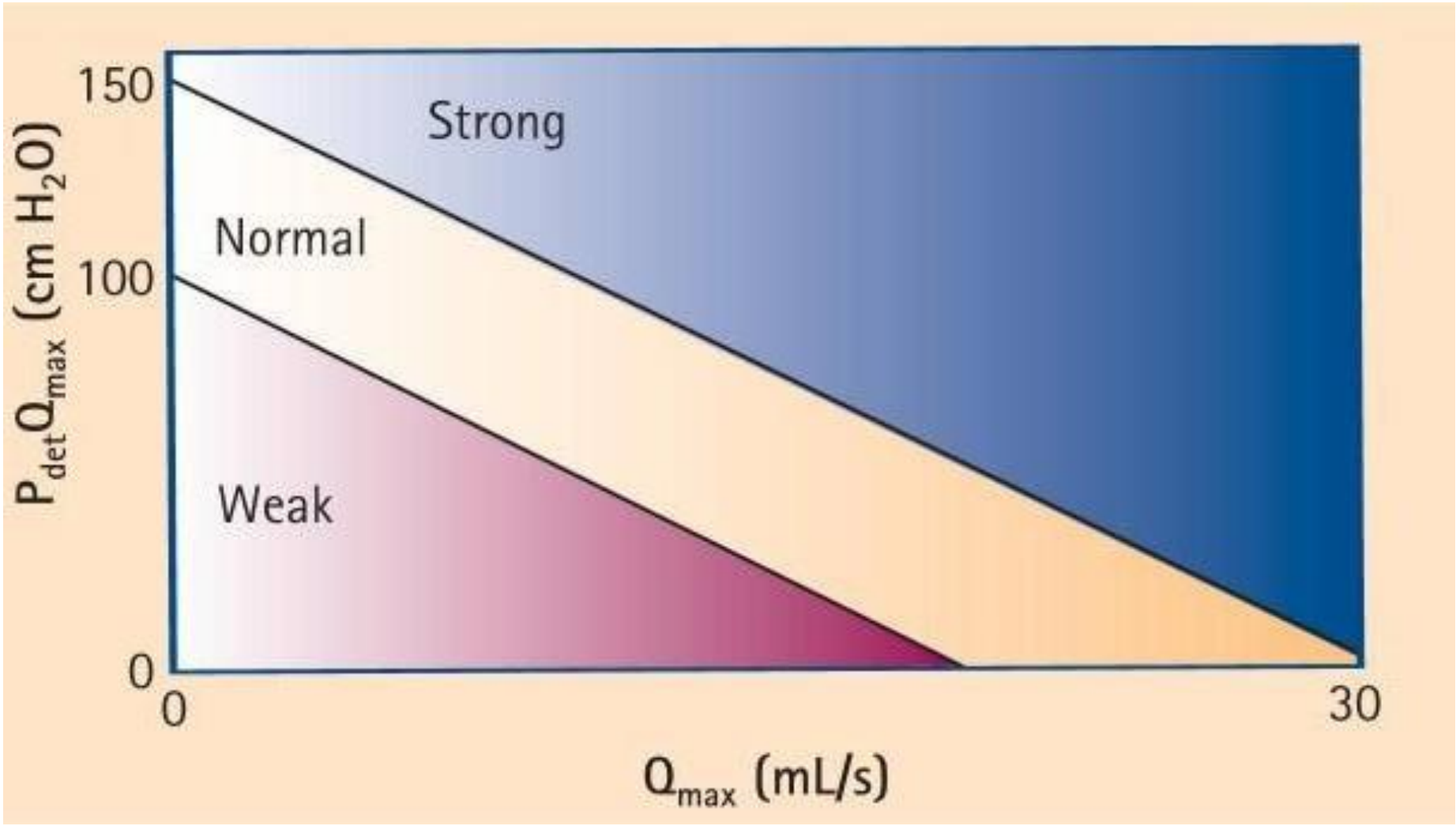
Bladder Contractility Index: BCI



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Urodynamics pattern of DO

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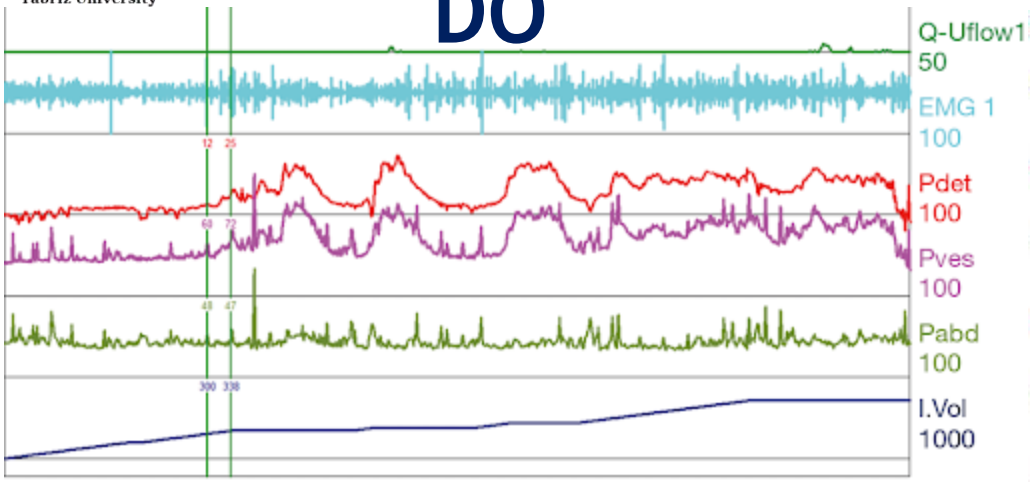

