Neurogenic bladder : Let's fun

Dr. Wit Viseshsindh

Ramathibodi Hospital

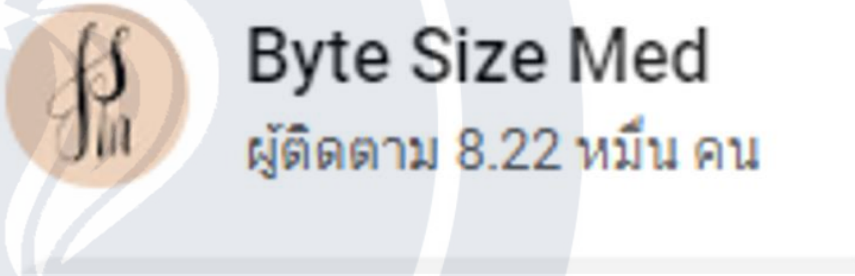
Mahidol University

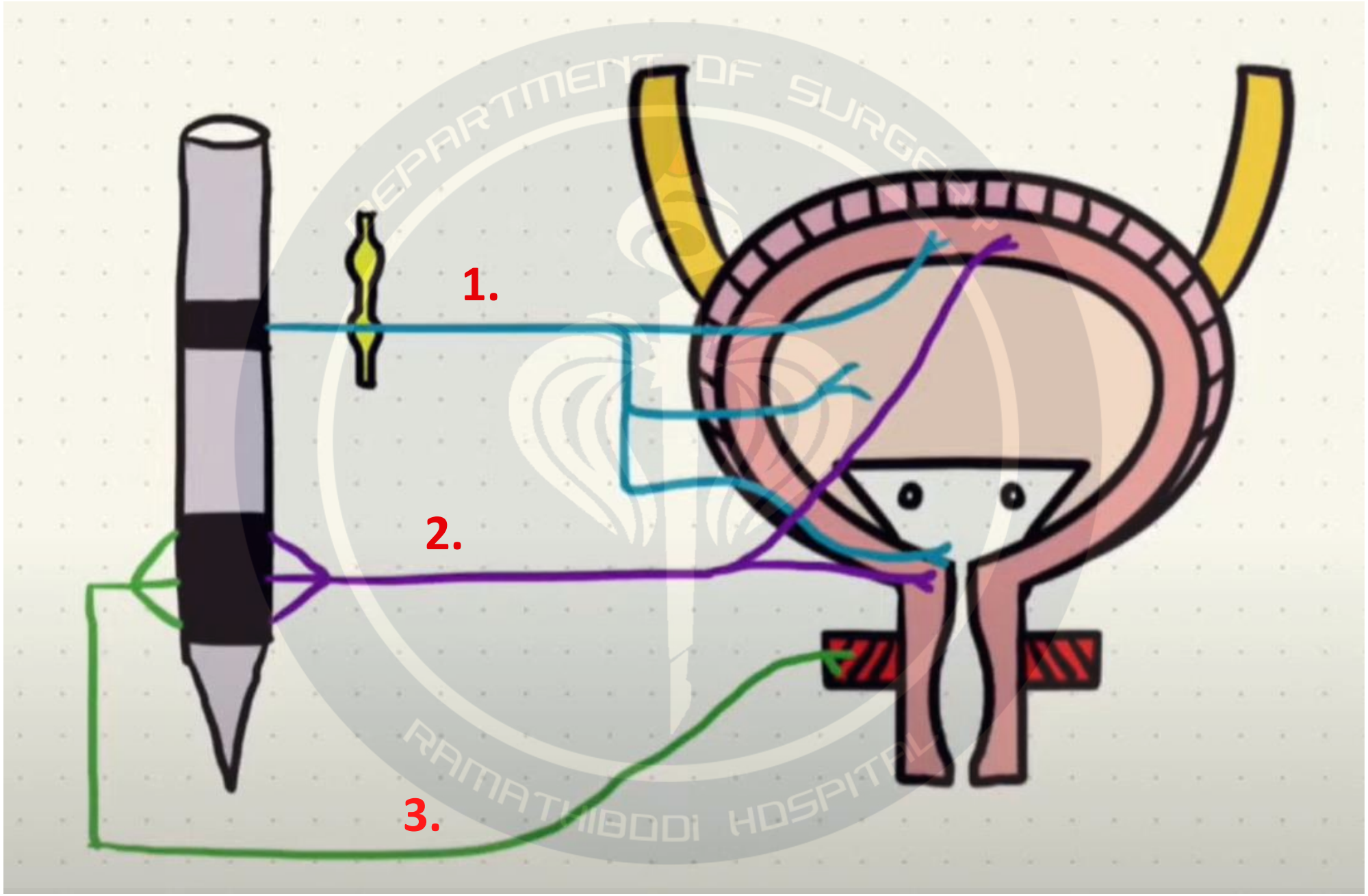
The rules

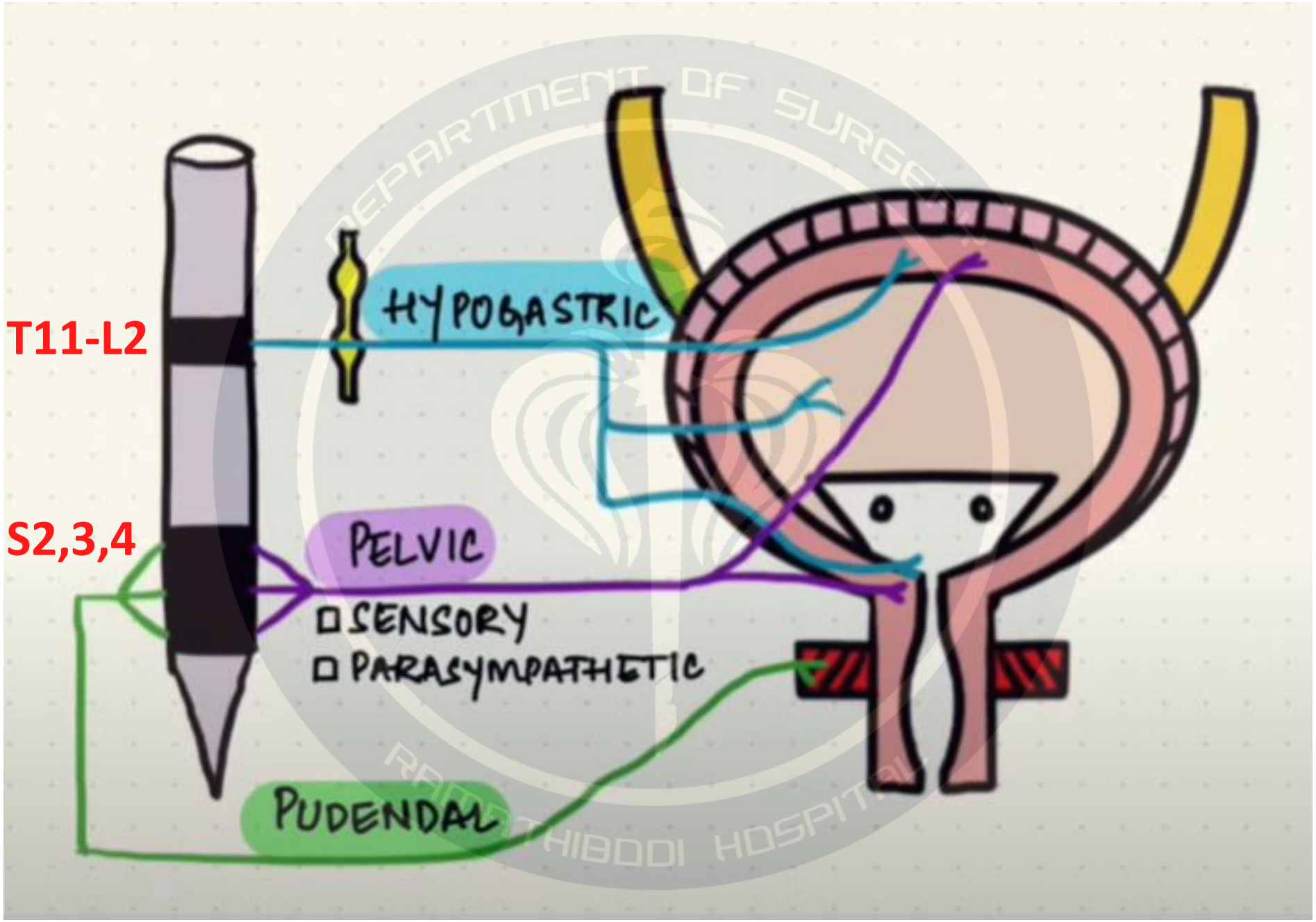
- Can talk but not noisy or disturb
- Can phone if urgent
- Can eat but not burp or spill
- Can sleep but not snoring
- Can pee but outside
- Don’t feeling stressed
- Always think along and have fun

