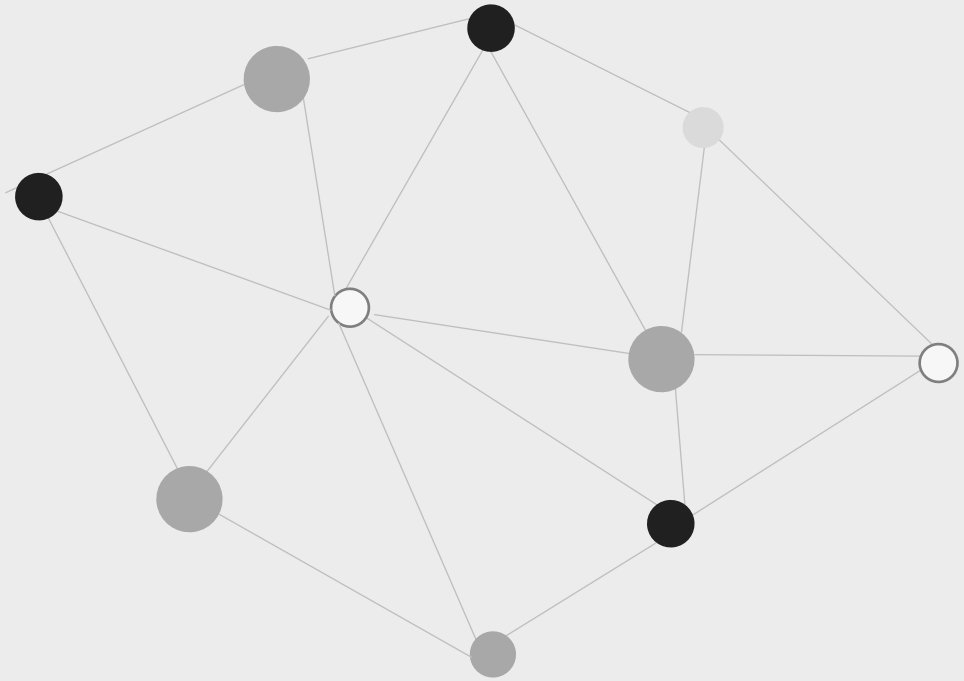

The application of PES in neurogenic bladder deriving from SCI

14364005 魏小雨　14364010 郭玉筱
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14364024 李键邦

CONTENT

NO.1

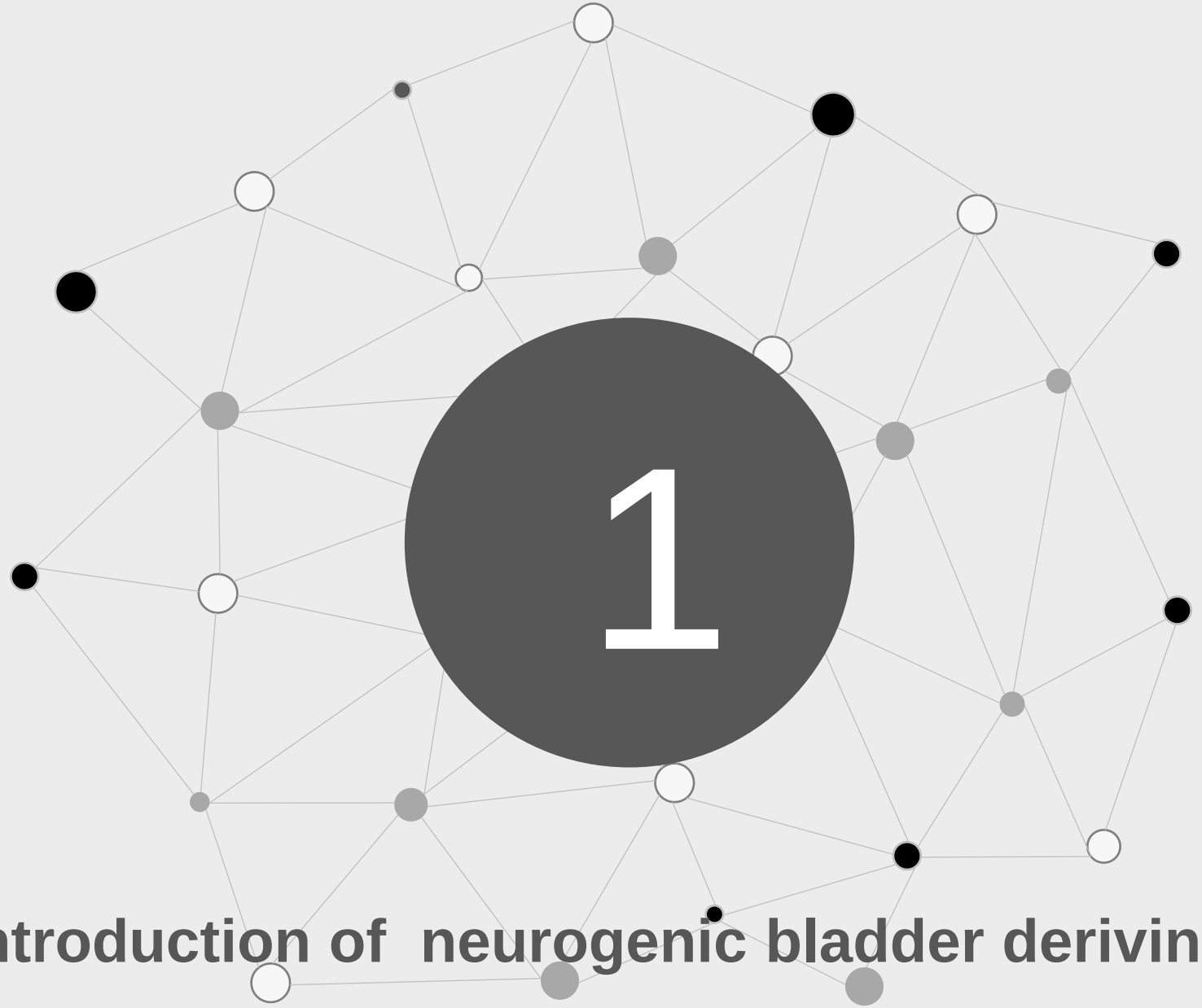
The introduction of neurogenic bladder deriving

NO.3

The Combination Therapy with PES

NO.2

PES using in neurogenic bladder deriving



The introduction of neurogenic bladder deriving from SCI

CONCEPT

Neurogenic bladder:

Refers to the dysfunction of the urinary bladder secondary to diseases of the nervous system that result in problems with urine storage, micturition, or both

[1]Manack, A. Epidemiology and healthcare utilization of neurogenic bladder patients in a US claims database[J]. Neurourol Urodyn, 2011, 30: 395-401