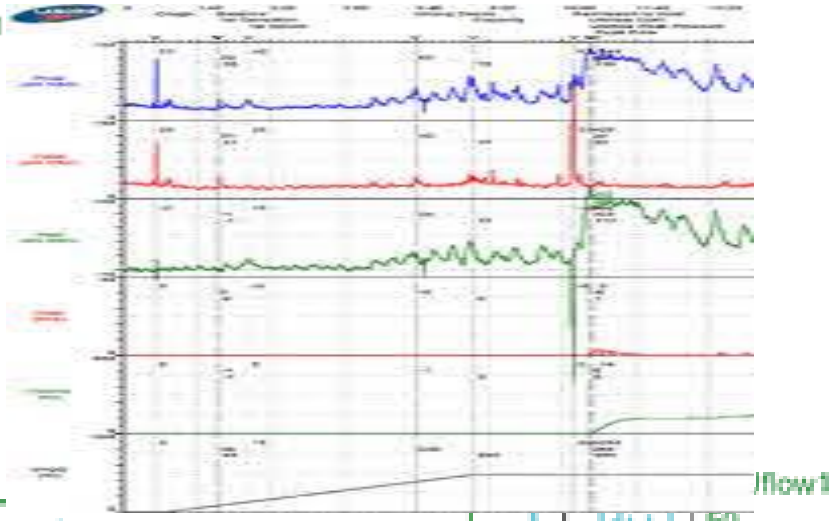

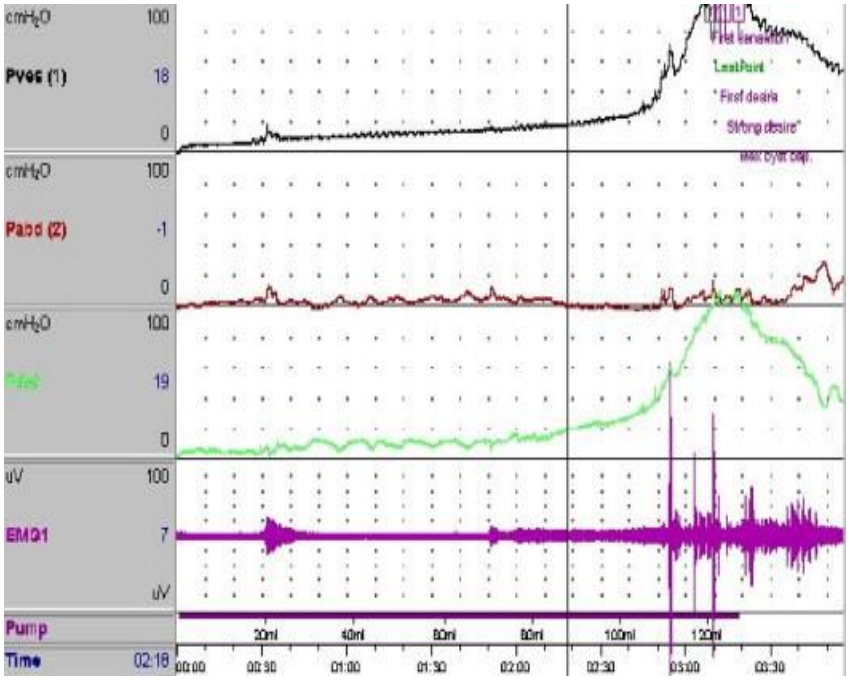

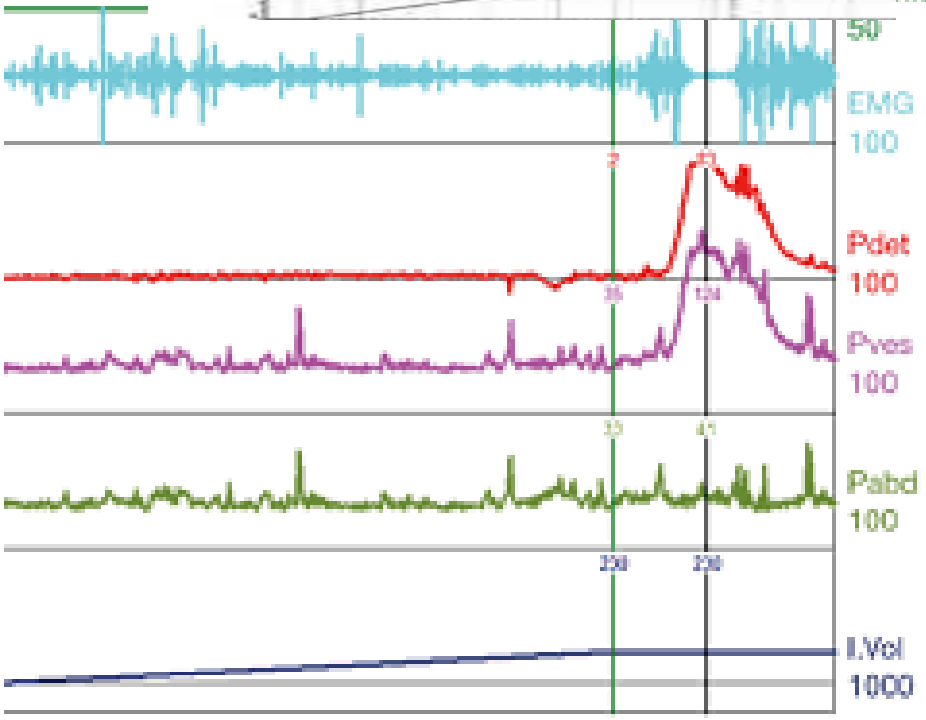

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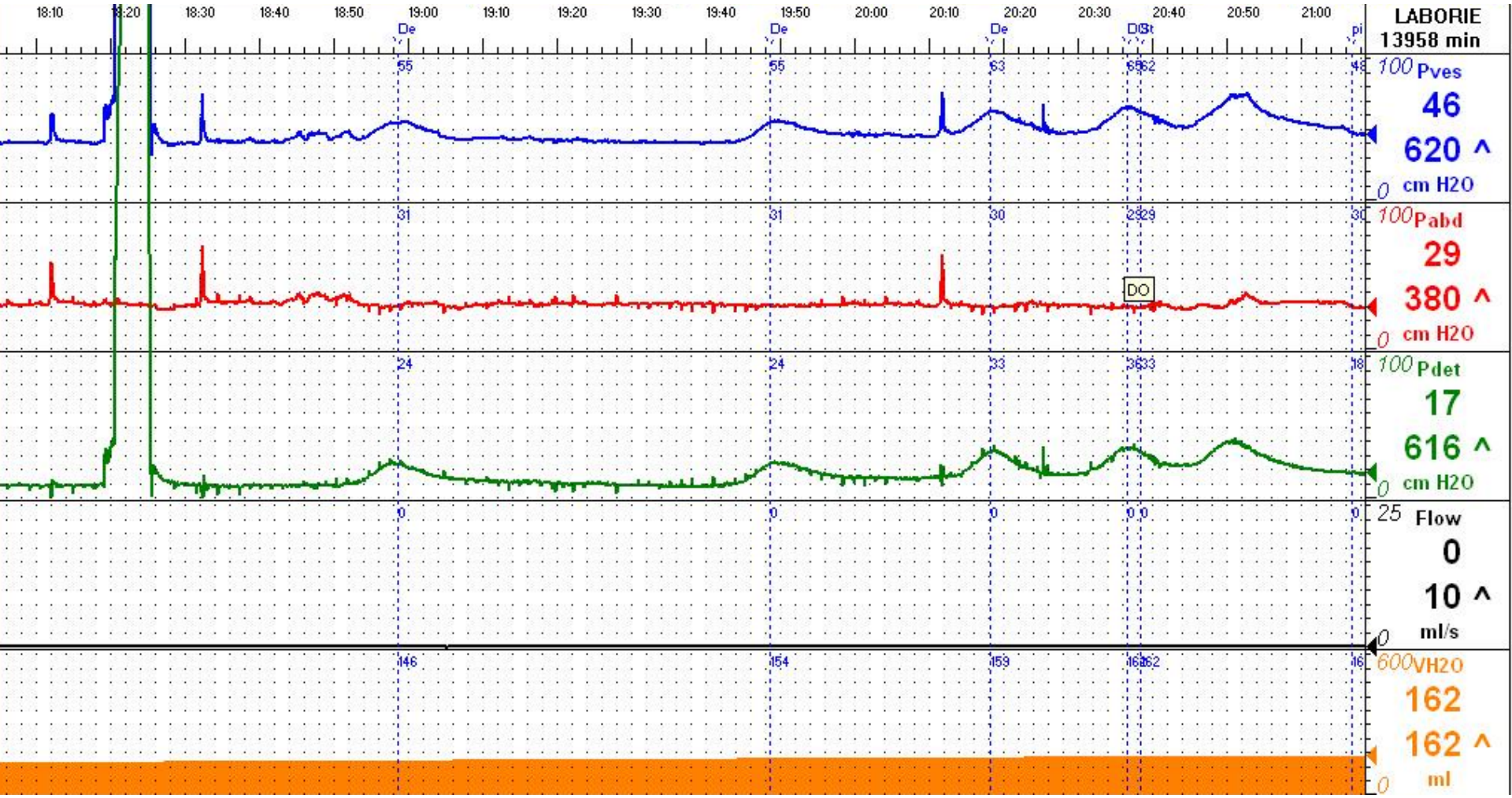
DO: phasic pattern



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Phasic pattern low compliance