Physiology of micturition


OPEN.OSMOSIS.ORG
@OSMOSISMED
@OSMOSEIT
/OSMOSEIT
/R/OSMOSEIT
/OSMOSIS

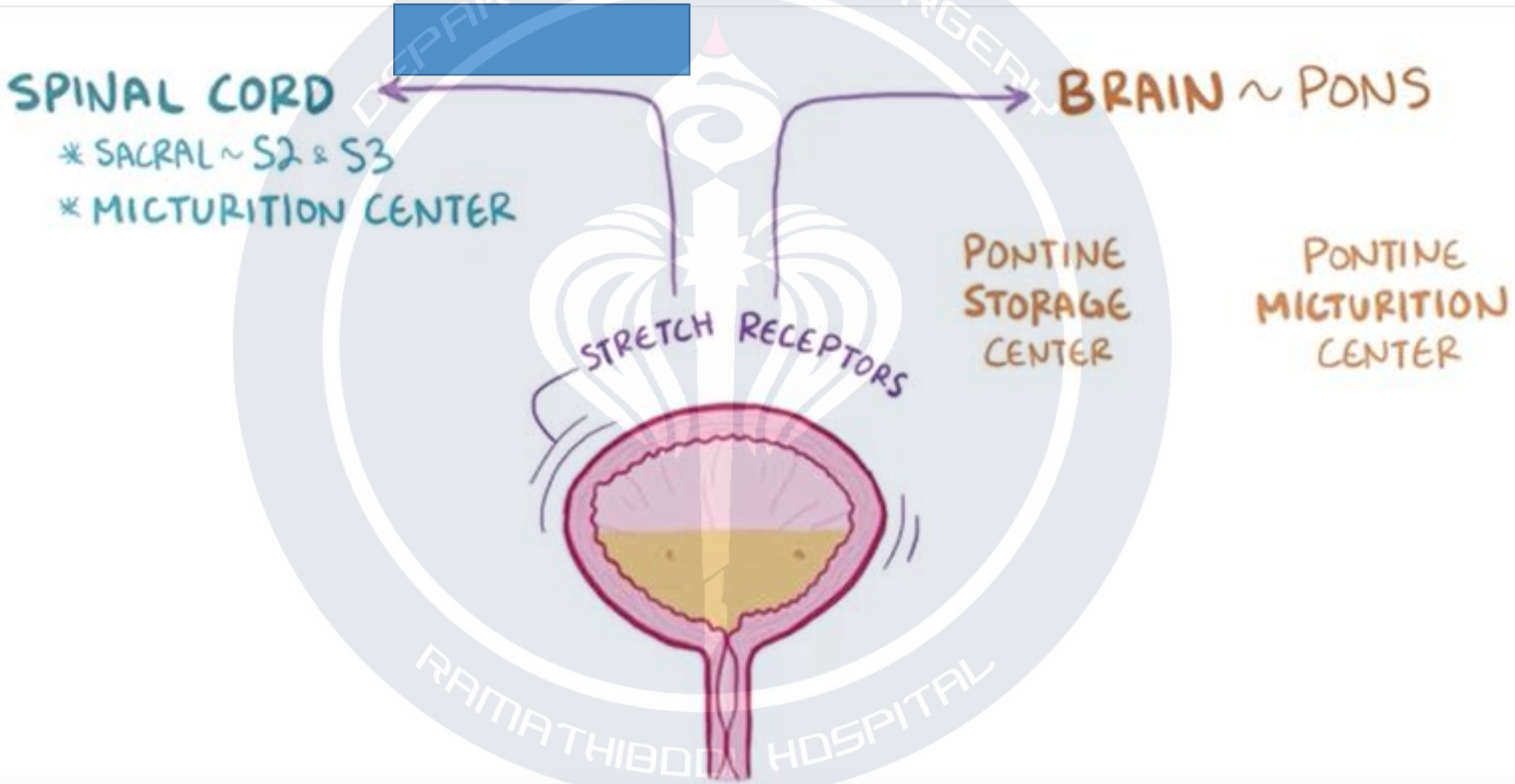

Byte Size Med
ผู้ติดตาม 8.22 หมื่น คน

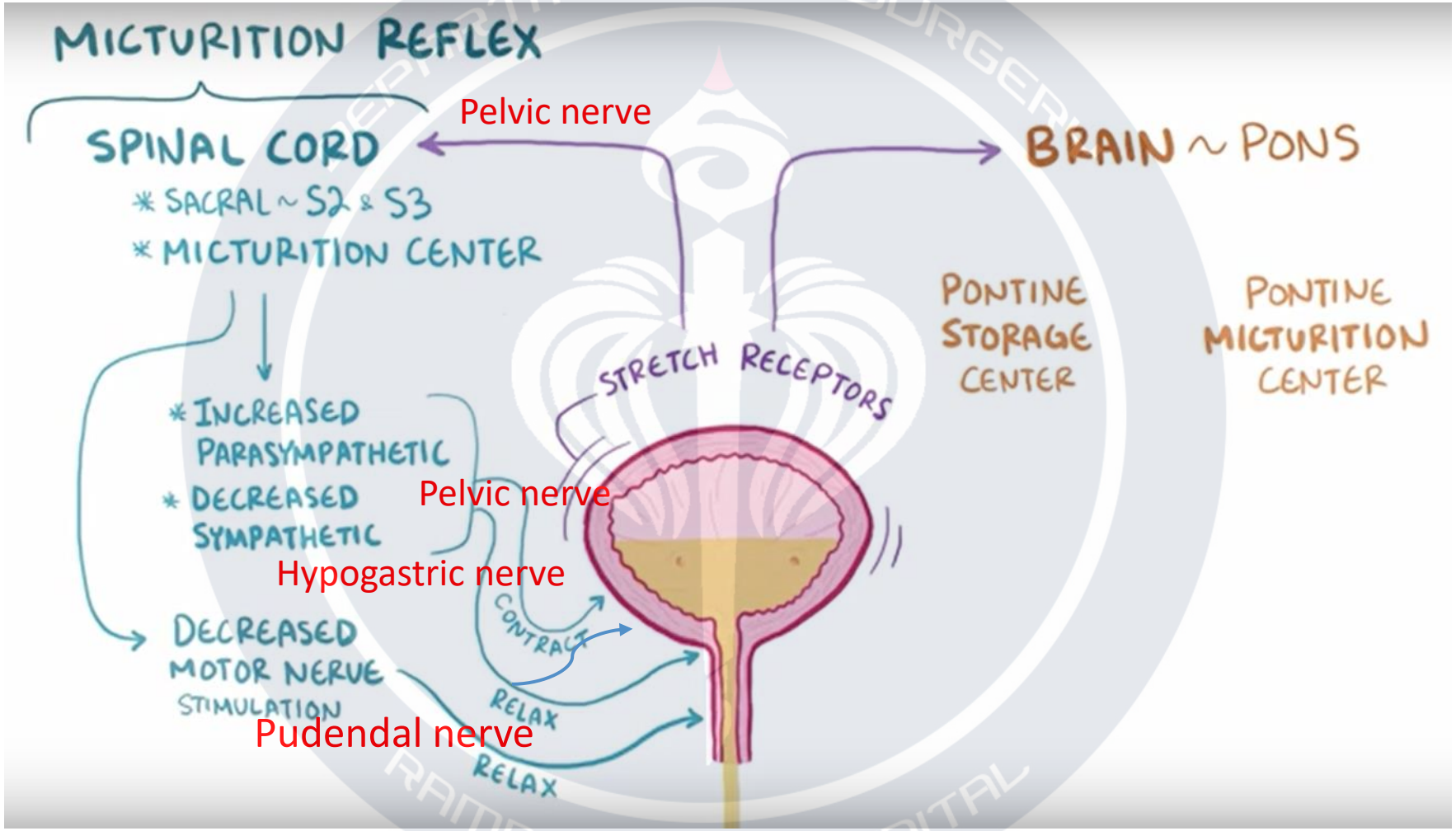

1.
2.
3.