CONSEQUENCES

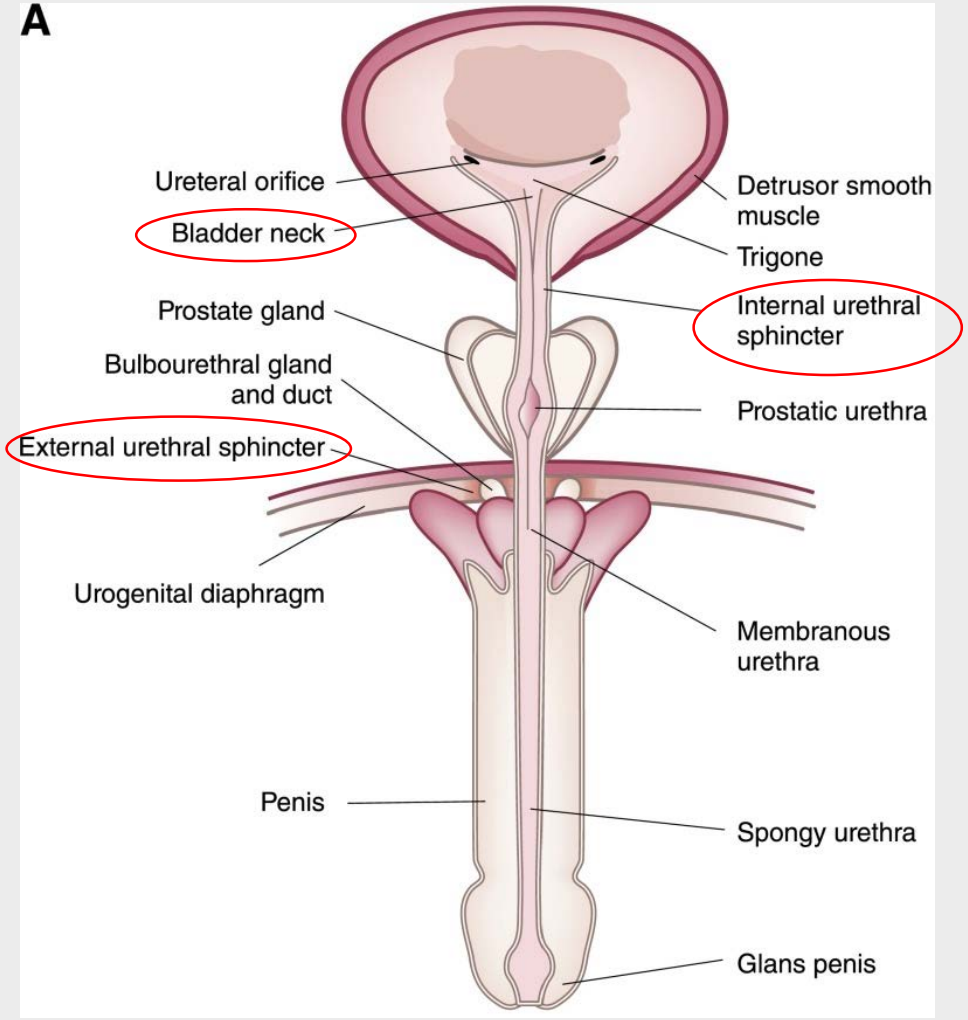
Nephropathy and renal failure

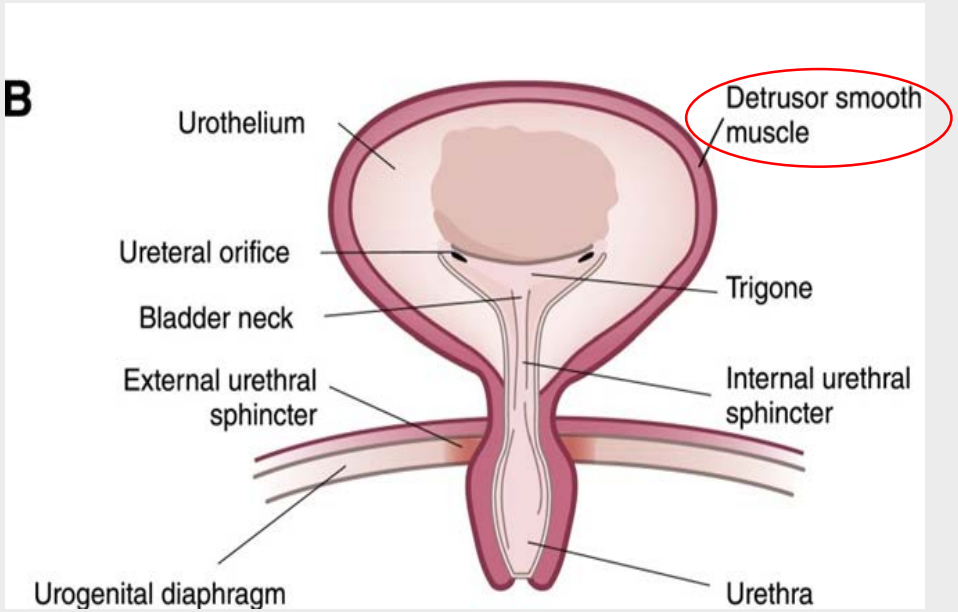
Patient’s health and life expectancy

Psychological stress

Affects social lives

ANATOMY





- Fundus vesicae urinariae
- Bladder neck
- Internal urethral sphincter
- External urethral sphincter
- Detrusor smooth muscle

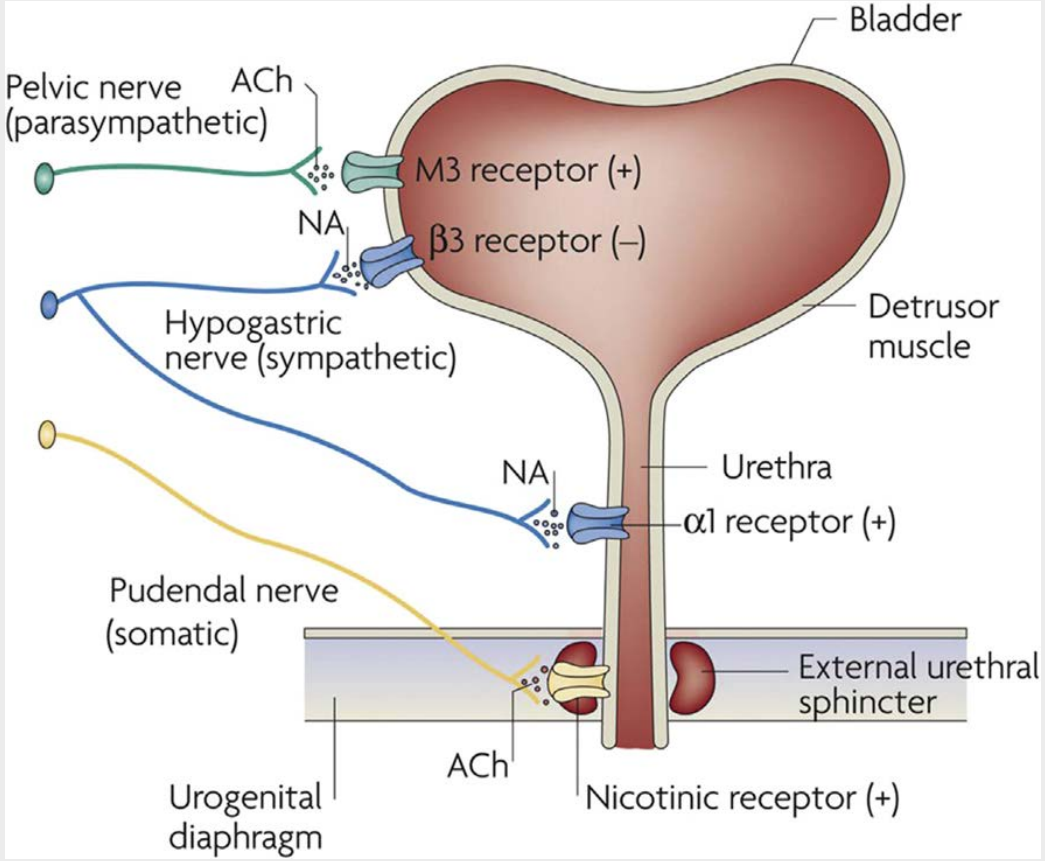
[2]Warren, G, Hill. Control of Urinary Drainage and Voiding[J]. Clin J Am Soc Nephrol, 2015, 10(3): 480-492

EFFERENT NERVE

Parasympathetic

Sympathetic

Pudendal Nerve



[3]Barry, D, Kyle. Ion channels of the mammalian urethra[J]. Channels, 2014, 8(5): 393-401

Parasympathetic

- Neural pathway :