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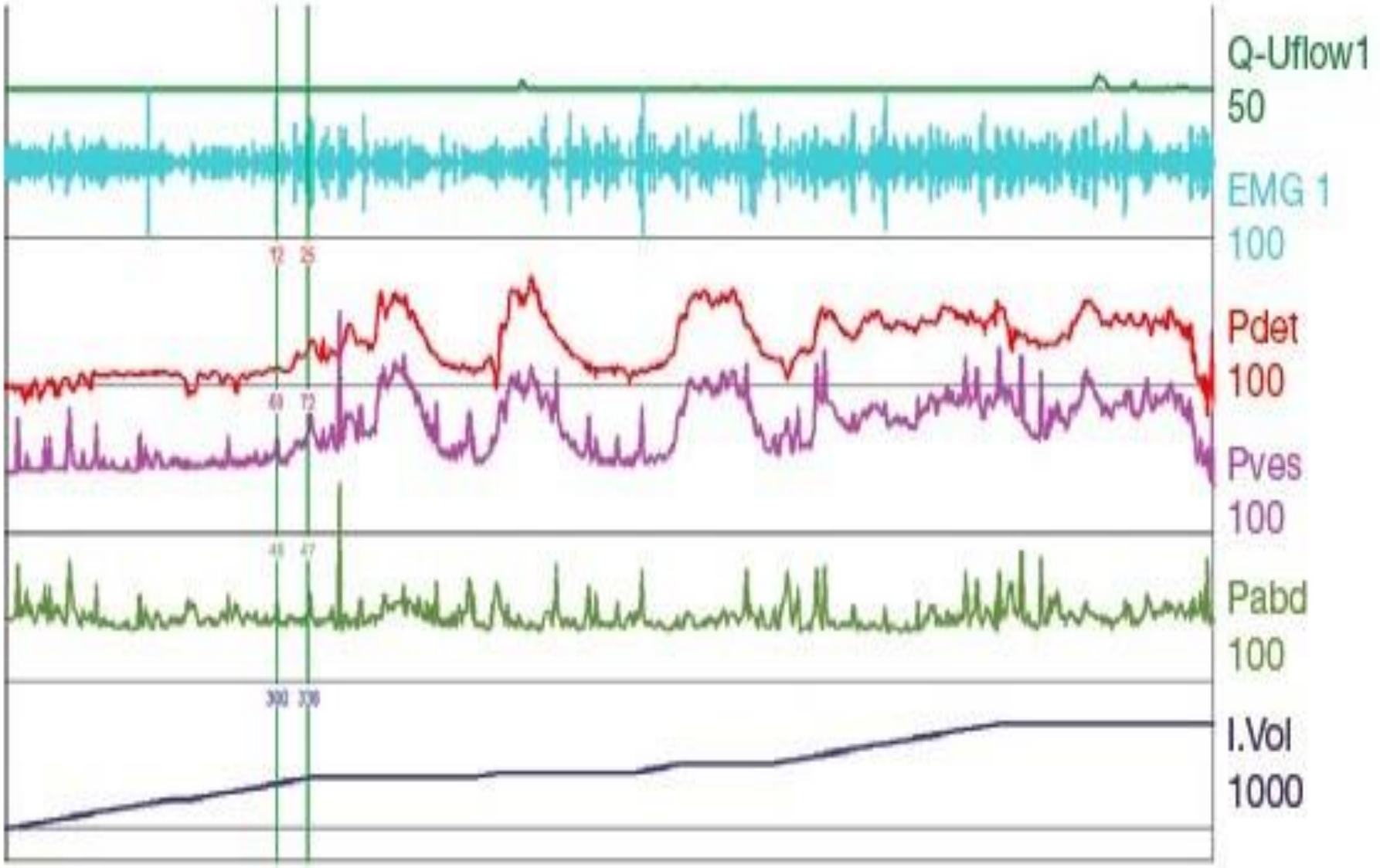
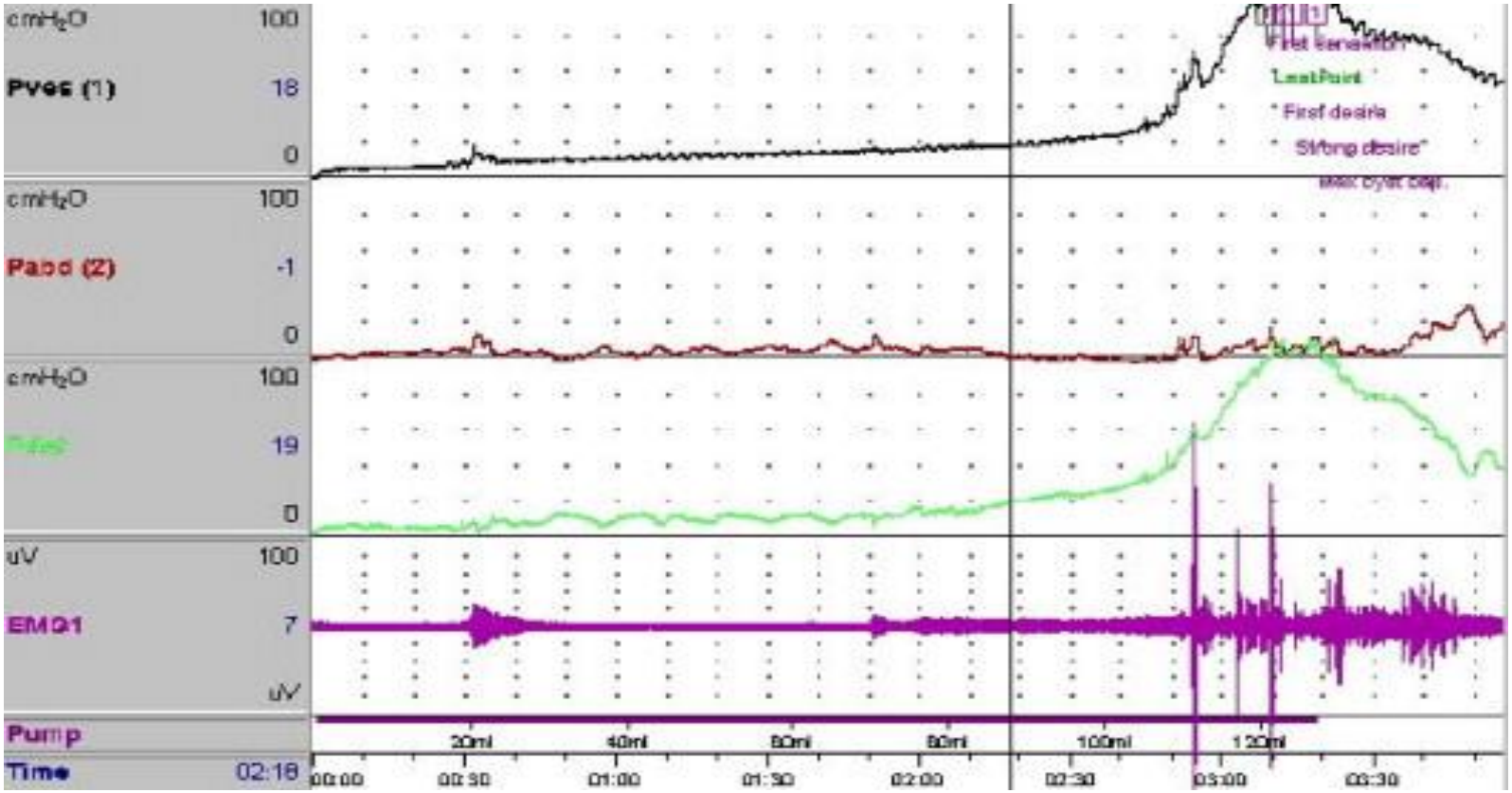