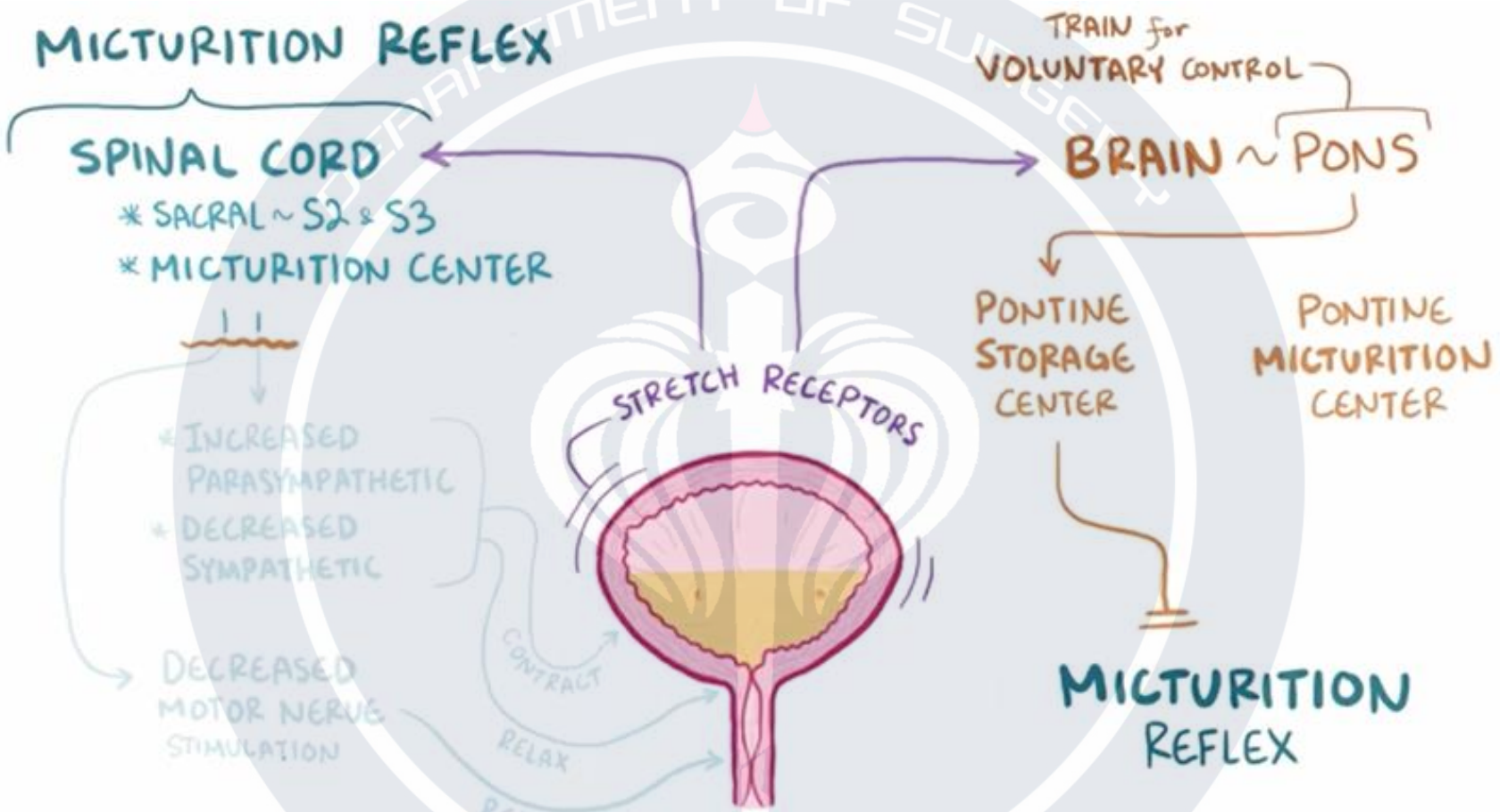

T11-L2
HYPOGASTRIC
S2,3,4
PELVIC
SENSORY
PARASYMPATHETIC
PUDENDAL

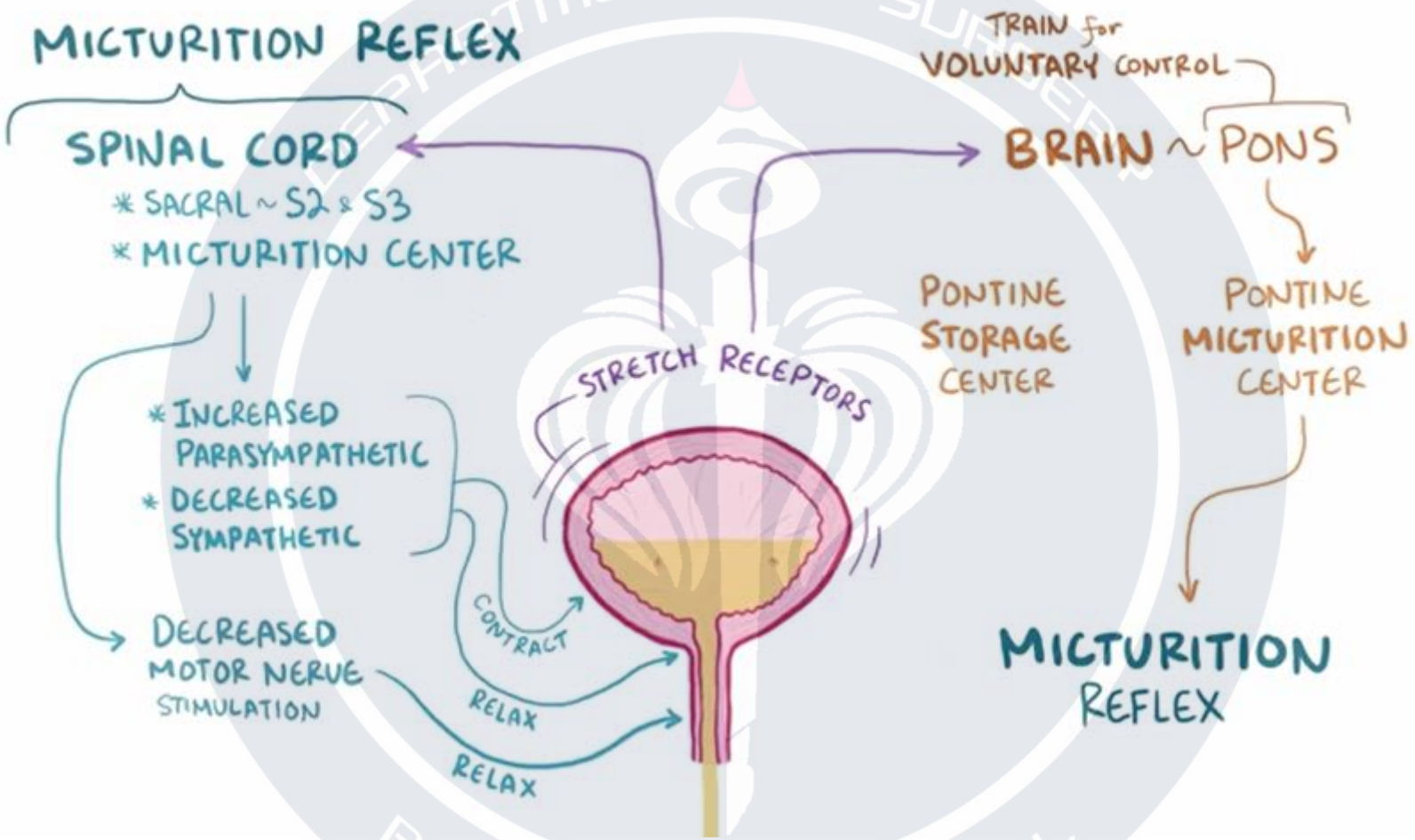
Cerebral cortex

Pontine micturition center (PMC)

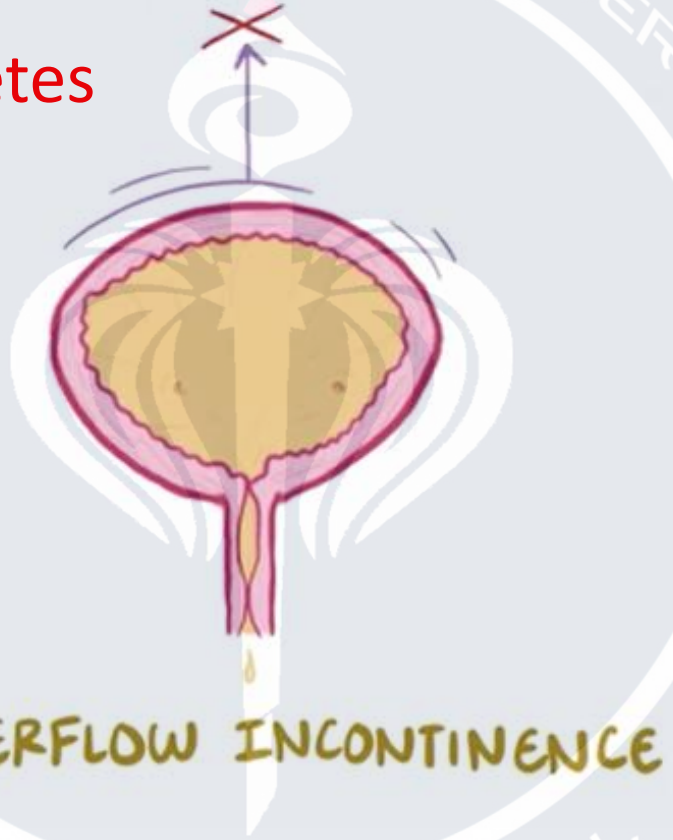


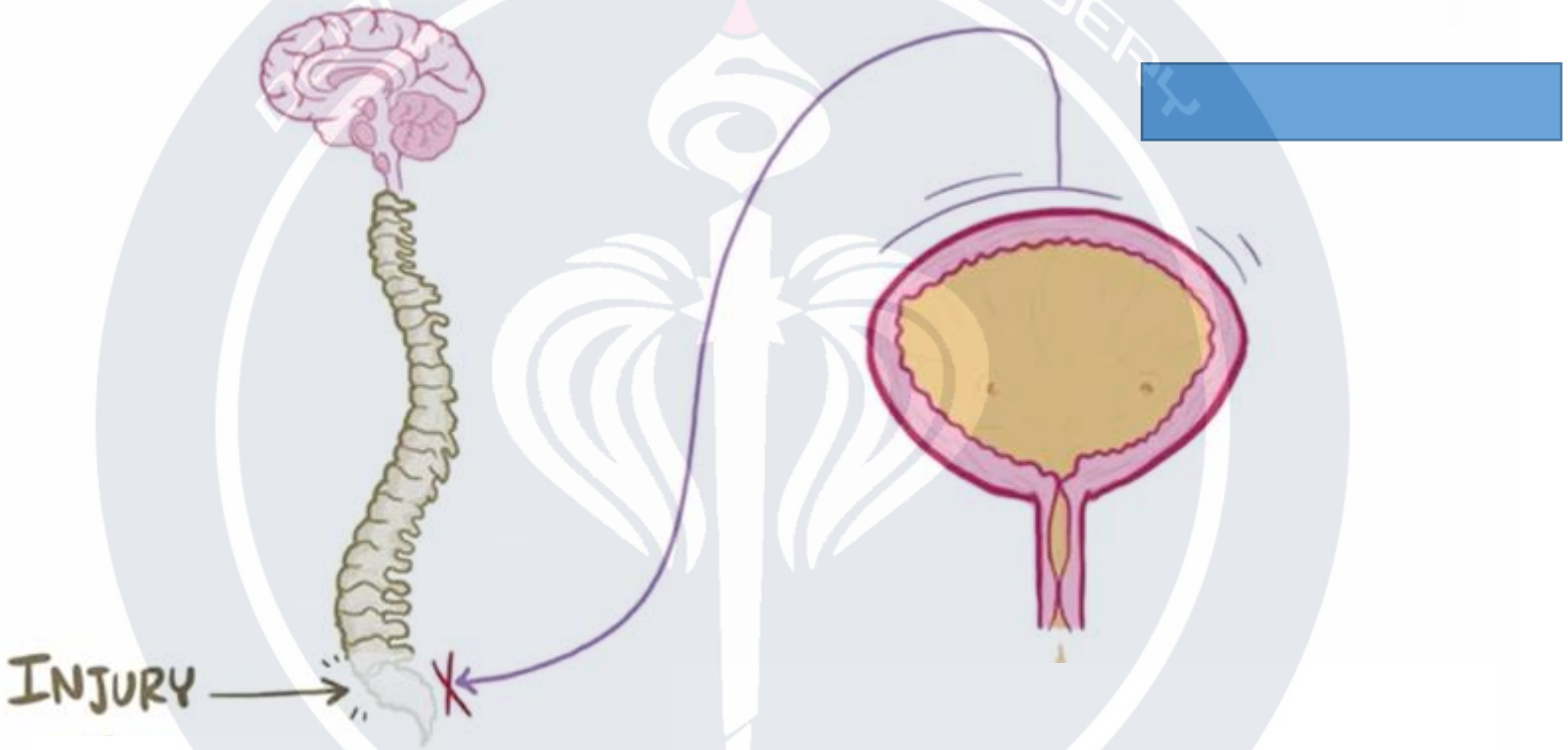

MICTURITION REFLEX
SPINAL CORD
* SACRAL ~ S2 & S3
* MICTURITION CENTER
Pelvic nerve
BRAIN ~ PONS
PONTINE STORAGE CENTER
PONTINE MICTURITION CENTER
STRETCH RECEPTORS
* INCREASED PARASYMPATHETIC
* DECREASED SYMPATHETIC
Pelvic nerve
Hypogastric nerve
CONTRACT
RELAX
DECREASED MOTOR NERVE STIMULATION
Pudendal nerve
RELAX

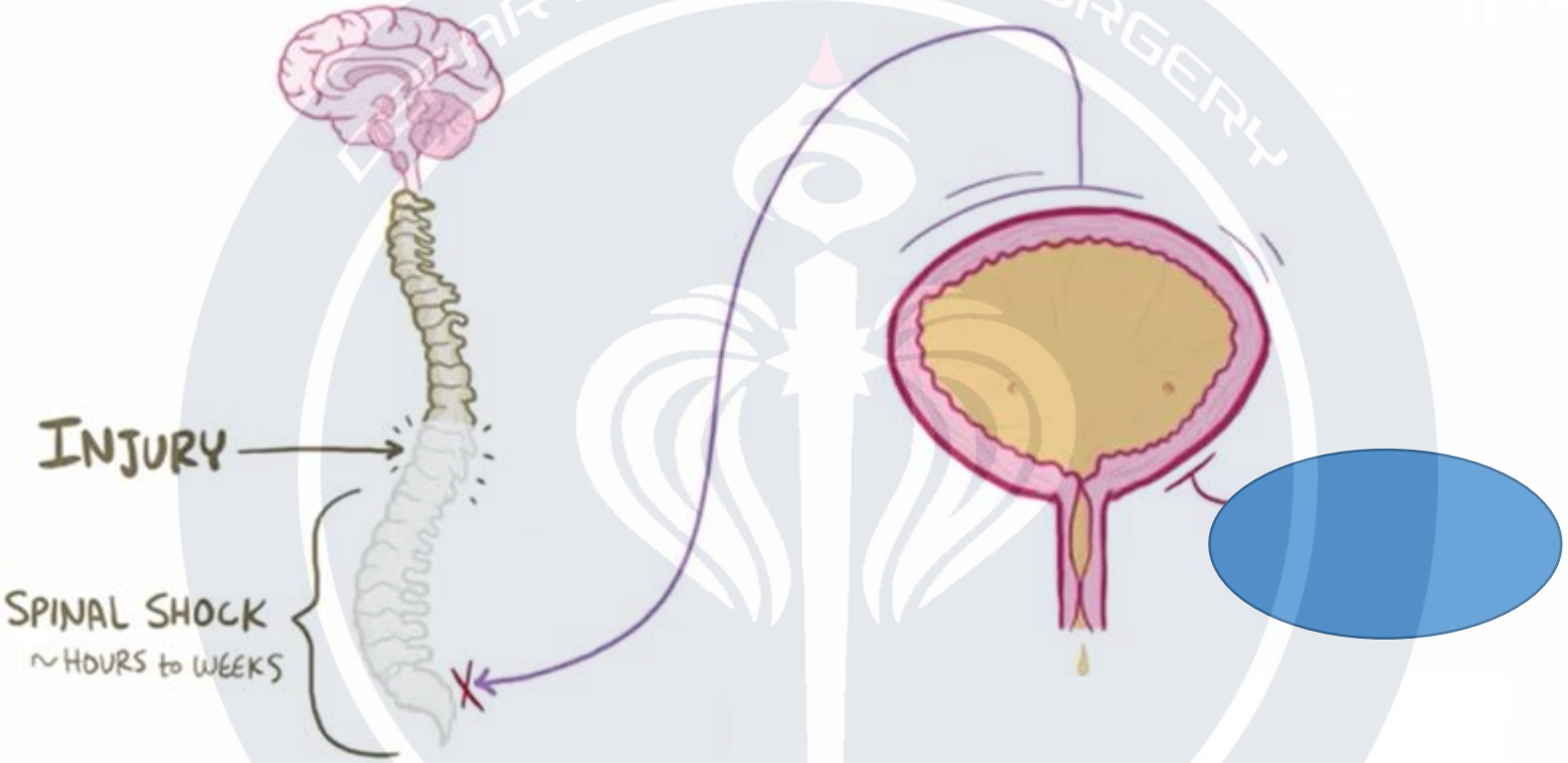

MICTURITION REFLEX
SPINAL CORD
* SACRAL ~ S2 & S3
* MICTURITION CENTER
TRAIN for VOLUNTARY CONTROL
BRAIN ~ PONS
PONTINE STORAGE CENTER
PONTINE MICTURITION CENTER
STRETCH RECEPTORS
* INCREASED PARASYMPATHETIC
* DECREASED SYMPATHETIC
DECREASED MOTOR NERVE STIMULATION
CONTRACT
RELAX
RELAX
MICTURITION REFLEX