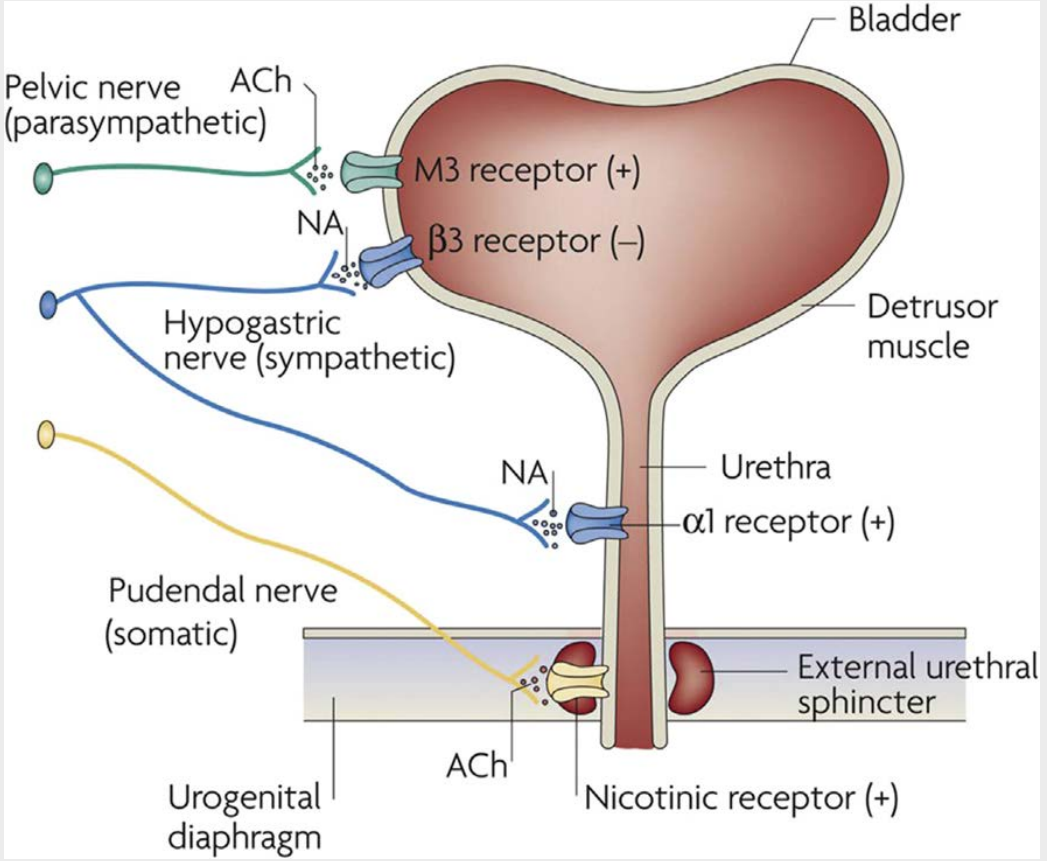
lateral horns of S2-S4 nerve roots

➢ Contraction of detrusor smooth muscle

➢ Relaxation of ureteral smooth muscle

Function:

➢ Pelvic splanchnic nerves → bladder wall (M2, M3-R)



Sympathetic

- Neural pathway :

  spinal ganglions of T11-L2

  hypogastric nerve

  detrusor smooth muscle B3-R

  internal urethral sphincter *a*1-R

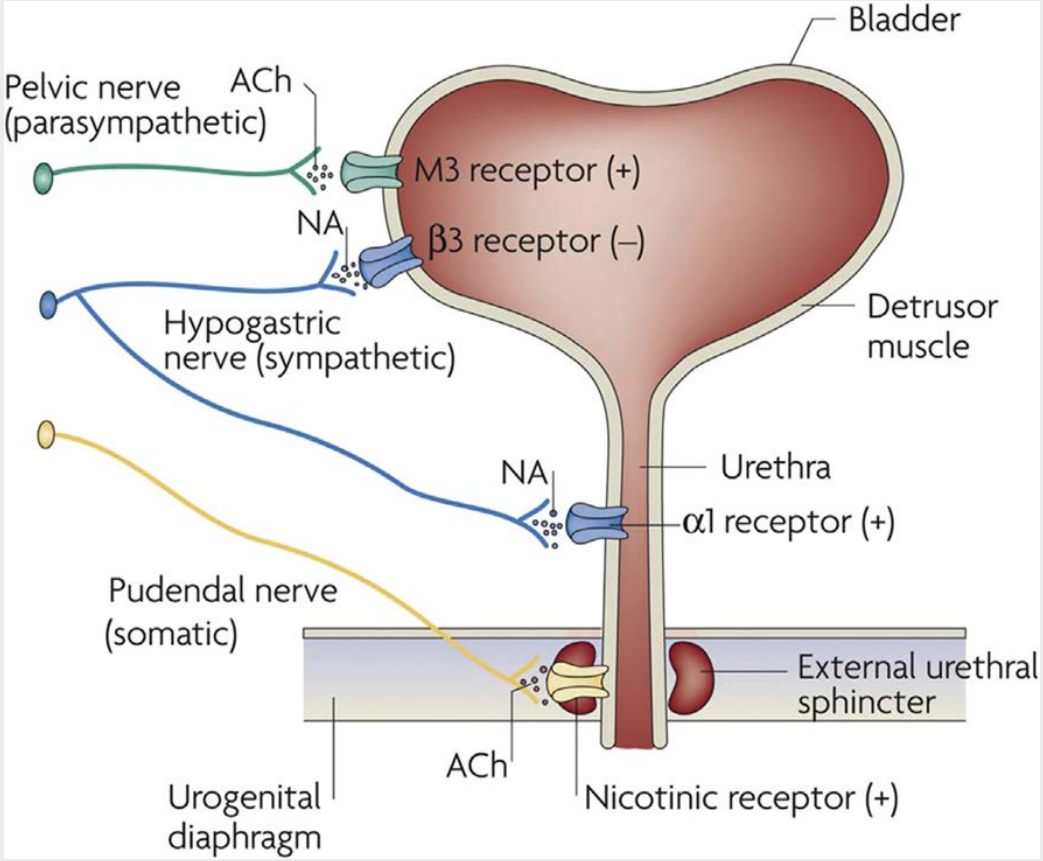
  sympathetic postganglionic neuron

Function :

·Inhibition of B3-R : suppress detrusor contraction

·Excitement of a1-R : relax bladder base and internal urethral sphincter

·Inhibition of parasympathetic postganglionic neurons



Pudendal Nerve

- Neural pathway :