DO: Terminal pattern



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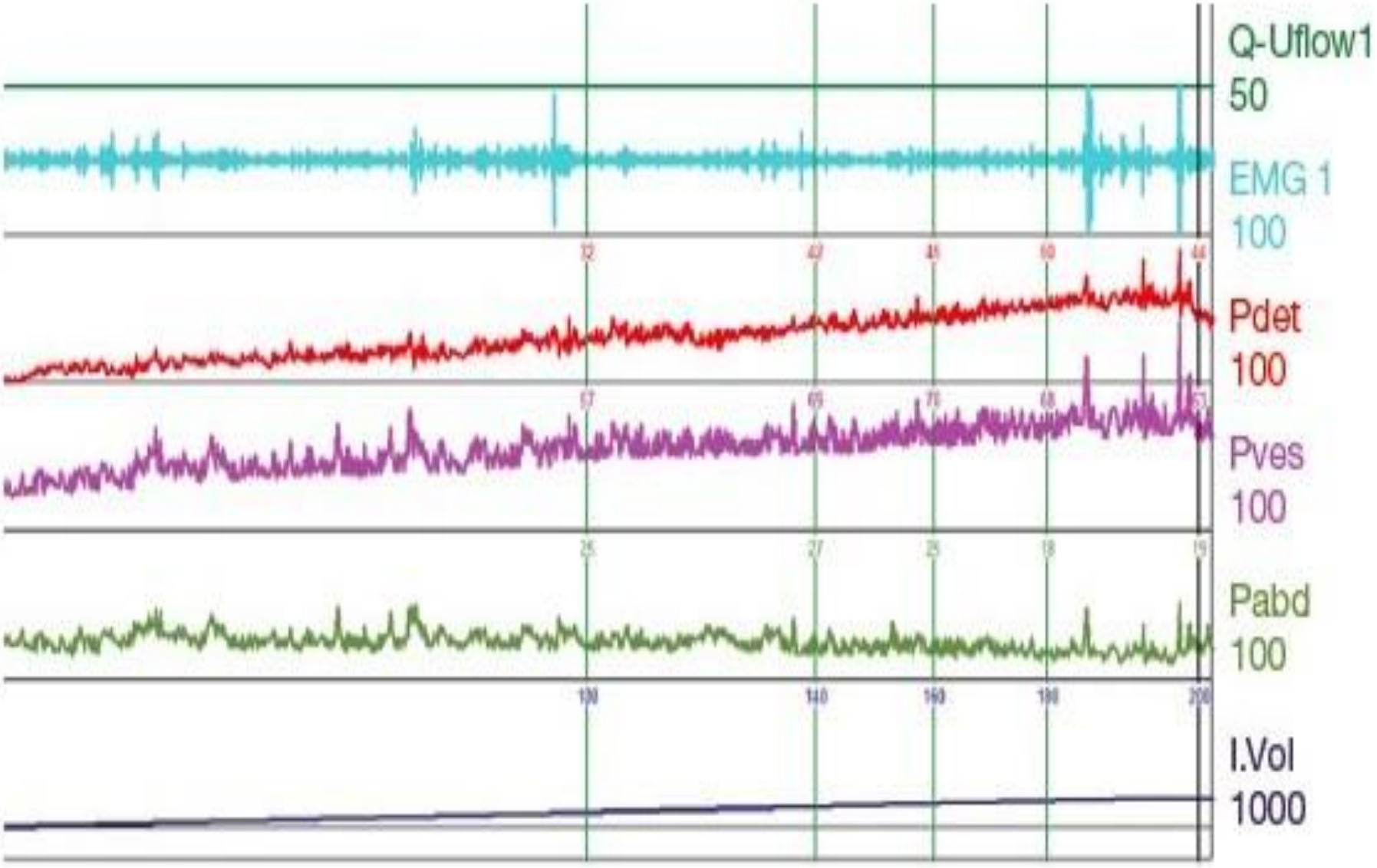
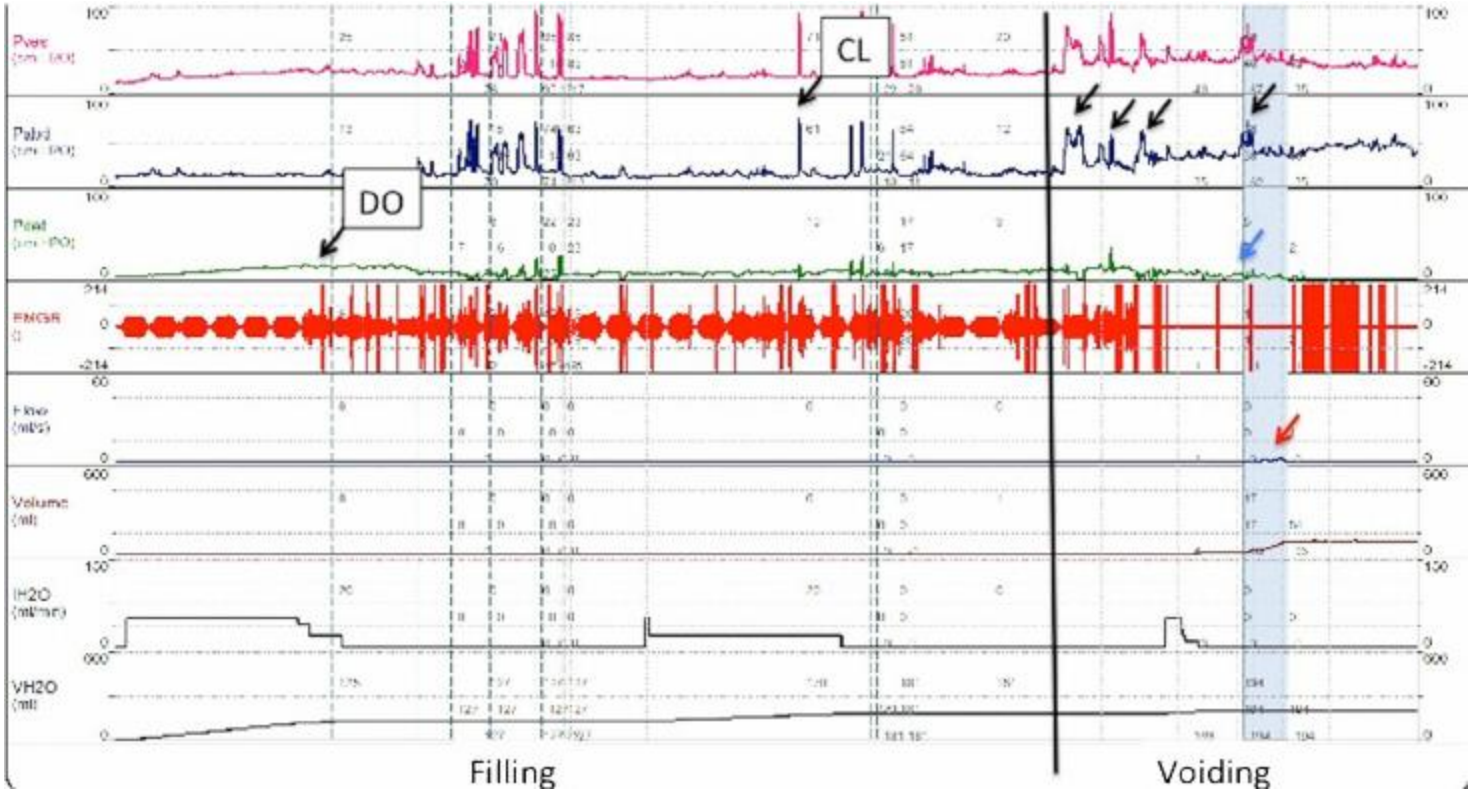
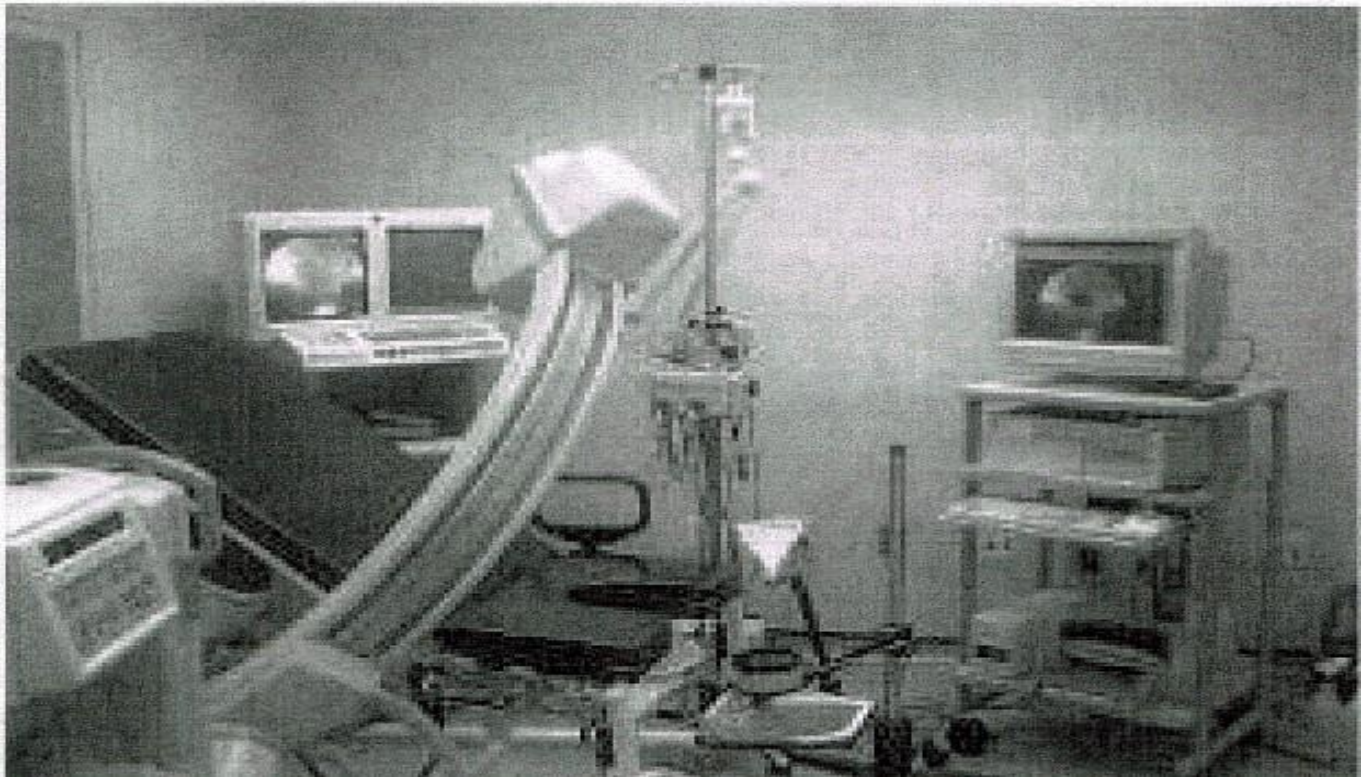
Neurogenic DO