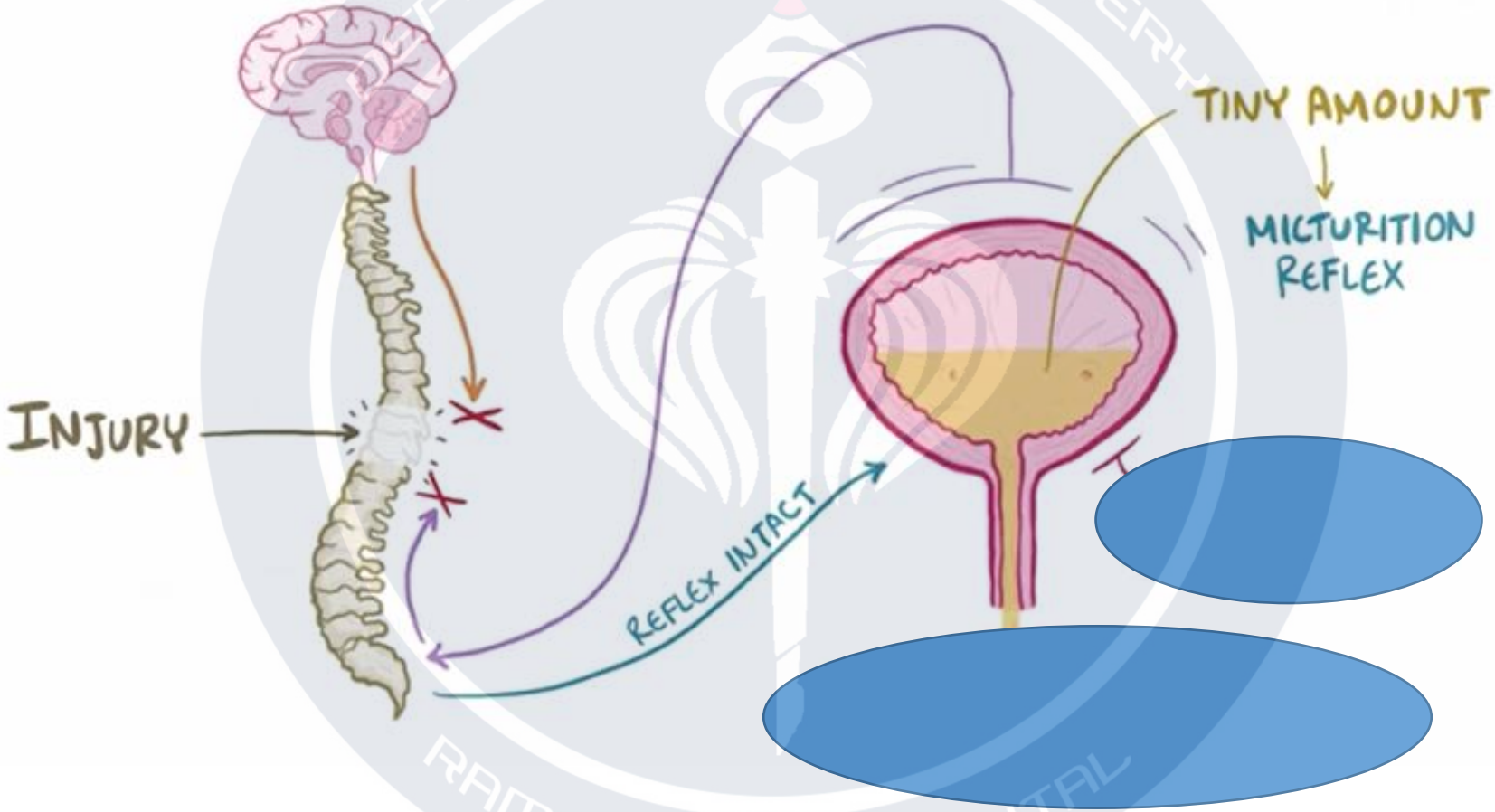


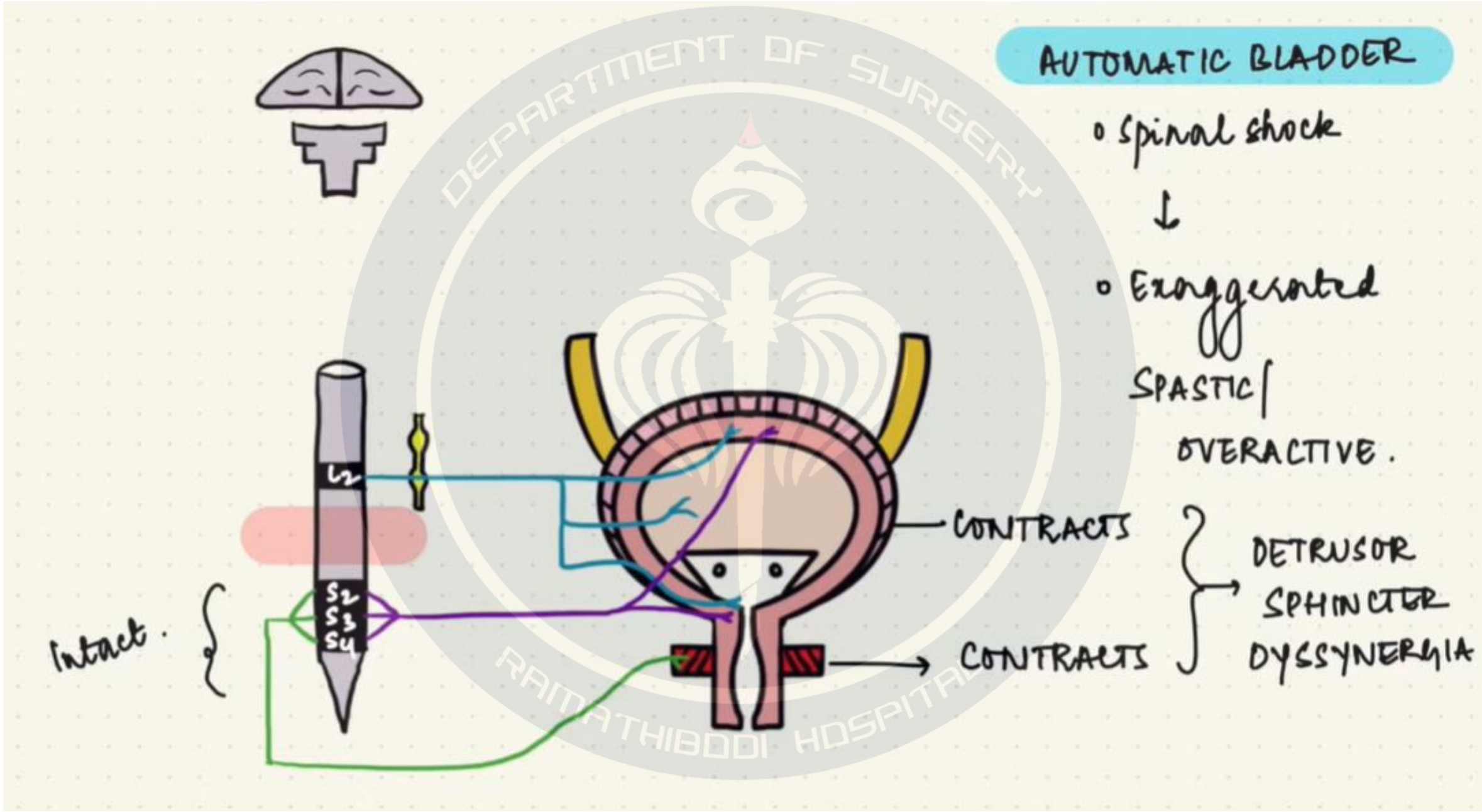
Diabetes

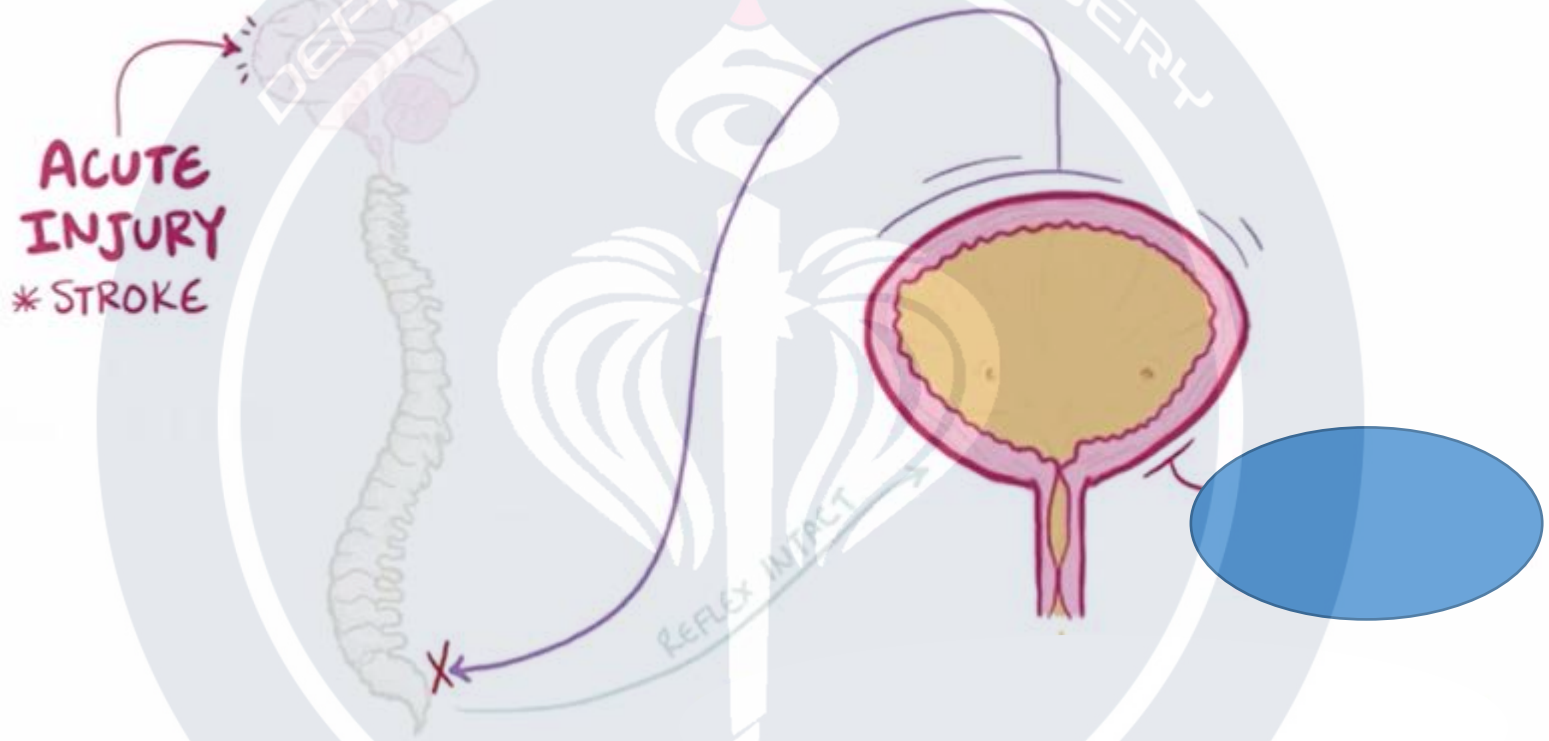


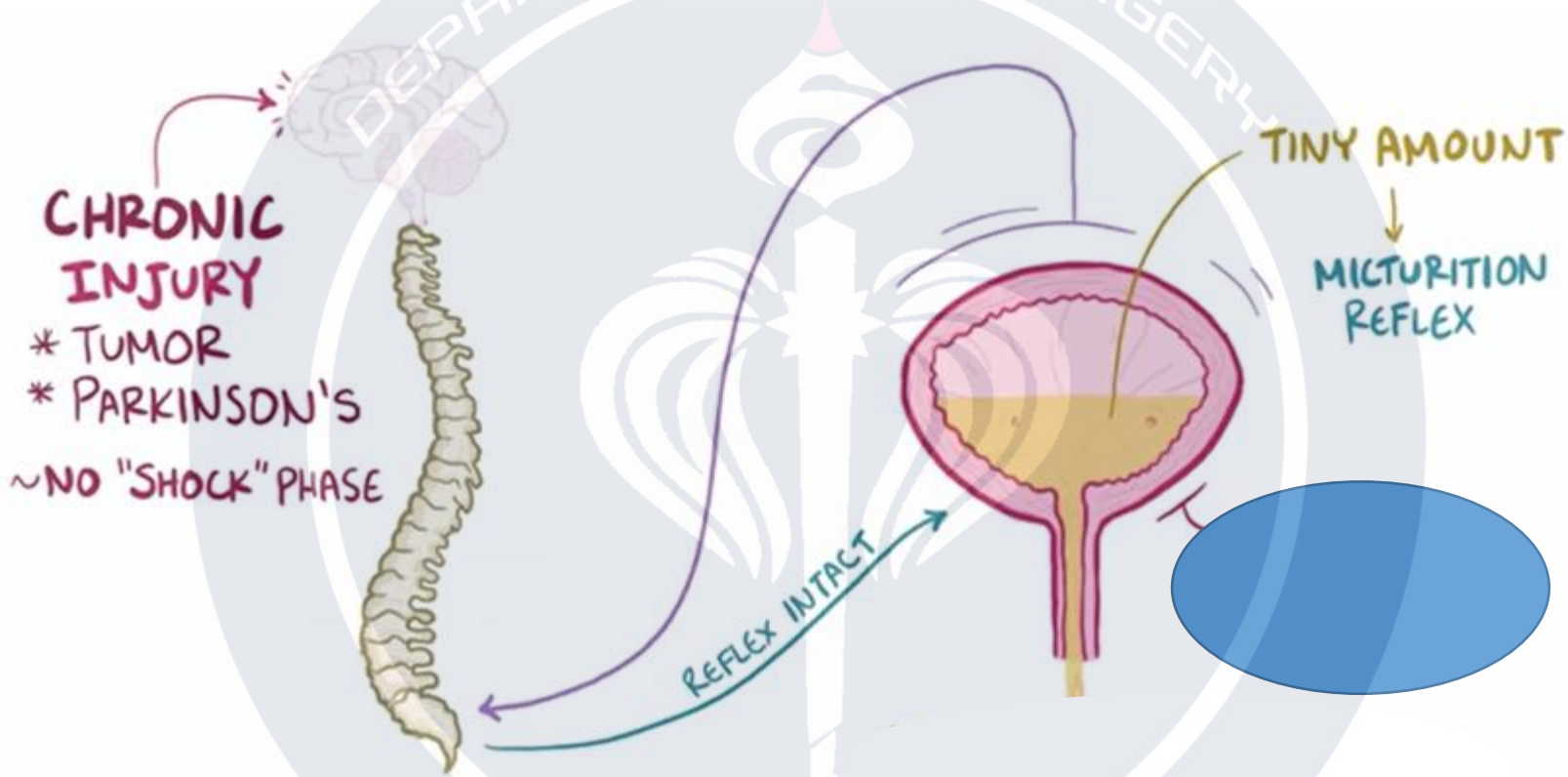

INJURY


INJURY
SPINAL SHOCK
~HOURS to WEEKS









Case discussion

- 6 month old male
- History of lower back lesion waiting for surgery
- No neurologic deficit
- Consult urologist at OPD

What is the proper management? 3

- BUN/Cr
- Ultrasound KUB
- Urodynamic study

What would you like to know from the UDS? 3

- Detrusor pressure (during filling phase and at leakage)
- Bladder capacity
- Residual urine

How do you calculate the capacity of the bladder?

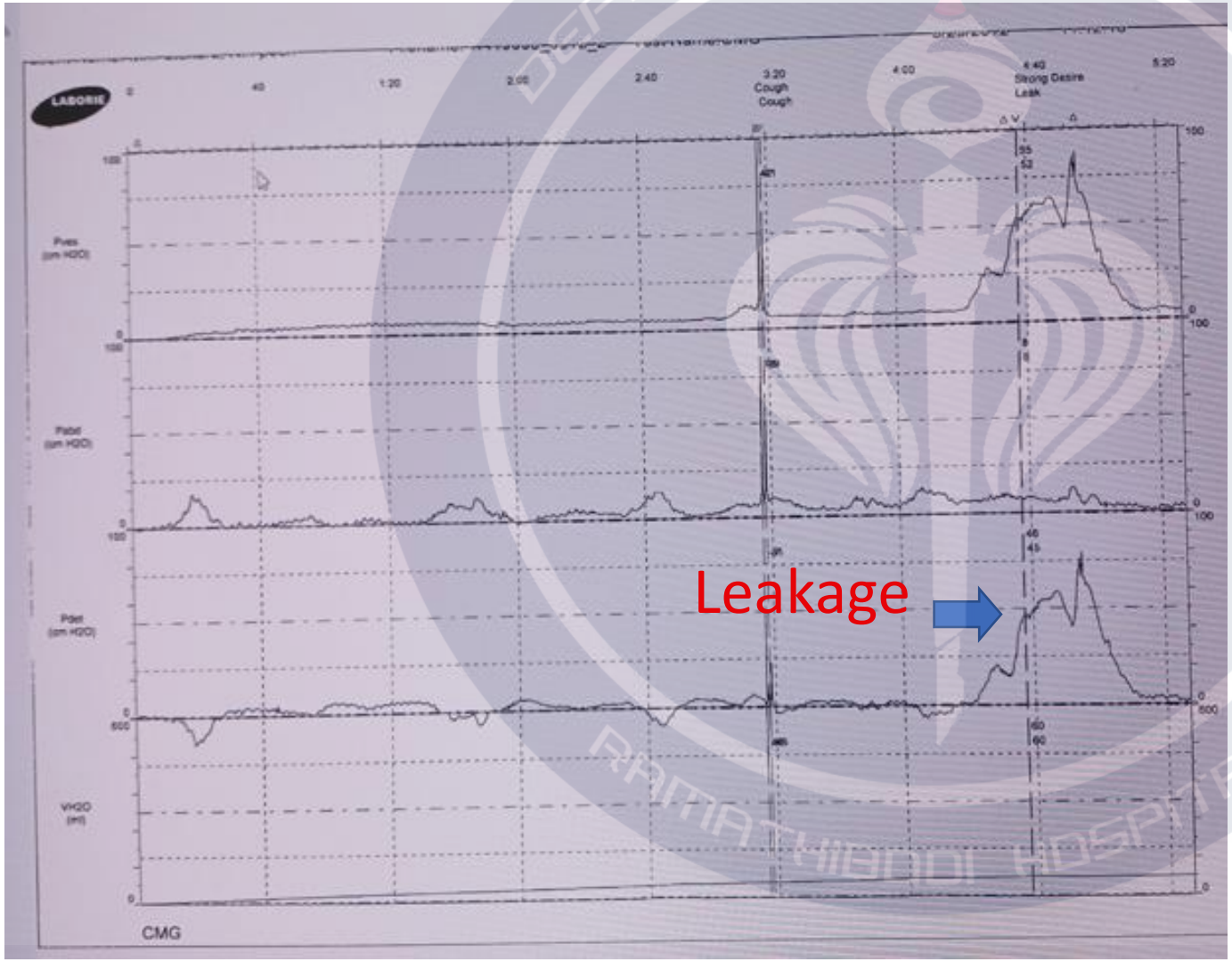
Estimating normal bladder capacity in children

References	No.Pts	Methods	Formula	Age
Koff 1983	35	Urodynamics (anesthetized)	Age(yrs) + 2 (oz)	All ages
Berger et al 1983	132	Cystoscopy and radionuclide cystography	Age(yrs) + 2 (oz)	All ages
Fairhurst et al 1991	70	VCUG	Wt. (kg) x 7 (ml)	< 1 yr
Kaefer et al 1997	2066	Radionuclide cystography	2(Age) + 2 (oz) Age/2 + 6 (oz)	< 2 yrs > 2 yrs

Result

- BUN/Cr = 0.2
- Ultrasound KUB : No HN

Result from the UDS?



- Residual urine = 20ml

What is the proper management? 2

- Anticholinergic (Diutropan)
- CIC

If parents deny CIC!!

Do you have any option for this patient?

How will you follow up with patients?