➢ Onuf's nucleus of S2-S4 ventral horns

⌄⌄

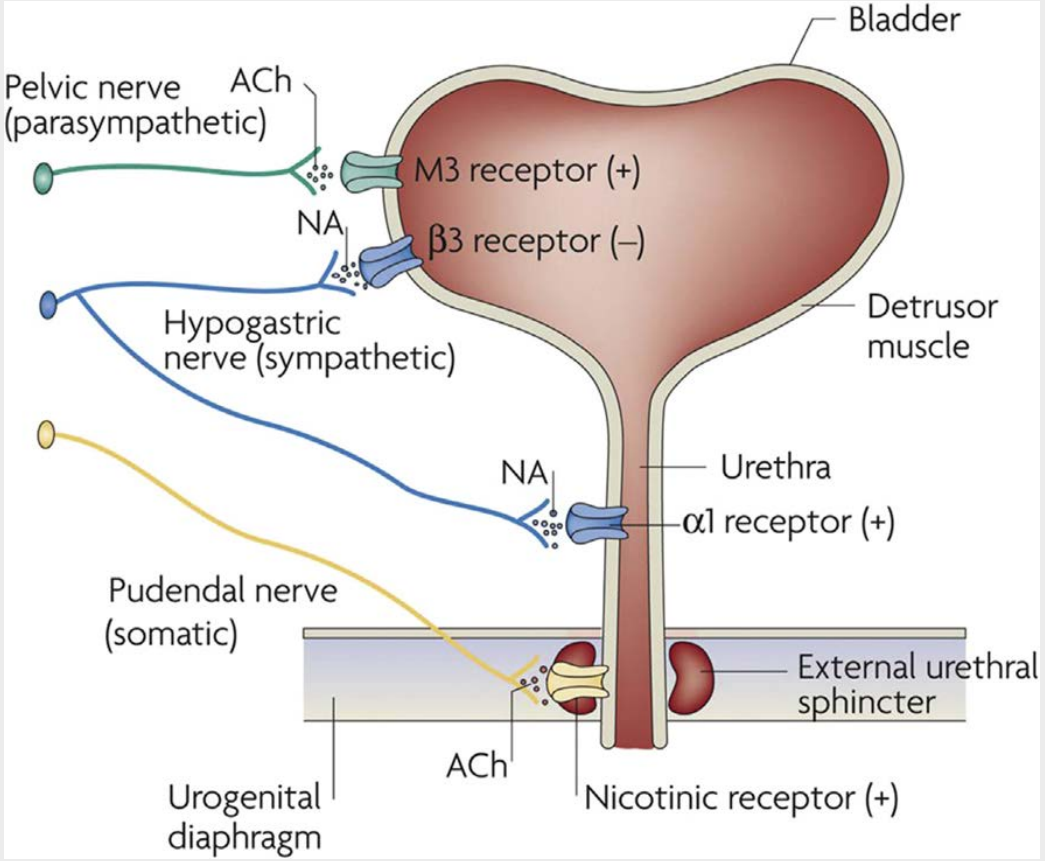
pudenal nerve

⌄⌄

external urethral sphincter

Function:

➢ Contraction of external urethral sphincter



AFFERENT NERVE

- A-fibers：small with myelin

  C-fibers：big without myelin

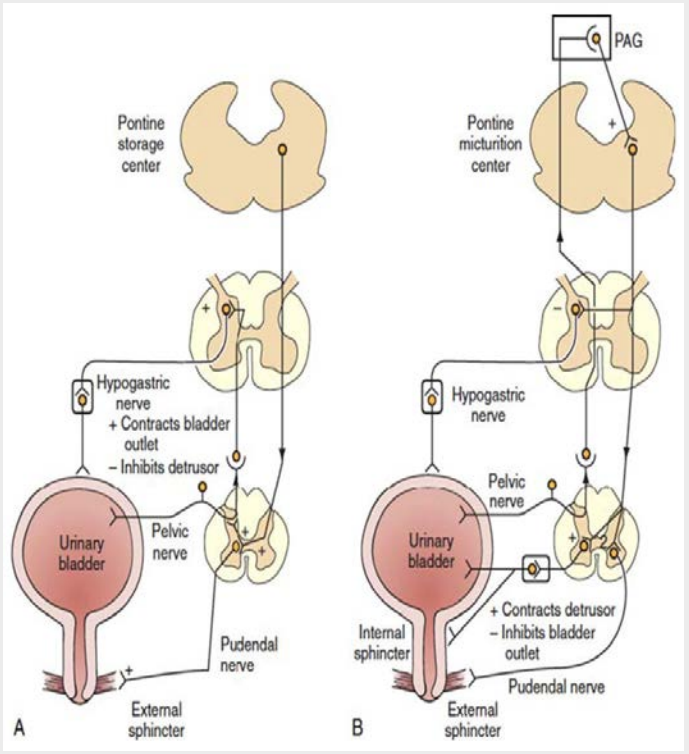
- Function

➢Bladder contracts and internal pressure rises:

☐Bladder base ⟶ T11-L2

☐Bladder neck & internal urethral sphincter ⟶ S2-S4

➢Connect spinal cord with PAG, PMC , and cerebrum, coordinate bladder urinary storage, micturition, and produce micturition desire

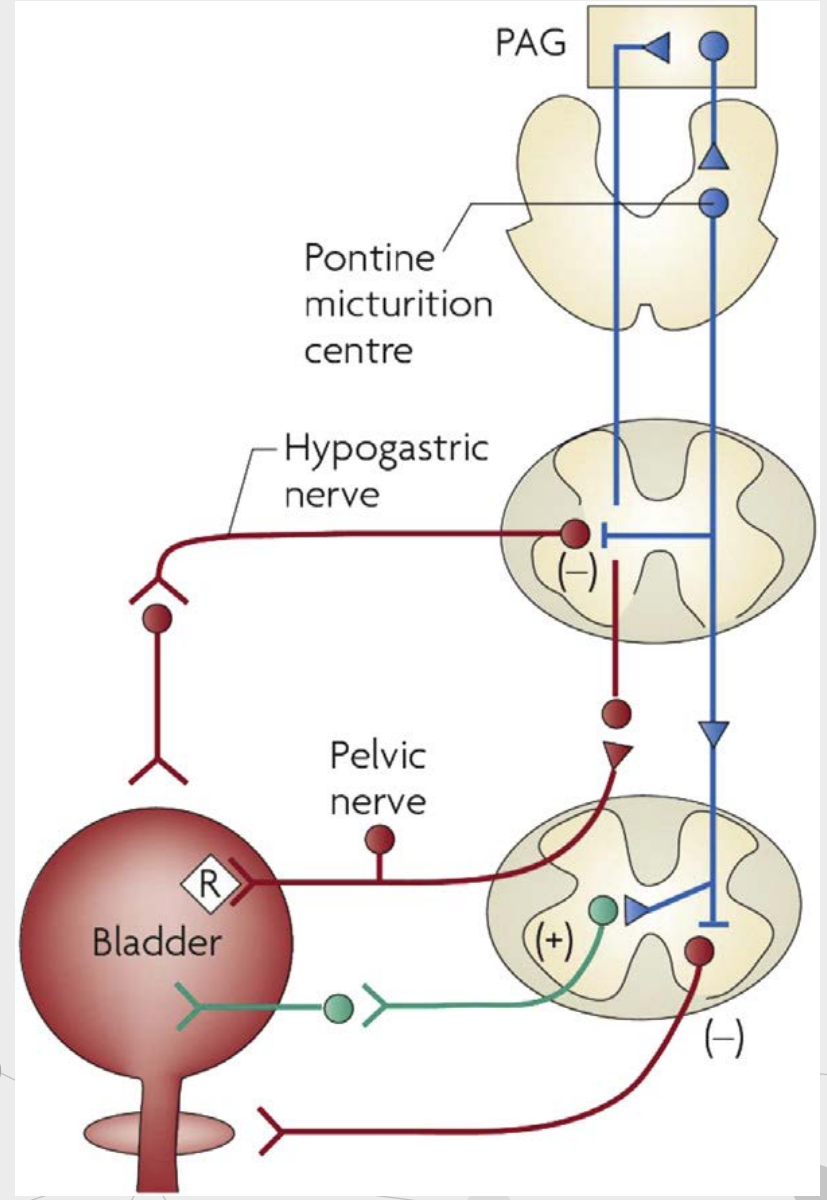


MECHANISM of NB

- Spinal shock stage（6-12w）：

urinary retention and overflow incontinence

- Parasympathetic (-)
- Sympathetic (+)
- Pudendal Nerve (-)



[4]Lai-Fung, Li. Sacral Nerve Stimulation for Neurogenic Bladder[J]. WORLD NEUROSURGERY , 2016, 2: 108