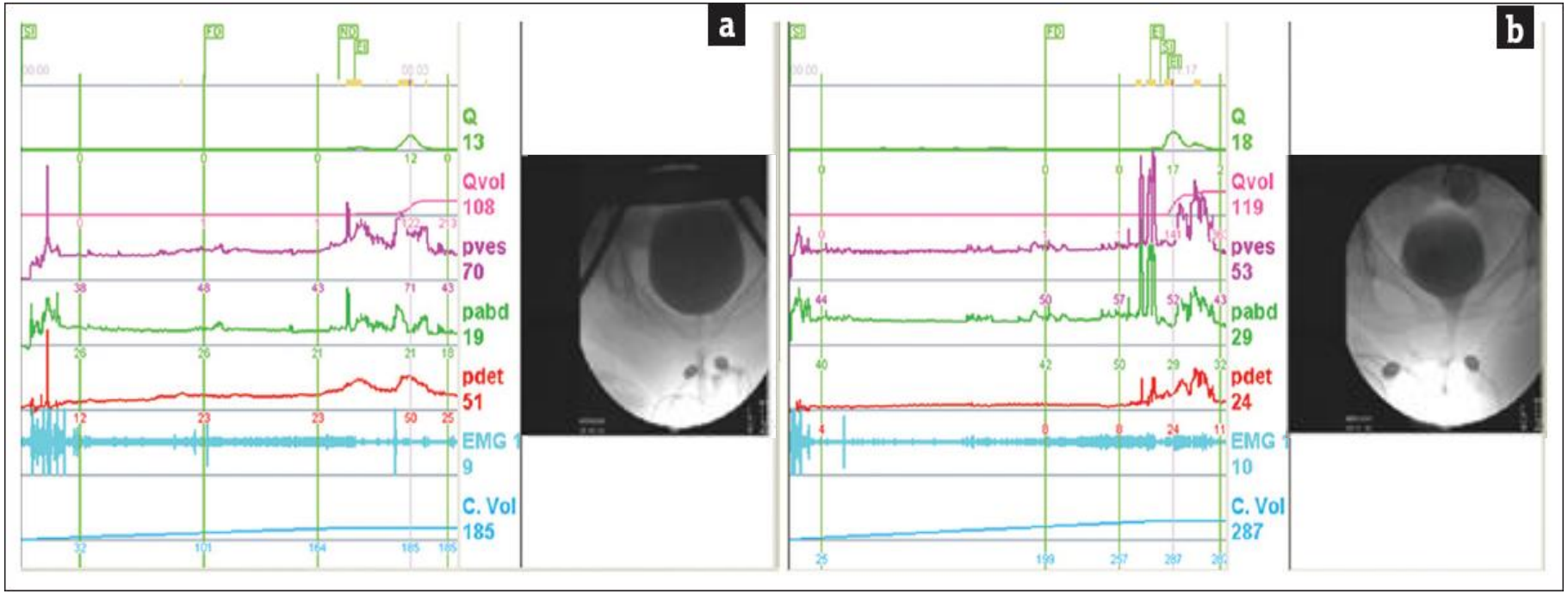
DO-DU



Video-Urodynamics



DO in VUDS



The detrusor overactivity occurs: (a) spontaneously during the end of bladder filling phase and spontaneous urination, and (b) provoked during coughs while urine leaks into the proximal urethra