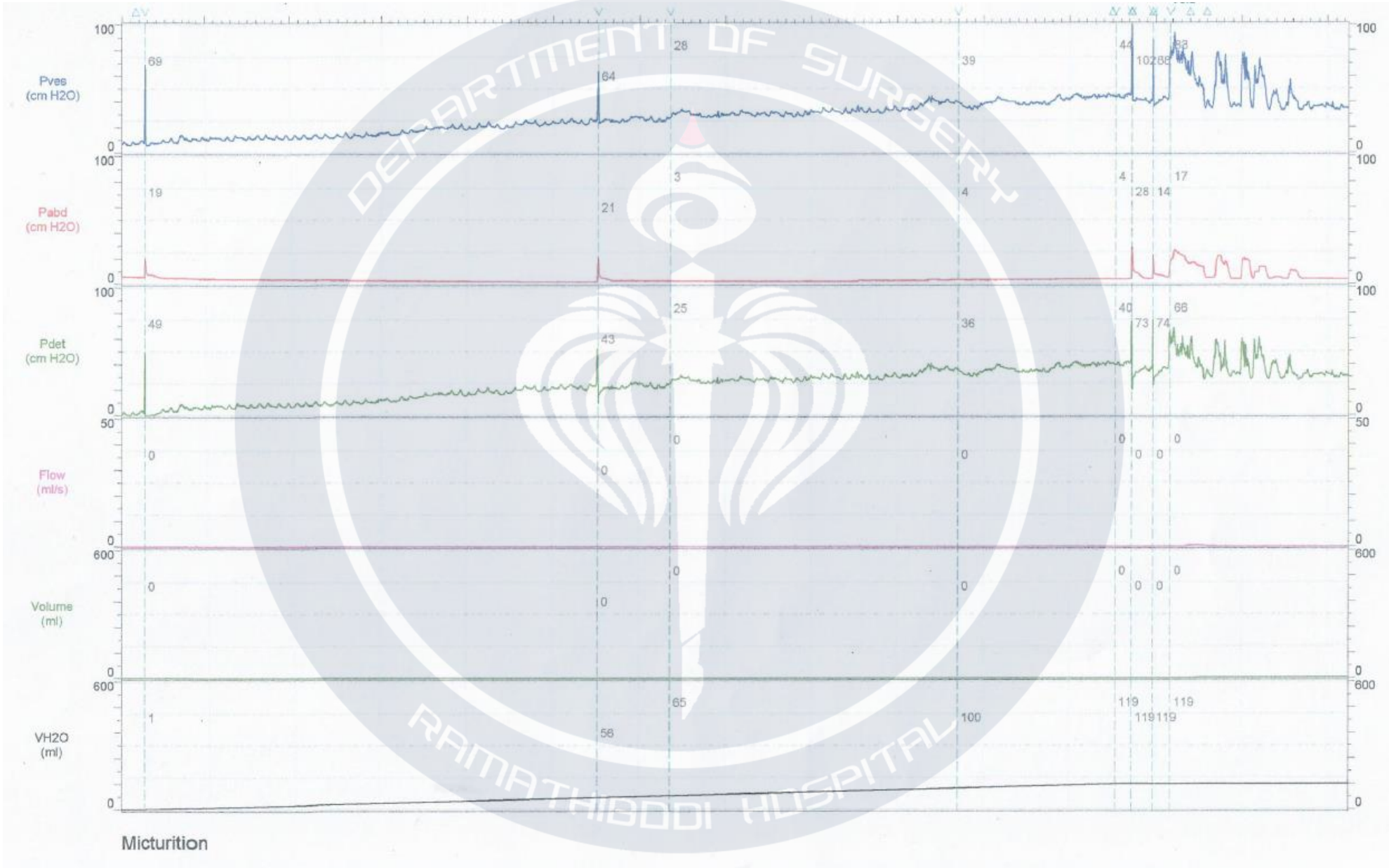
TABLE 34.3 Summary of the International Children's Continence Society Recommendations for the Diagnostic Evaluation and Follow-Up of Congenital Neurogenic Bladder

AGE GROUP	TYPE OF INVESTIGATION	RECOMMENDED FREQUENCY OF INVESTIGATION	INDICATION FOR INVESTIGATION
Newborn to toddler	Ultrasonography	Every 6 months until 2 years of age	High risk for tethering with rapid growth
	UDS	Every 12 months	UTIs or lower extremity changes
	DMSA renal scan	When indicated	Consider if VUR on initial VCUG/RNC or febrile UTIs
Toddler to adolescent	Ultrasonography	Every 12 to 24 months	Low risk for tethering with slower growth
	UDS	When indicated	Change in ambulation or lower extremity function
	DMSA renal scan	When indicated	Febrile UTIs
Adolescent to adult	Ultrasonography	Every 12 months	Low risk for tethering with slower growth; may decrease to every 24 months once growth velocity has decreased
	UDS	When indicated	Development of hydronephrosis, more frequent CIC required for continence, new wetting, recurrent UTI
	VCUG/RNC	When indicated	Recurrent UTI
Adult	Ultrasonography	Every 36 months	Low risk for tethering without ongoing somatic growth
	UDS	When indicated	Development of hydronephrosis, more frequent CIC required for continence, new wetting, recurrent UTI

CIC, Clean intermittent catheterization; *DMSA,* dimercaptosuccinic acid; *RNC* radionuclide cystography; *UTI,* urinary tract infection; *UDS,* urodynamic studies; *VCUG,* voiding cystourethrography; *VUR,* vesicoureteral reflux.

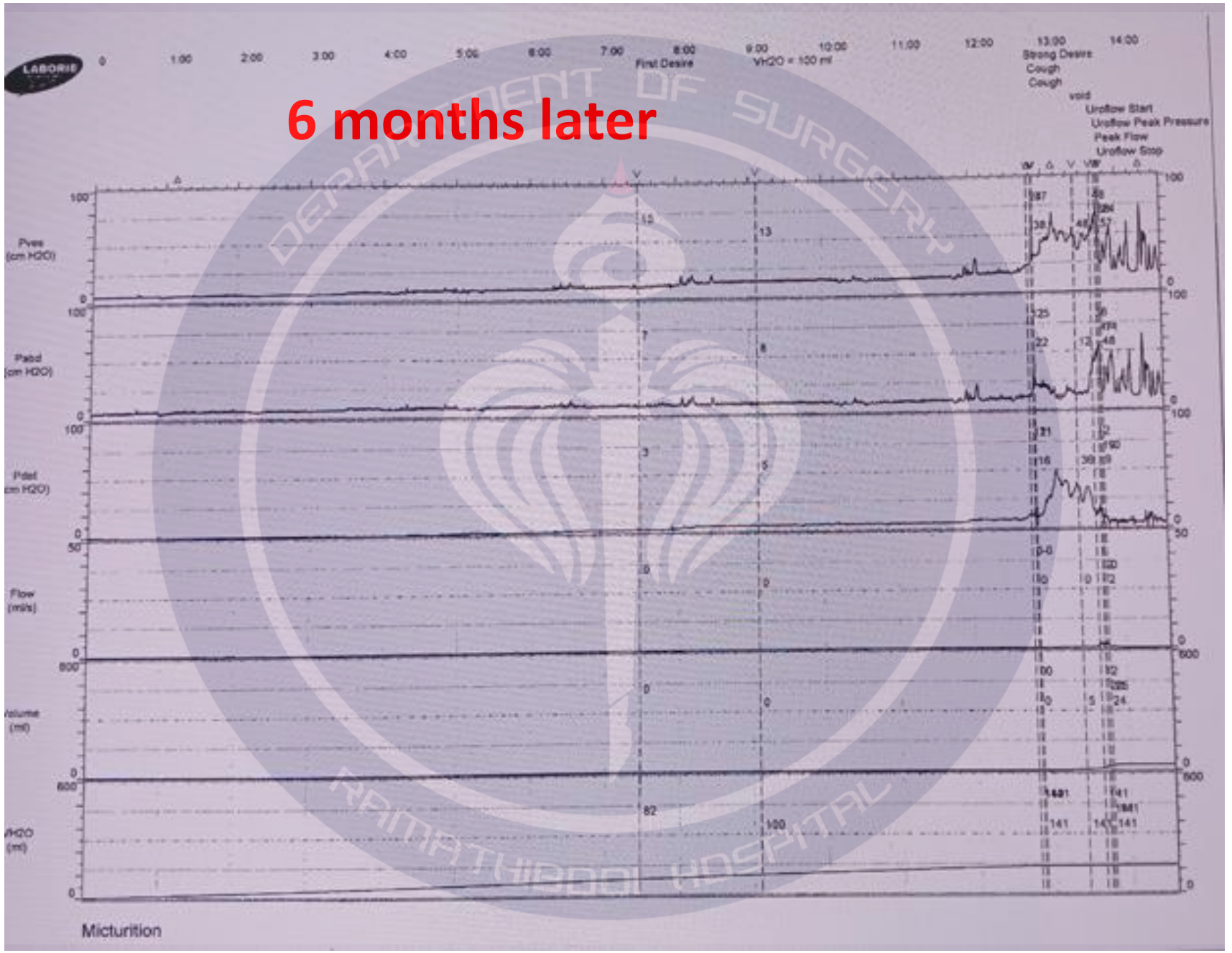
8 months later (post spinal cord surgery)

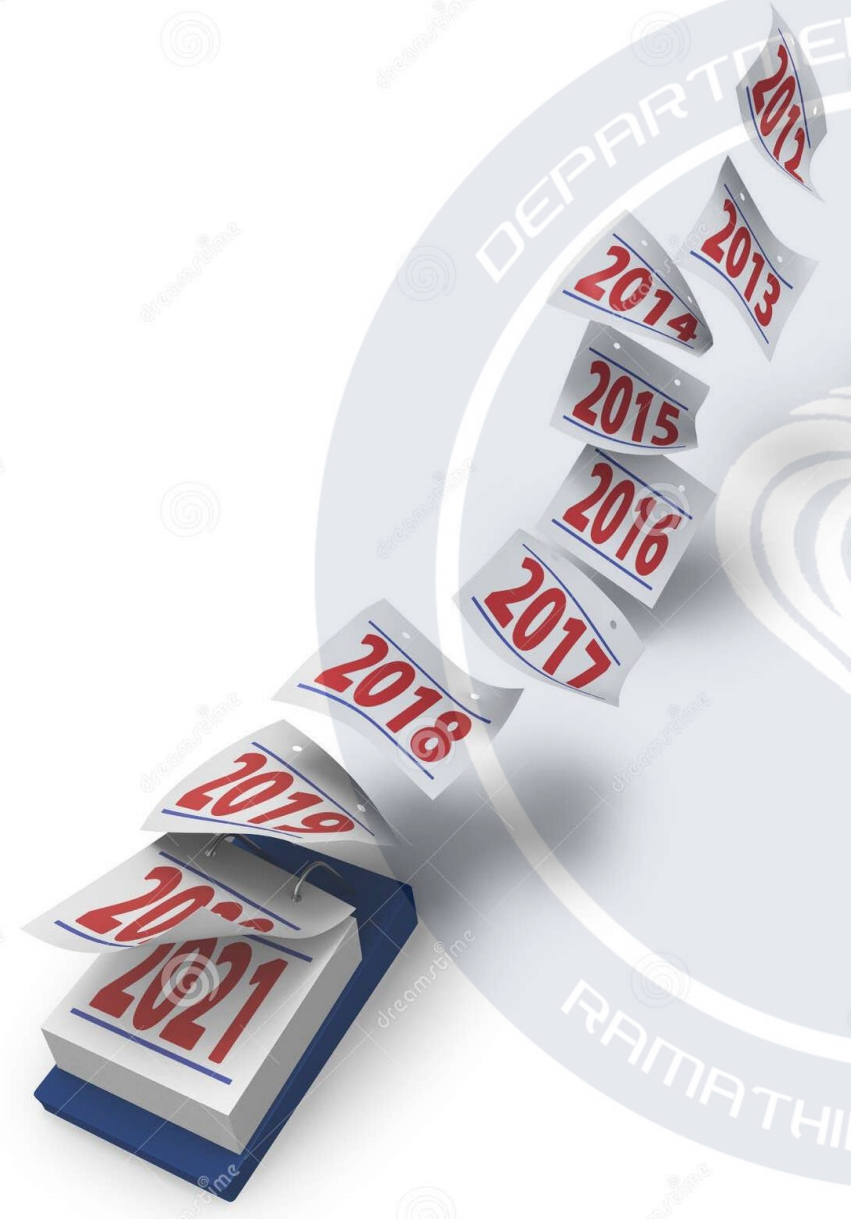
- Ultrasound : no HN and no HU
- Cr = 0.2
- UDS : as figure


Pves
(cm H2O)
Pabd
(cm H2O)
Pdet
(cm H2O)
Flow
(ml/s)
Volume
(ml)
VH2O
(ml)
Micturition

What is the proper management? 2

- Increase dose of anticholinergic (Diutropan)
- CIC


6 months later
LABORIE
First Desire
VH2O = 100 ml
Strong Desire
Cough
Cough
void
Uroflow Start
Uroflow Peak Pressure
Peak Flow
Uroflow Stop
Pves (cm H2O)
Pabd (cm H2O)
Pdet (cm H2O)
Flow (ml/s)
Volume (ml)
VH2O (ml)
Micturition



Ten year later

He develops daytime leakage and enuresis!!


whathappened

Tethered cord syndrome

The term "tethered cord syndrome" originates from an article in 1976 authored by Hoffman et al., wherein they describe 31 patients with elongated spinal cords whose symptoms improved following sectioning of the filum terminale.