MECHANISM of NB

- Chronic stage：

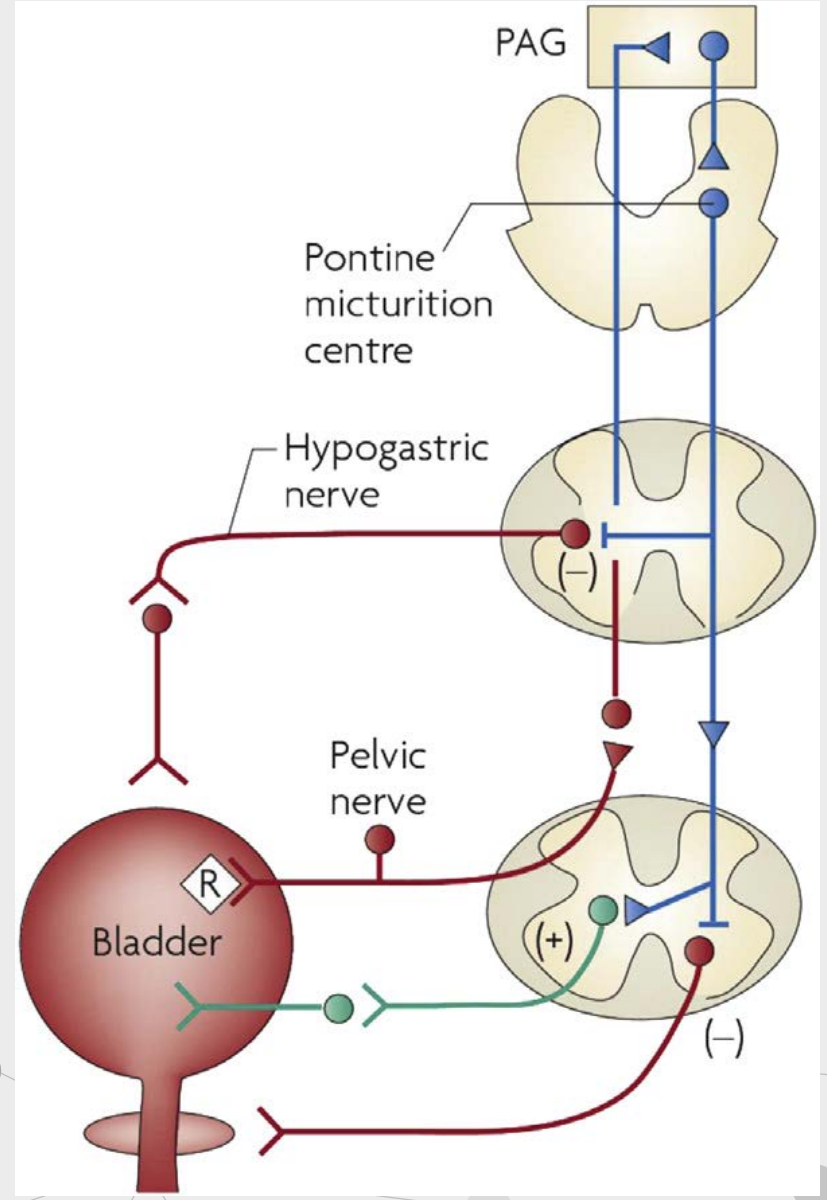
C replaces A

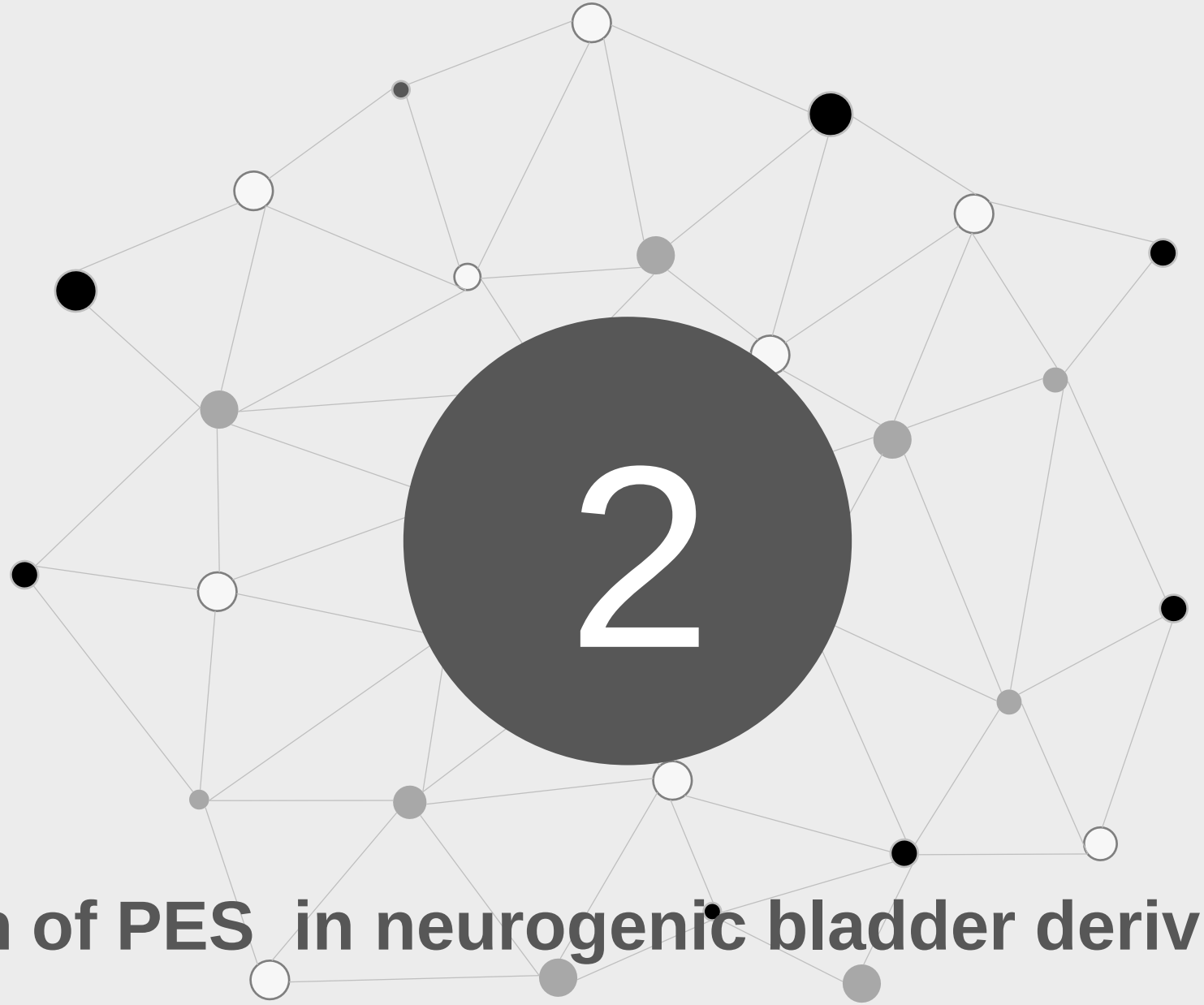
Reorganize pathway

threshold of micturition reflex is lower

detrusor overactivity

When $V_{bladder}$ ↑，urinary incontinence

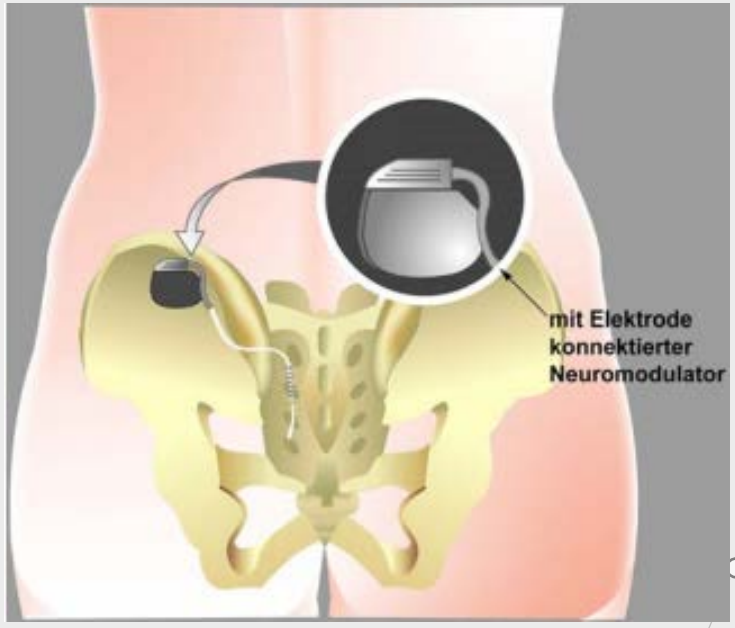




Application of PES in neurogenic bladder deriving from SCI

Why we choose the electrical stimulus？

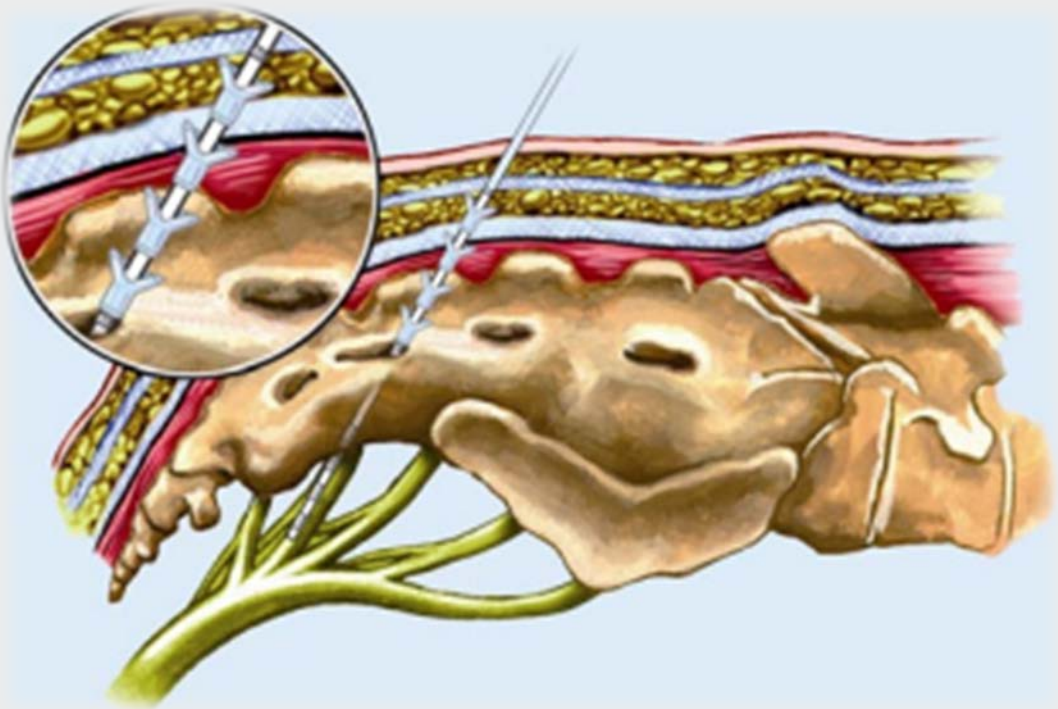
- Manipulation：Low security of micturition
- Anticholinergic drug ：Serious side effect