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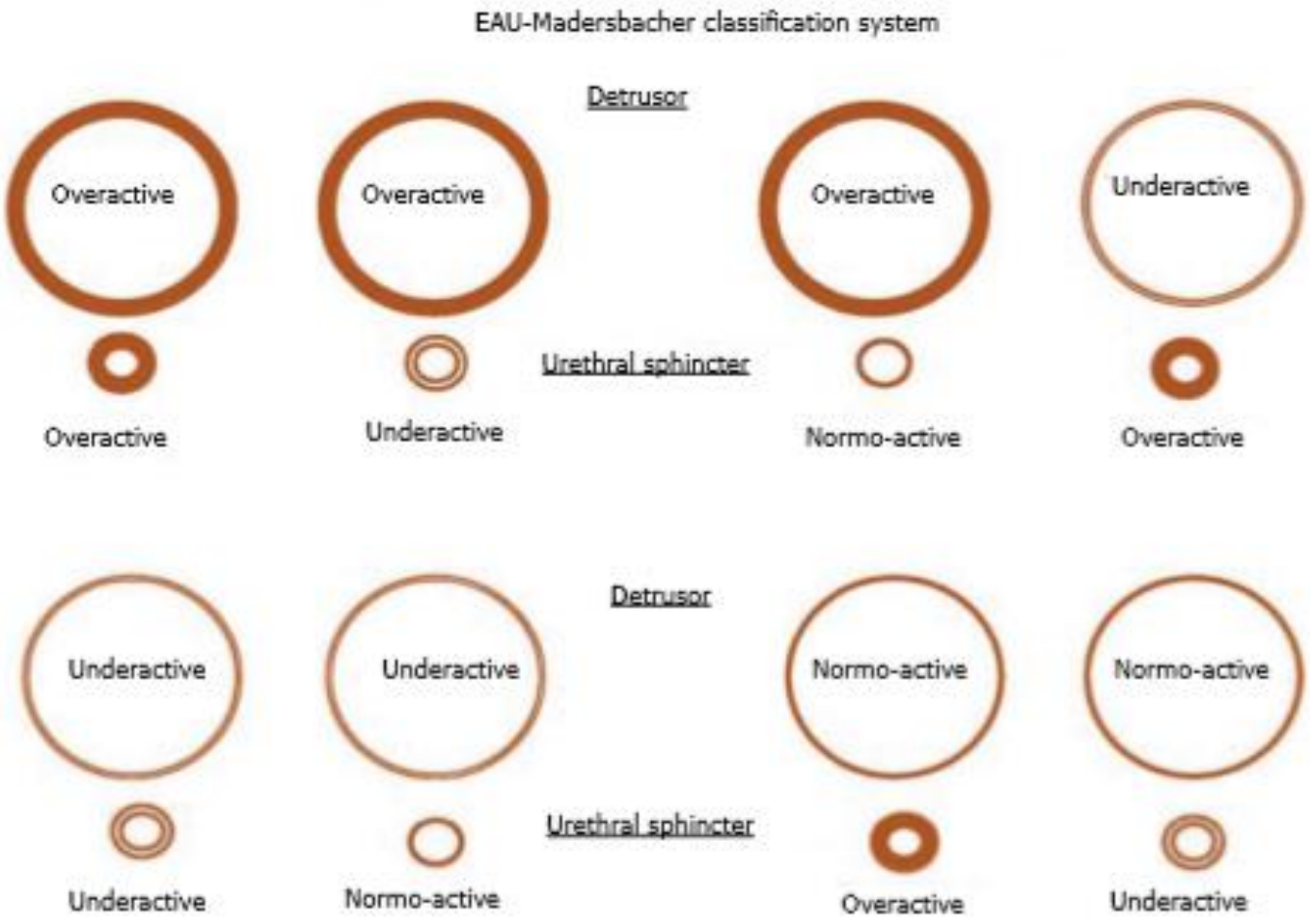
Neurogenic Bladder Classification



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Fibrotic areflexic detrusor, DO -DSD

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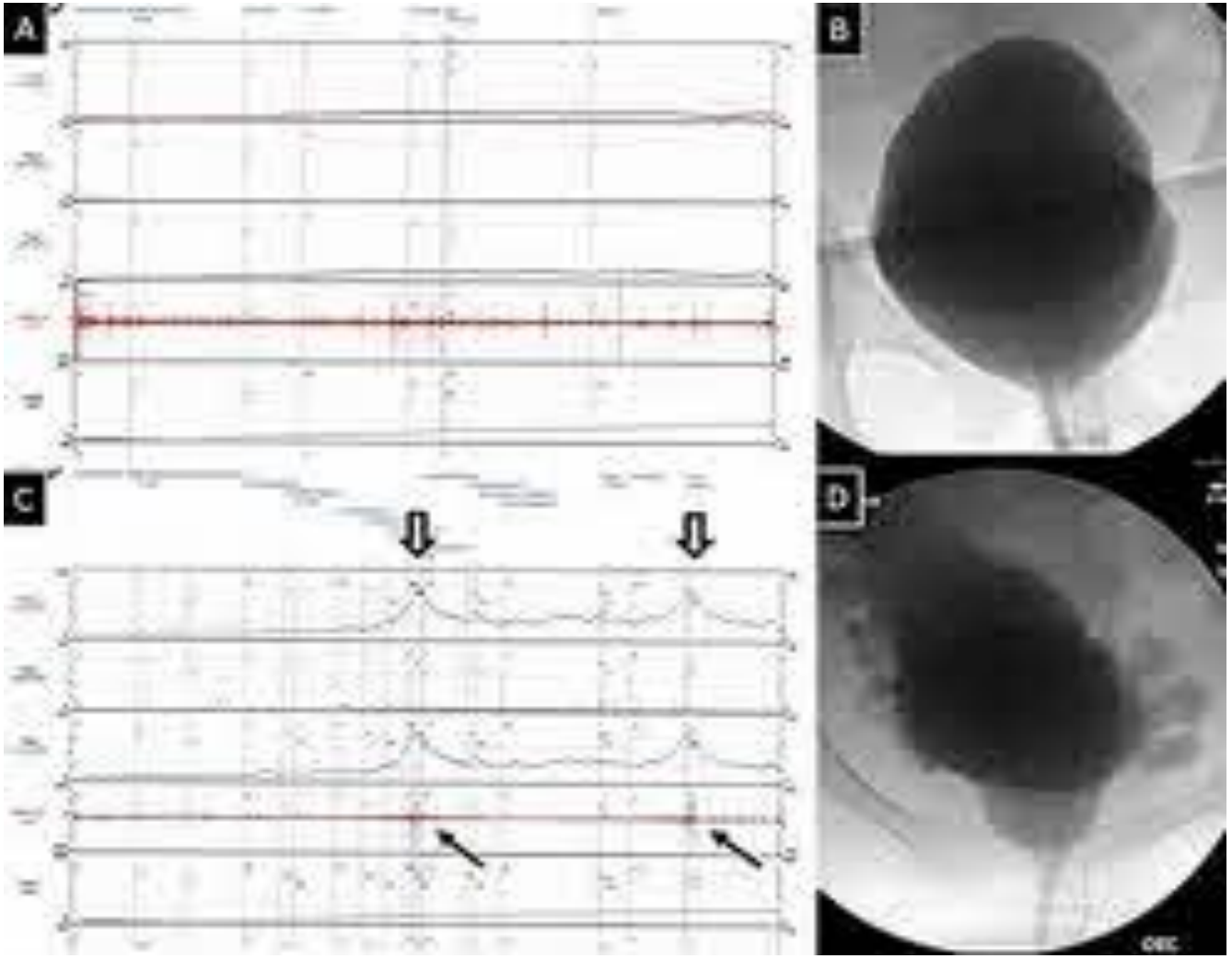