Hoffman HJ, et al. Childs Brain. 1976;2(3):145-55.

Excessive traction on the spinal cord due to TCS results in impaired spinal cord perfusion, oxidative metabolism, reduced glucose metabolism, and mitochondrial failure with corresponding electrophysiologic changes and neurologic dysfunction.

Yamada S, et al. Neurosurg Clin N Am. 1995 Apr;6(2):311-23.

Please be careful !!

- The neurologic lesion produced by tethered cord syndrome can be variable
- The neurologic lesion produced by this condition influences lower urinary tract function in a variety of ways and cannot be predicted just by looking at the spinal abnormality or the neurologic function of the lower extremities
- No two children have the same neurourologic defect

- The neurologic lesion in myelodysplasia is a dynamic disease process in which changes take place throughout childhood

Epstein, 1982
Reigel, 1983
Venes and Stevens,1983
Oi et al, 1990

especially in early infancy and later at puberty

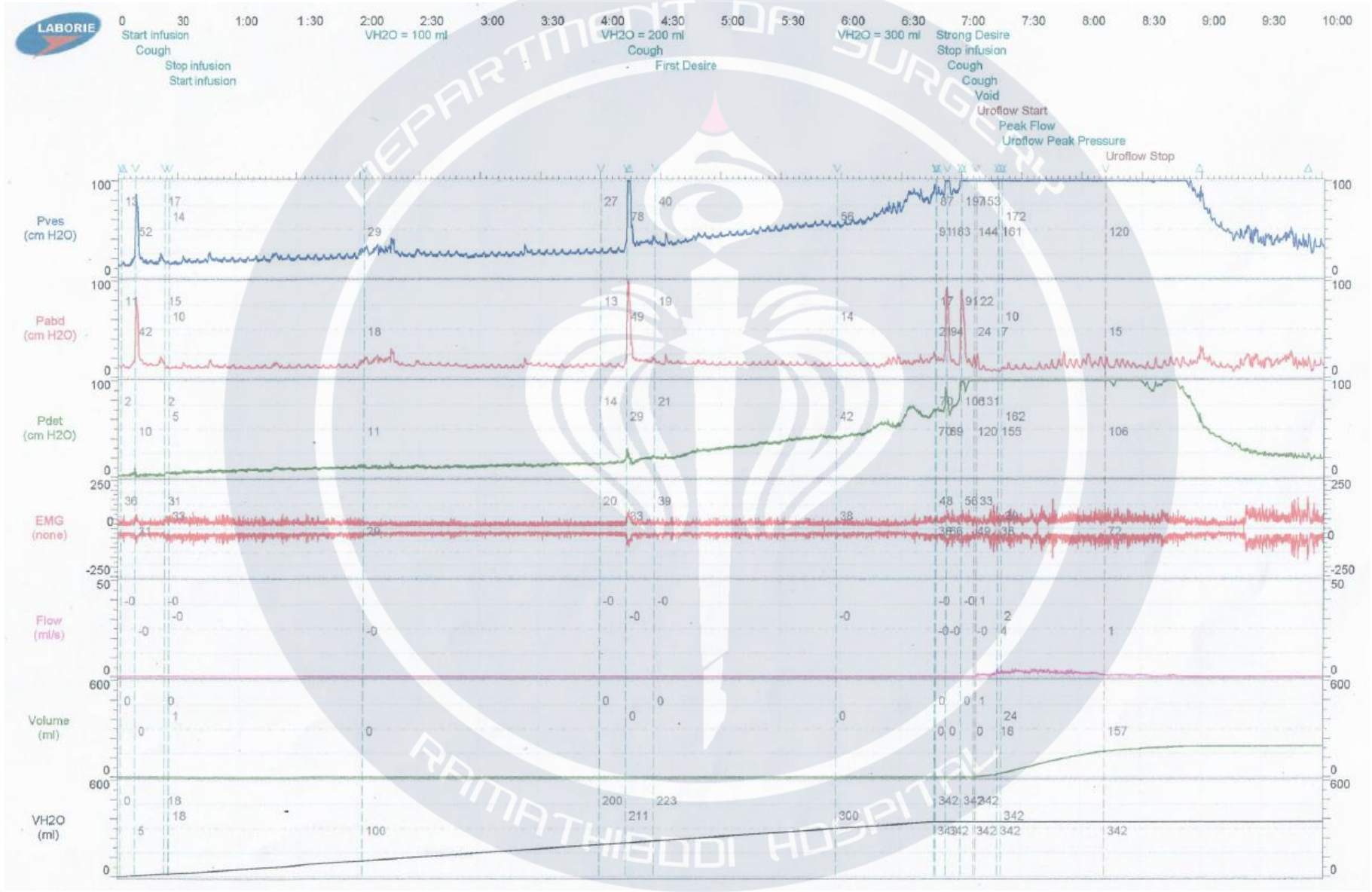
Spindel et al, 1987
Begger et al, 1986

What is the proper management? 6

- History of antimuscarinic dose and CIC times??
- Urodynamic study
- BUN/Cr
- Ultrasound KUB
- MRI spine
- Consult neurosurgeon

Results

- History of antimuscarinic dose and CIC times
  - Diutropan 5mg BID
  - Can not void
  - CIC q6hr RU about 300ml
  - UTI 1-2 episode/year
- Urodynamic study : as figure
- Cr = 0.9 (GFR = 80)
- Ultrasound KUB : Bilateral mild HN and HU


LABORIE
Start infusion
Cough
Stop infusion
Start infusion
VH2O = 100 ml
VH2O = 200 ml
Cough
First Desire
VH2O = 300 ml
Strong Desire
Stop infusion
Cough
Cough
Void
Uroflow Start
Peak Flow
Uroflow Peak Pressure
Uroflow Stop
Pves (cm H2O)
Pabd (cm H2O)
Pdet (cm H2O)
EMG (none)
Flow (ml/s)
Volume (ml)
VH2O (ml)

What is the proper management?

- Increase antimuscarinic??

Pharmacologic treatment

- Anticholinergic agents

- Oxybutynin hydrochloride is most commonly used, and long-term experience supports its safety also in newborns and infants.

Edelstein RA, et al. J Urol 1995

Pharmacologic treatment

- Combined high-dose anticholinergic medication in adults with neurogenic bladder .
  - Successful therapy in 85% (improvement in incontinence, mean bladder capacity and compliance)
  - Group A: 8mg tolteridine and oxybutynin 15 and 30mg
  - Group B: 90mg trospium and tolteridine 4-8mg
  - Group C: 30mg oxybutynin and trospium 45-90mg
  - Group B and C: greater improvement in bladder capacity over group A.

Pharmacologic treatment

- These results suggest that one should ensure maximal medical therapy including dose escalation and the addition of a second anticholinergic prior to embarking on surgical management in children with NBD.

Amend B, et al. Eur Urol 2008;53:1021-1028.

Pharmacologic treatment

- Double Anticholinergic Therapy for Refractory Overactive Bladder.

Stephane Bolduc, et al. J Urol. 2009 Oct;182:2033-8.

- 19 boys and 14 girls
- age 12.0 ± 3
- Neurogenic 19 Nonneurogenic 14
- 10-30 mg oxybutynin, 4 mg tolterodine, 5-10 mg solifenacin

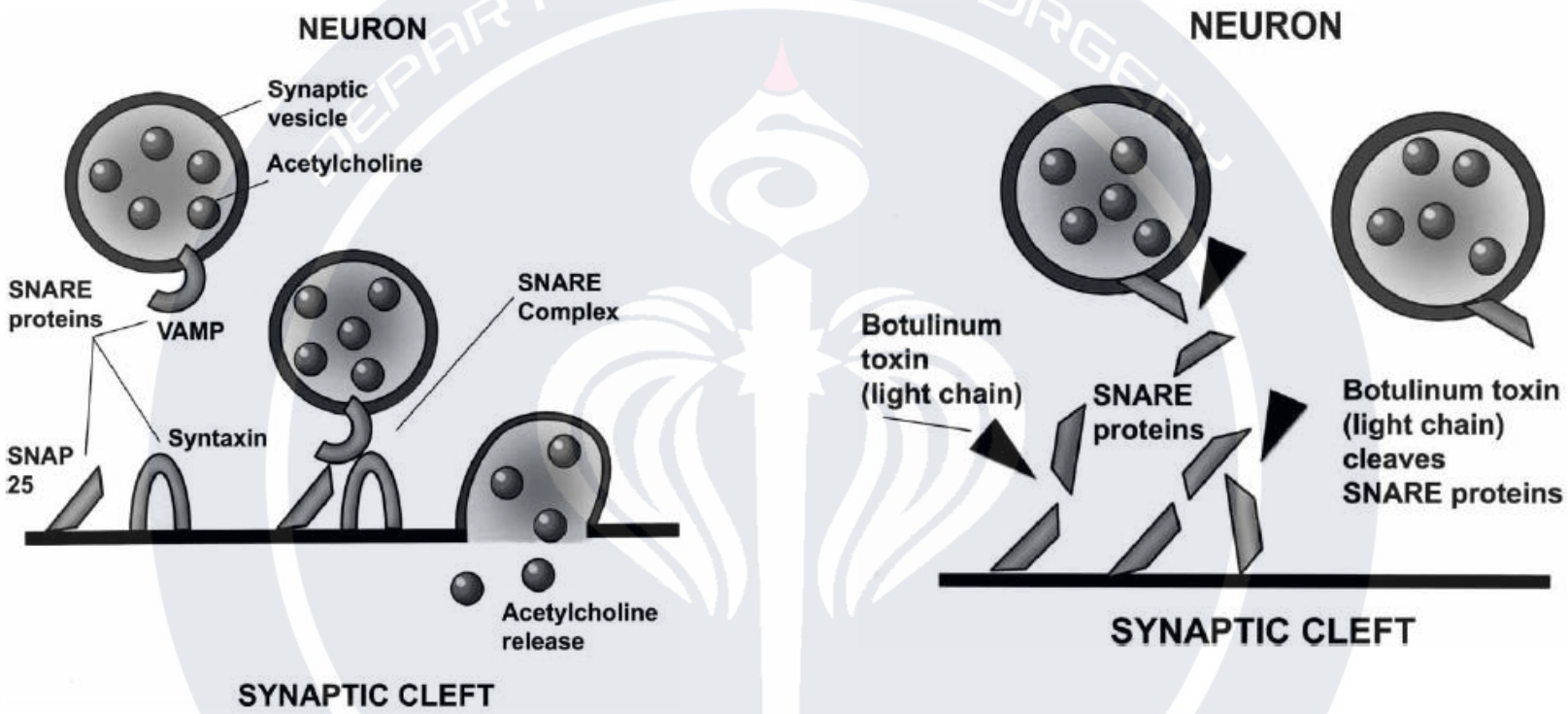
"In children with refractory overactive bladder double anticholinergic therapy is an efficient and serious alternative to surgery. Patients and families were satisfied with this nonoperative, innovative approach."