- Injection of kreotoxin A to detrusor
- Surgery：Severe complications



(T.M.Kessler 2012)

[5]廖利民, 吴娟, 李建军. 脊髓损伤患者泌尿系管理与临床康复指南[J]. 中国康复理论与实践, 2013, 19(4): 301-317

Electrical Stimulus patterns



(T.M.Kessler 2012)

TENS：Effects are limited

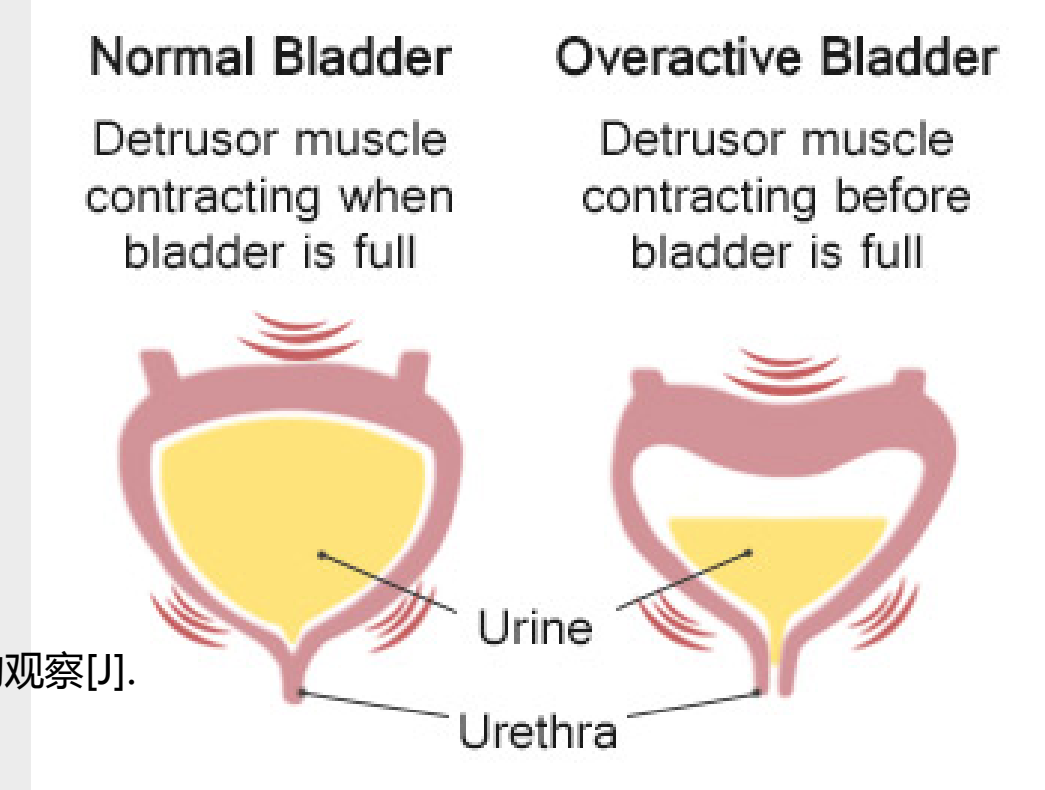
SNM or Sacral nerve stimulation：invasive, pain, translocation of implanted electrode

PES

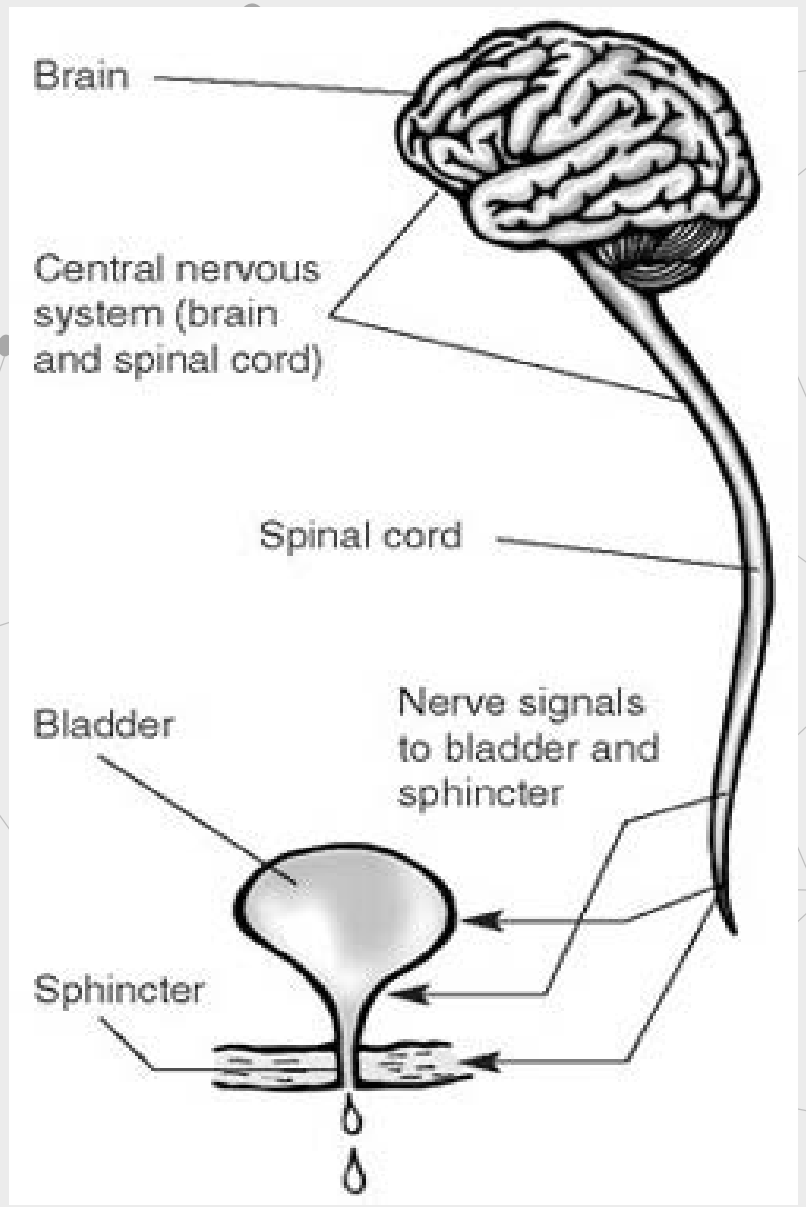
[6]陈亚平, 杨延砚, 周谋望等. 视觉反馈排尿训练在治疗脊髓损伤后神经源性膀胱中的应用[J]. 中华物理医学与康复杂志, 2013, 30 (4): 267-268