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Male BOO & VUDS

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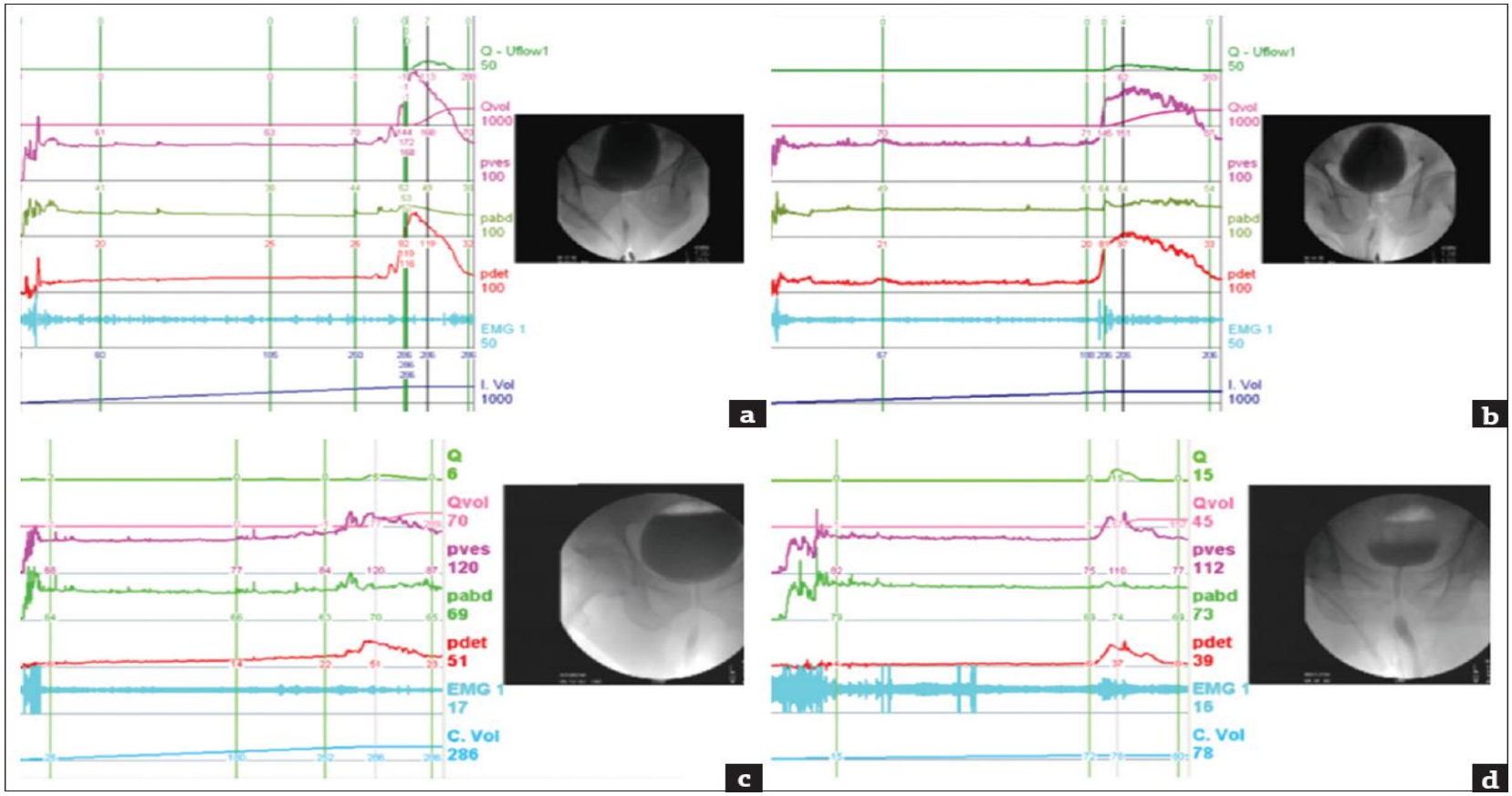
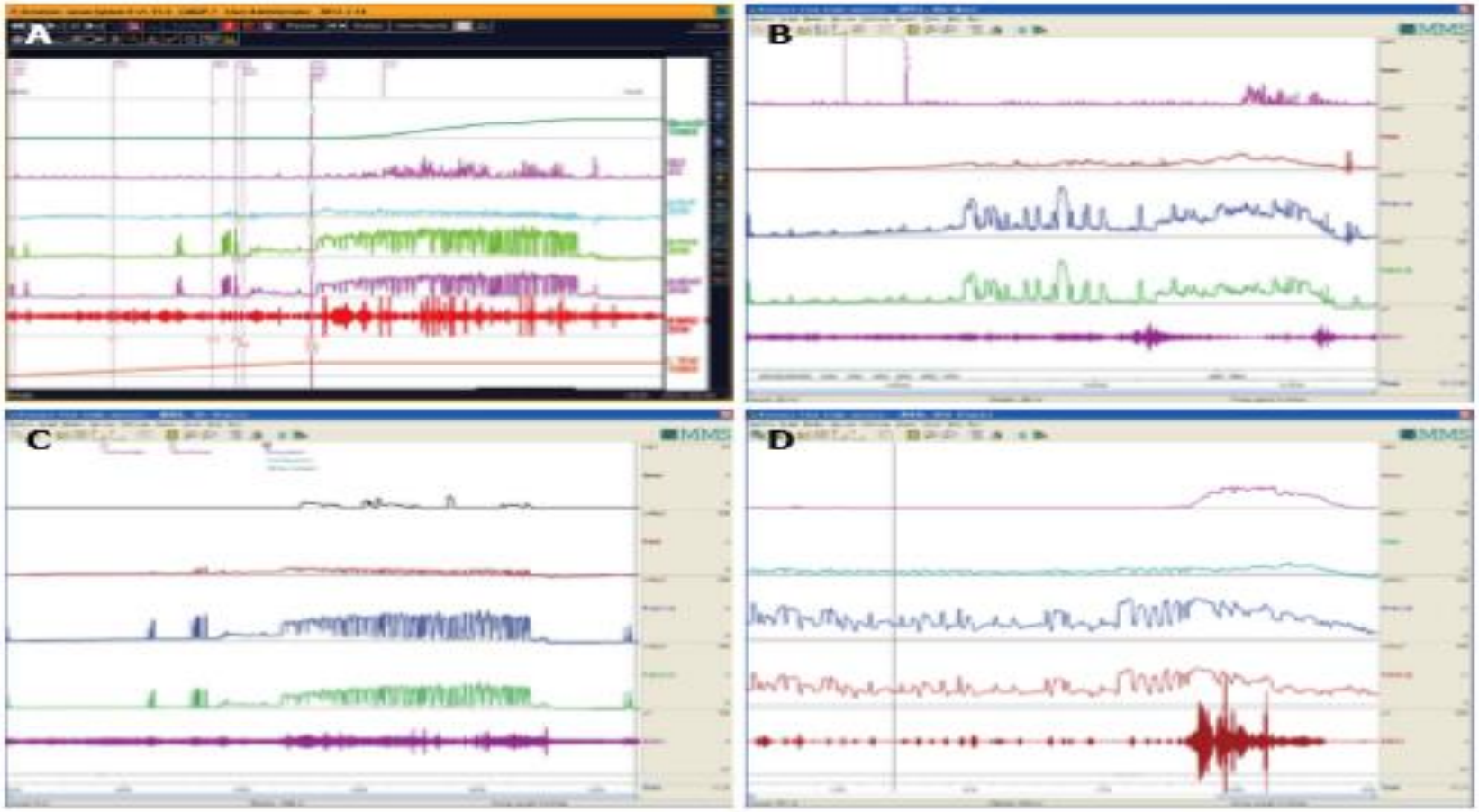


The videourodynamic study findings in men with lower urinary tract symptoms: (a) benign prostatic obstruction and high-pressure bladder outlet obstruction,(b) primary bladder neck obstruction and high-pressure bladder outlet obstruction, (c) bladder neck dysfunction and low-pressure bladder outlet obstruction, (d) poorrelaxation of external sphincter without bladder outlet obstruction

Detrusor Underactivity



Various detrusor underactivity manifestations coupled with idiopathic sphincter overactivity and abdominal straining. A: A woman complaining of urinary incontinence was confirmed with detrusor underactivity (DUA) and idiopathic sphincter overactivity (ISO); B: A male patient aged 86 years complaining of poorweak flow after benign prostatic hyperplasia (BPH) operation was confirmed with DUA and abdominal straining with detrusor-sphincter synergia; C: A female patient suffering from bladder overdistention was confirmed with DUA and ISO; D: A female aged 55 years suffering from incontinence was proved with DUA, ISO and nearly normal Qmax.