Patient cannot tolerate side effect of AM

What is your choice?

Botulinum A toxin

- Botulinum A toxin injections into the detrusor muscle have been shown to be a potentially valuable approach in the neurogenic overactive bladder.
- BTX-A is not a long lasting treatment
- Long-term effects on the structure and function of the bladder with repeated detrusor BTX-A injection have not been defined.



Todd A. Linsenmeyer. The Journal of Spinal Cord Medicine 2013

Injection protocol (Children with NB)

- Most commonly injected dose is 10 IU/kg
- Maximum total dose of up to 200 IU
- Usually as 20 injection sites
- Sparing the trigone
- Under cystoscopic guidance (rigid) and
- Under general anaesthesia

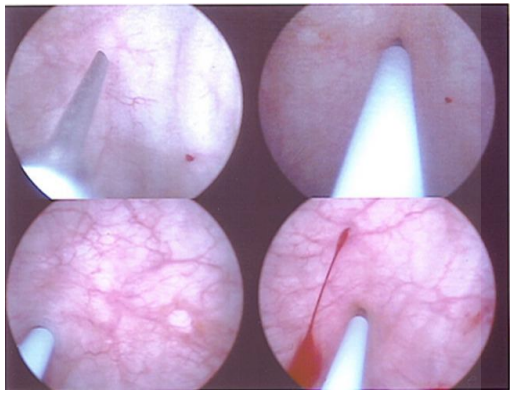


Table 4 Impact of Botox on Pdetmax (cm H_2O).

First author	No. of patients	Mean baseline	Mean endpoint	Mean change vs baseline	Mean % change vs baseline
Schulte-Baukloh [11]					
First injection	10	65.7	60.7	−5.0	−8
Third injection	10	73.6	41.8	−31.8	−43
First injection	4[c]	52.0	48.3	−3.7	−7
Fifth injection	4	58.5	36.0	−22.8	−39
Schulte-Baukloh [12]					
Schulte-Baukloh [14]	17	58.9	39.7	−19.2**	−33
Altaweel [15]	20	43.0[a]	21.6[a]	−21.4[b]**	−50
Kajbafzadeh [16]	26	139.3	83.2	−56.1**	−40

**$P < 0.01$, and ***$P < 0.001$.
[a] Results for 13 continent patients.
[b] Similar improvement after second injection.
[c] Same patients who received fifth injection.
[d] All patients received a second injection after 1 year.
[e] Similar improvement after second injection.

All studies showed a significant impact of Botox in reducing Pdetmax. The percentage mean reduction in Pdetmax from baseline was approximately 33-55%

Problem: Unanswer question?

- There is no study that assesses the impact of repeated injections on bladder wall, and on the risk of fibrosis and of bladder compliance alteration in time

Reinjections: When?

- Reinjections after a predefined time interval of 7-8 months based on literature data on duration of effect
- Reinjection only based on symptoms or urodynamic worsening

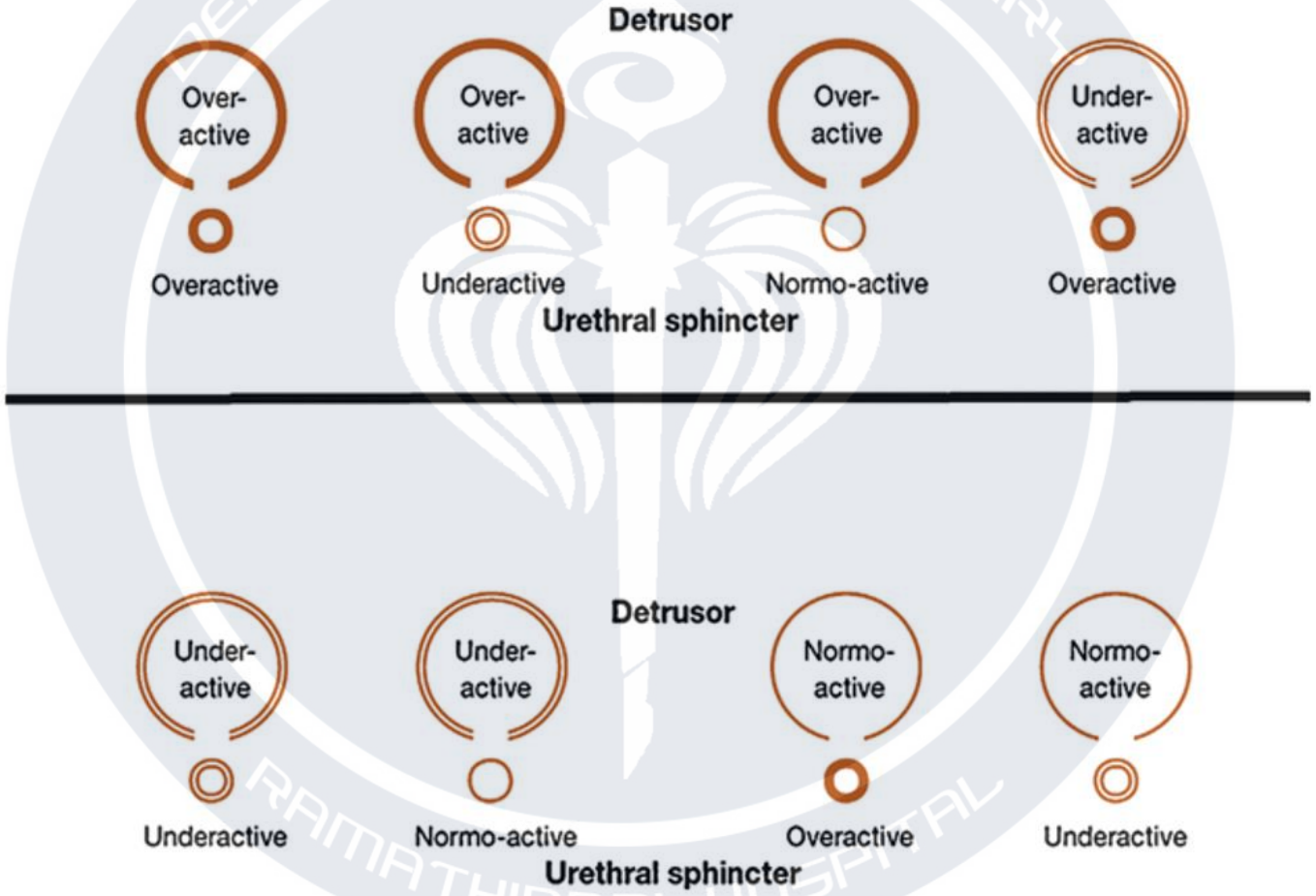

GOOD
JOB

Wrap Up

Dangerous Bladder

Safe Bladder

Patterns of neurogenic lower urinary tract dysfunction (NLUTD)



Madersbacher H. Paraplegia 1990;28:217-29.

Urodynamic study

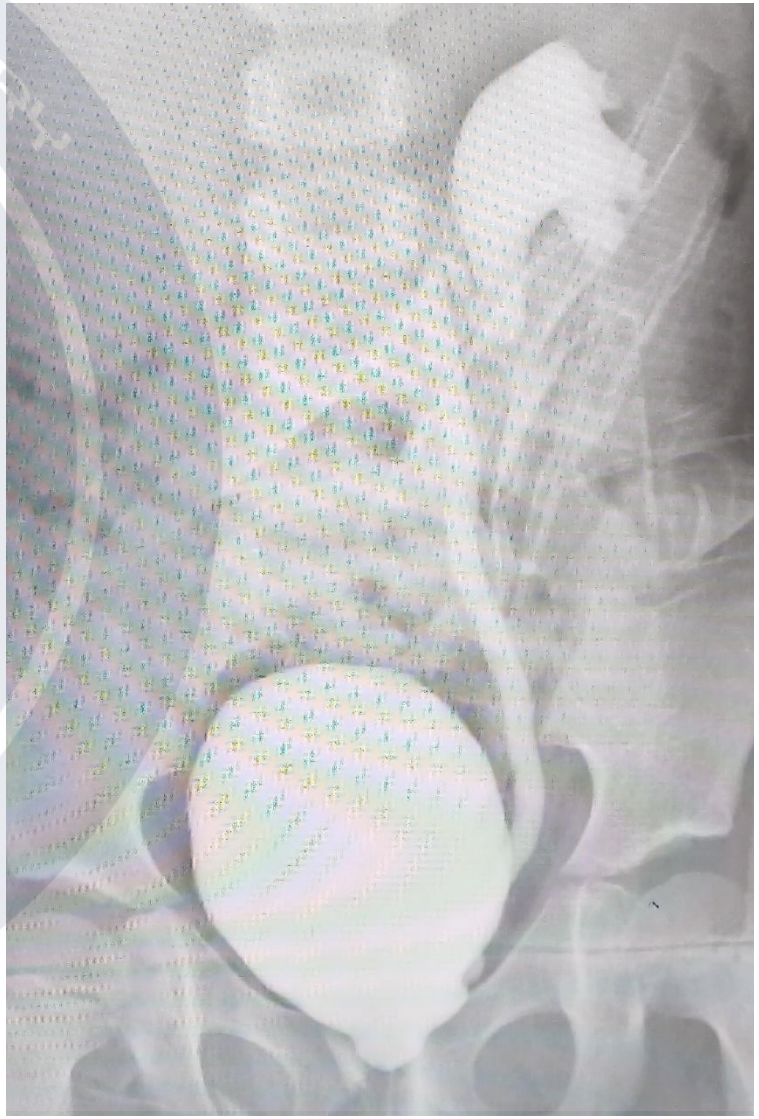
WE CAN HELP

Goal of management

- Protecting the upper urinary tract
- Ensuring storage
- Achieving continence
- Avoidance of UTI
- Improvement of the patient's QoL.

Pathophysiology

- When the detrusor (filling) pressure is high.
  - Glomerular filtration rate decreases.
  - Pyelocaliceal and ureteral drainage deteriorates.
  - Leading to obstructive hydronephrosis and/or vesicoureteral reflux.



Pathophysiology

- Detrusor filling pressures need to be looked at.
- Landau et al. (1994) developed the concept of low detrusor filling pressure (< 30 cm H_2O) not at maximal capacity.
- Applying this notion, they reported significantly improved sensitivity in predicting upper urinary tract deterioration.

Centers for Disease Control and Prevention (CDC)-sponsored spina bifida management protocol categorized UDS into four groups

- Hostile bladder
  - end filling pressure or detrusor leak point pressure (DLPP) 40 cm H_2O or greater or detrusor overactivity (DO) with DSD
- Intermediate risk
  - DO, reduced compliance, and end filling pressure or DLPP 25 to 39 cm H_2O.
- Abnormal but safe
  - end filling pressure or DLPP less than 25 cm H2O.
- Normal bladder
  - normal capacity, compliance greater than 15 cm H_2O, no NDO, no DSD and minimal postvoid residual

Antimuscarinics
Botulinum A toxin
Augmentation Cystoplasty

CIC

CIC

Collective devices

Bladder neck reconstruction

Sling procedure

Artificial urinary sphincter (AUS)

Thank You