Theory of PES

- Restrain detrusor
- Elevate urethral closure pressure



[7]杨幸华, 燕铁斌. 盆底肌电刺激用于治疗脊髓损伤患者神经源性膀胱的观察[J]. 中国康复医学杂志, 2013, 24(8): 715-726



■ Restrain detrusor

Pudendal nerve afferent fibers→

Sacral detrusor nucleus→Pelvic nerve

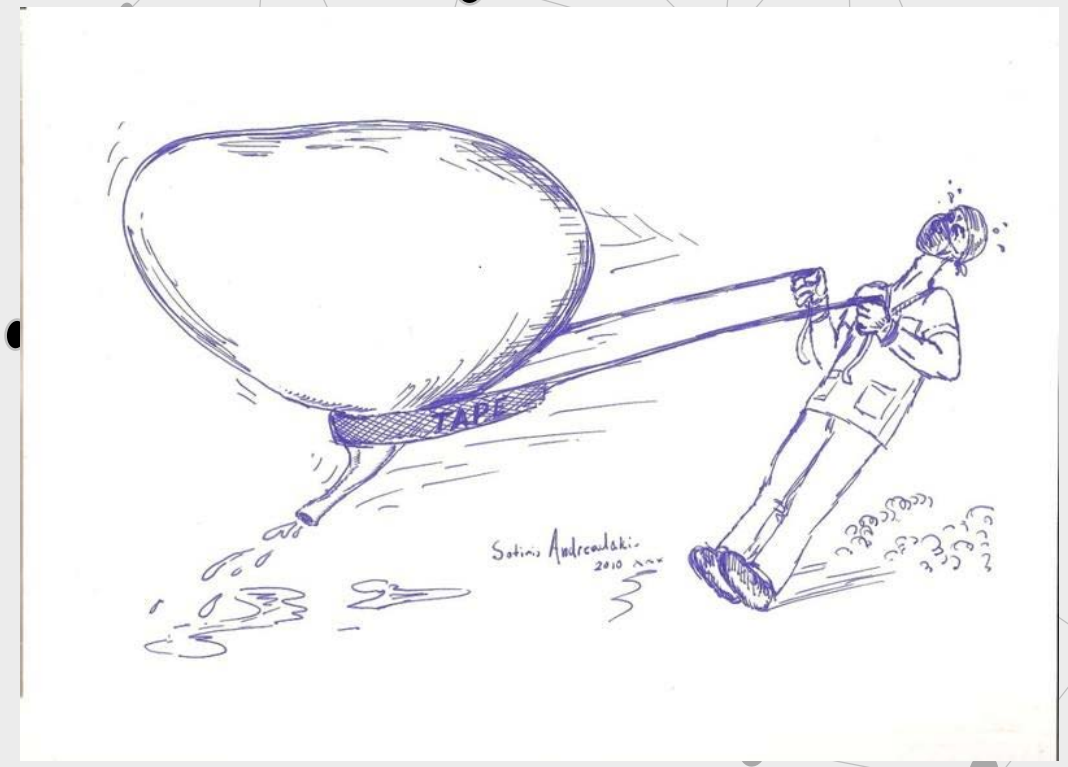
→Suppress detrusor contraction

Neurotransmitter：Gly, GABA, ENK

Electrical Stimulus restrain vesical reflex

[8]陈国庆.不同频率的阴部神经电刺激对骶上脊髓损伤犬神经源性膀胱功能障碍的影响[J]. 中国泌尿外科杂志, 2012, 35(9): 678-695

■ Elevate urethral closure pressure



I. Act on muscles directly

II. Act on neural circuit

[7]杨幸华, 燕铁斌. 盆底肌电刺激用于治疗脊髓损伤患者神经源性膀胱的观察[J]. 中国康复医学杂志, 2013, 24(8): 715-726

Ⅰ. Muscles

➢ **Cellular level：**

- Nucleic acid and protein ↑
- Ca^{2+}/Pi^{3+}、Ca^{2+}/Mg^{2+} & cAMP ↑
- Content of organelles & activity ↑

Contraction and Urinary continence function ↑

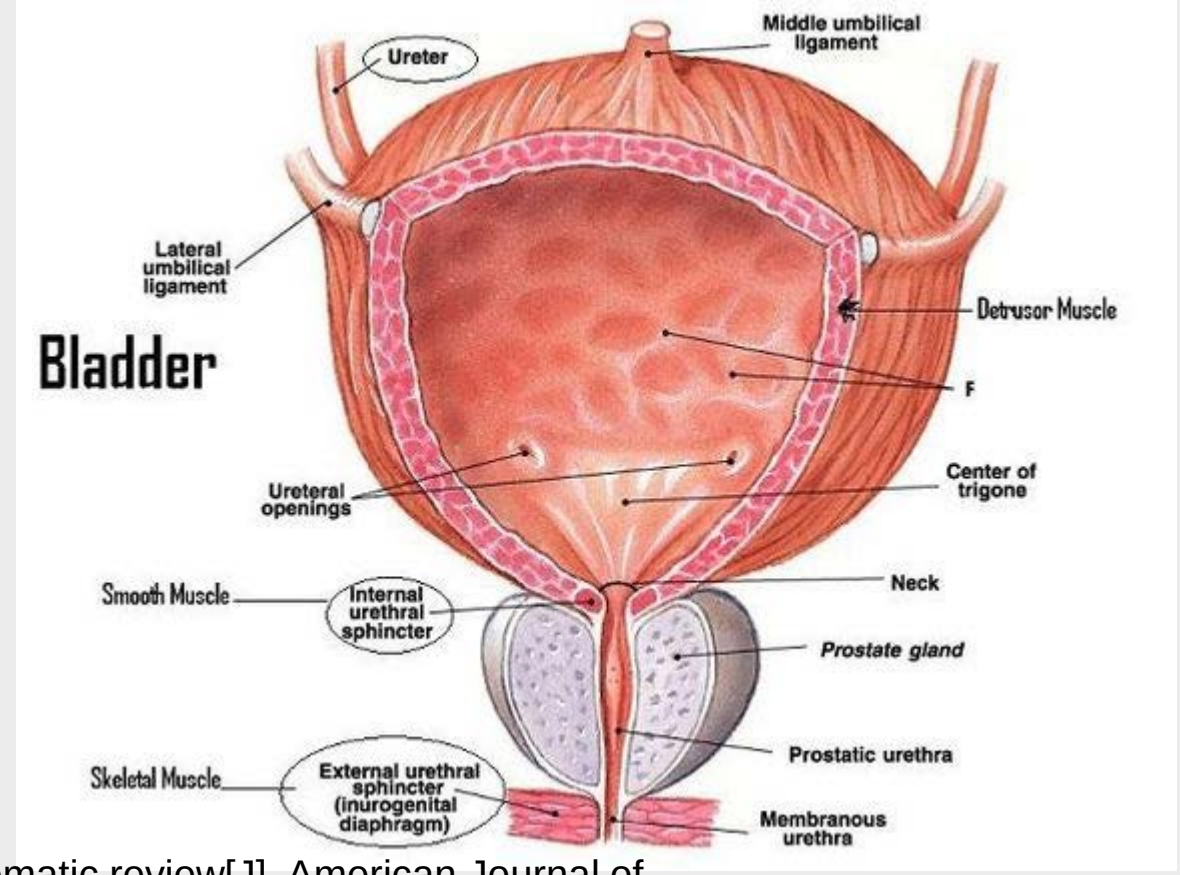
[8]陈国庆.不同频率的阴部神经电刺激对骶上脊髓损伤犬神经源性膀胱功能障碍的影响[J]. 中国泌尿外科杂志, 2012, 35(9): 678-695