A

Diagnostic value of urodynamic bladder outlet obstruction to select patients for prostate surgery

- With considering the **BOOI >40 as BOO +**
- BOO positive patients have better surgical outcomes in all parameters (symptom score, quality of life, Q_{max}, and PVR) than BOO negative patients

Diagnostic value of urodynamic bladder outlet obstruction to select patients for transurethral surgery of the prostate: Systematic review and meta-analysis.*Kim M, Jeong CW, Oh SJ PLoS One. 2017; 12(2):e0172590*

The Cochrane Database of Systematic Reviews

- Only two trials met the inclusion criteria
- There was no difference in Q_{max} or International Prostate Symptom Score before and after surgery for LUTS in the two groups who underwent or did not undergo UDS.
- However, the test was influential for therapy choice

Invasive urodynamic studies for the management of lower urinary tract symptoms (LUTS) in men with voiding dysfunction.*Clement KD, Burden H, Warren K, Lapitan MC, Omar MI, Drake MJ Cochrane Database Syst Rev. 2015 Apr 28; (4):CD011179.*

The Urodynamics for Prostate Surgery Trial: Randomized Evaluation of Assessment Methods (UPSTREAM)

- The trial will determine whether urodynamics reduces surgery rates while achieving similar symptom outcome

Urodynamics for Prostate Surgery Trial; Randomised Evaluation of Assessment Methods (UPSTREAM) for diagnosis and management of bladder outlet obstruction in men: study protocol for a randomised controlled trial.*Bailey K, Abrams P, Blair PS, Chapple C, Glazener C, Horwood J, Lane JA, McGrath J, Noble S, Pickard R, Taylor G, Young GJ, Drake MJ, Lewis AL*

UPSTREAM Trial

- Surgery was more beneficial in those with higher symptom score(IPSS>16),age <74y, Qmax<9.8,BOOI>46 and BCI> 123
- Urodynamic can predict the outcome of surgery in Qmax>15

*Recommendations(*Qualitative)

- Good communication before and during the procedure, in line with patient preferences, to ensure patients are well prepared and informed.
- Prioritizing patient privacy, including minimizing the number of people present during the test and introducing the staff members who are present.
- Discussing test results with patients promptly, in the amount of detail they wish.
- Training and guidance for urology clinicians and urodynamics technicians in these areas.

Recommendations for conducting invasive urodynamics for men with lower urinary tract symptoms: Qualitative interview findings from a large randomized controlled trial (UPSTREAM).*Selman LE, Ochieng CA, Lewis AL, Drake MJ, Horwood J*
Neurourol Urodyn. 2019 Jan; 38(1):320-329.

Implications of storage dysfunction for surgery to relieve BOO

- Persistent DO can be noted in approximately 30% and 50% of the patients after prostatectomy.
- The emergence of de novo DO is unusual following prostatectomy, so any postoperative DO is likely to represent persistence of DO, as opposed to new onset.

Analysis of prognostic factors regarding the outcome after a transurethral resection for symptomatic benign prostatic enlargement.*Seki N, Takei M, Yamaguchi A, Naito S Neurourol Urodyn. 2006; 25(5):428-32.*

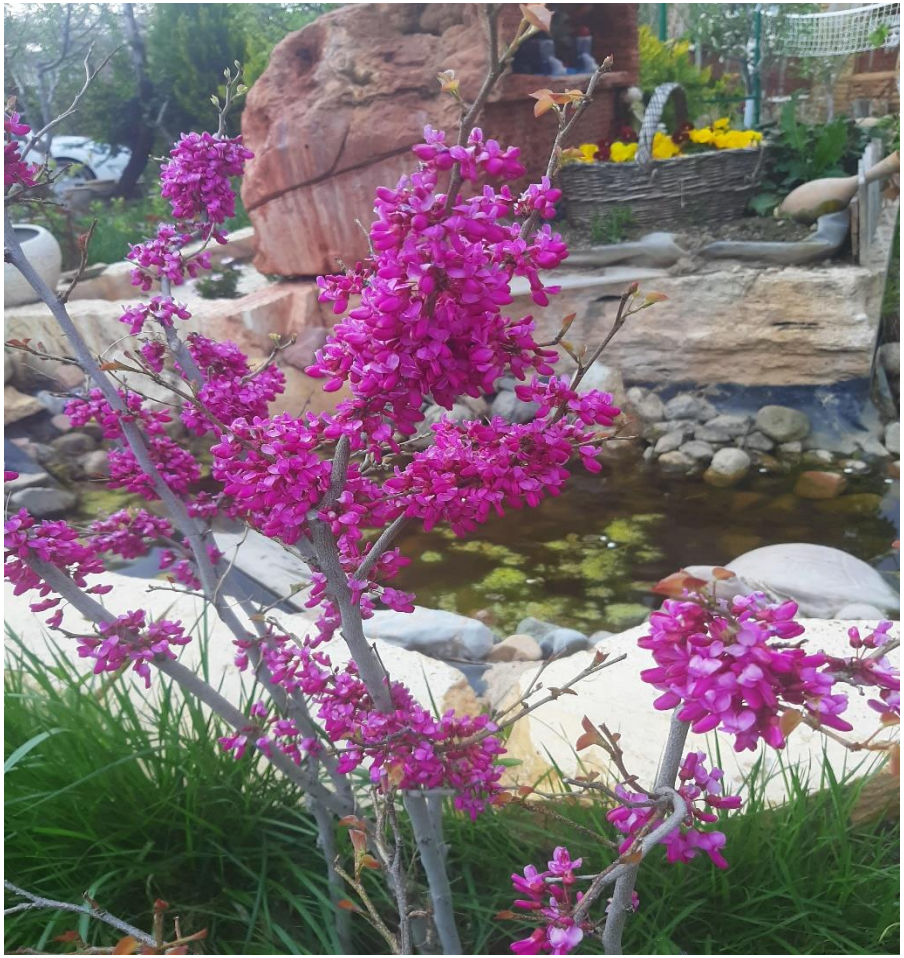
DUA and prostatic surgeries

- Kim et al:
- performed a systematic review and meta-analysis
- assessing a total of 10 comparative studies evaluating
- transurethral surgery, and found that those with DUA had significantly poorer improvement in the International Prostate Symptom Score and maximal flow rate than those with preserved contractility.

Kim M, Jeong CW, Oh SJ. Effect of preoperative urodynamic detrusor underactivity on transurethral surgery for benign prostatic hyperplasia: a systematic review and meta-analysis. J Urol 2018;199:237–44

Full urodynamics are essential prior to invasive therapy:

- to make a precise diagnosis
- to allow selection of an appropriate technique (?)
- to warn the patient of possible problems
- to allow properly informed consent



Conclusion

- Management and monitoring of LUTS will likely be orchestrated and instrumental, and that process requires "good evidence based practice"