Ⅰ. Muscles

➢**Soft tissue level :**

1.Reconstruct the neuromuscular activity

2.Increase the number of anti-fatigue muscle fibers



[9]Cedric, K. K,Nonantimuscarinic treatment for overactive bladder:a systematic review[J]. American Journal of Obstetrics and Gynecology, 2016, (6): 34-57

Ⅱ. Neural Circuit

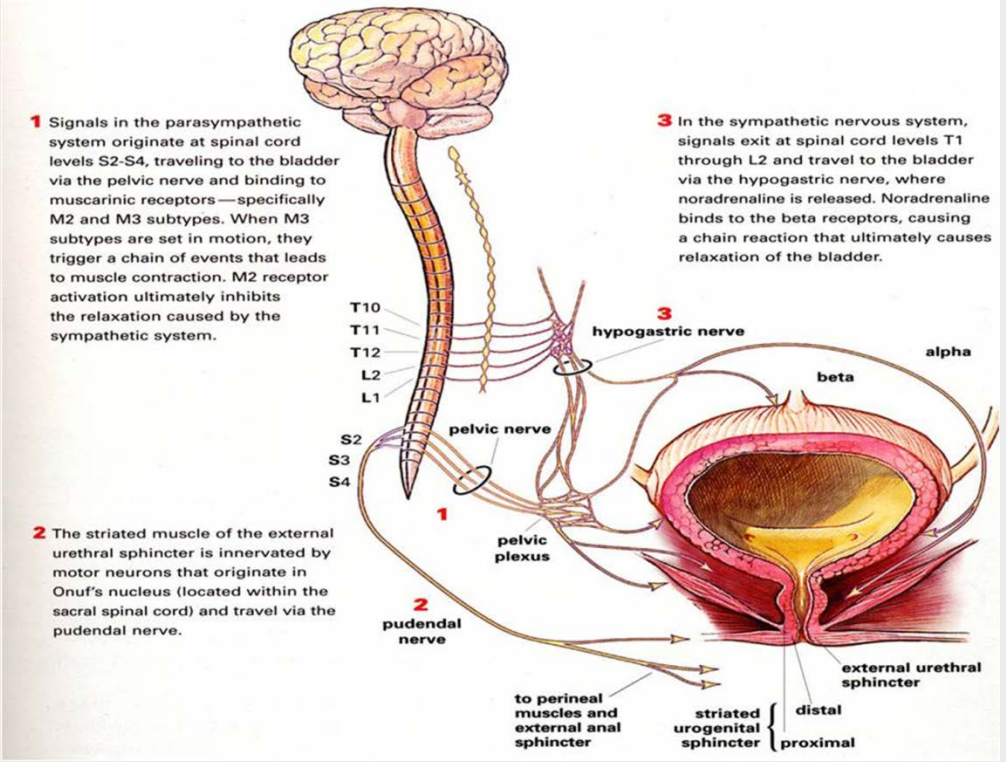
Impulse electrical stimulation to Alpha-adrenergic receptor thoracolumbar

Bladder neck& Proximal urethra Excite sympathetic pathway & contract

Restrain parasympathetic pathway

Increase the function of urethral Restrain the contraction of bladder closure

Reduce bladder contraction ability



[10]Krzysztof Radziszewski, outcomes of electrical stimulation of the neurogenic bladder: Results of a 2 year follow-up study[J], Neurorehabilitation, 2013,(36): 867-873

NeuroRehabilitation 32 (2013) 867–873
DOI:10.3233/NRE-130911
IOS Press

Outcomes of electrical stimulation of the neurogenic bladder: Results of a two-year follow-up study

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Department of Clinical Fundamentals of Physiotherapy, Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University, Warsaw, Poland

Abstract.
INTRODUCTION: The complications of neurogenic dysfunction of the urinary bladder still constitute an important cause of death among spinal cord injury patients.
AIM OF STUDY: The aim of this study was to assess transcutaneous electrical stimulation of the urinary bladder as a treatment for micturition disorders in patients after spinal cord injury (SCI) over 2 years of follow-up.
MATERIAL AND METHODS: The study involved 28 patients (22 men and 6 women) with neurogenic bladder dysfunction following a spinal cord injury. The patients were 16 to 68 years old and 2 to 26 months since their spinal cord injury. The therapeutic programme involved 30 sessions of electrical stimulation of the urinary bladder, five sessions per week. The outcomes of electrical

[10]Krzysztof Radziszewski. Outcomes of electrical stimulation of the neurogenic bladder: Results of a two-year follow-up study[J], Neurorehabilitation, 2013,(32): 867-873

Contraindication

- 1.Cardiac pacemaker
- 2.Pregnancy
- 3.Haemorrhoid(bleeding)
- 4.Inflammation of vagina

Precautions

- 1.Epilepsy
- 2.Armamentarium in body
- 3.Heart disease
- 4.Haemorrhoid
- 5.Abnormal reflection of autonomic nerve
- 6.Inflammation, metabolic syndrome

Operations

Key parameter：

Pulse width	200μS
Power off ratio	4s/4s
Amplitude rise/down	1s/1s
Stimulus frequency	20HZ 4MIN，2HZ 10MIN,10HZ 20MIN
Stimulus intensity	Till the patients' tolerance degree

- Stimulus Intensity
- Stimulus Frequency

[11]冯碧珍, 解东风. 盆底肌电刺激联合干扰电治疗脊髓损伤后尿失禁患者的疗效观察[J]. 临床医学工程, 2011, 18(4): 544-545

➢Stimulus Intensity

A. **Patients with no sensory disturbance：**

- Adjust current from small to large slowly
- Till the patients' tolerance degree

B. **Patients with sensory disturbance：**

- Put the electrode to the opisthenar
- Adjust current gradually
- Put the electrode to the treated

[12]Scaldazza. Percutaneous tibial nerve stimulation versus electrical stimulation with pelvic floor muscle training for overactive bladder syndrome in women: results of a randomized controlled study[J]. Int Braz J Urol, 2016, 2: 199-211

➢Stimulus Frequency

Automatic parameter settings：

20Hz~4min，3Hz~10min，10Hz~20min

Special treatment：

- Restrain detrusor
- Improve the function of micturition

[11]冯碧珍, 解东风. 盆底肌电刺激联合干扰电治疗脊髓损伤后尿失禁患者的疗效观察[J]. 临床医学工程, 2011, 18(4): 544-545

The Combination Therapy with PES

Combinative Therapy

Interference current

Biofeedback

[13]Herderschee R, Hay-Smith EC, Herbison GP,Roovers JP, Heineman MJ. Feedback or biofeedback to augment pelvic floor muscle training for urinary incontinence in women: shortened version of a Cochrane systematic review. Neurourol Urodyn 2013;32:325-9

Reference

1.Manack, A. Epidemiology and healthcare utilization of neurogenic bladder patients in a US claims database[J]. Neurourol Urodyn, 2011, 30: 395-401

2.Warren, G, Hill. Control of Urinary Drainage and Voiding[J]. Clin J Am Soc Nephrol, 2015, 10(3): 480-492

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THANKS