The Urinary Sphincter and its Central Control.

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Conflict of interest

• Current Funding:
  • Co-Investigator: Evaluation of Pudendal Nerve Block and Stimulation for Voiding and continence. PI: G. Creasey DOD SCIRP SC130204.

• Other Financial Relationships:
  • Dignify Therapeutics – Scientific consultant.

• Conflicts of Interest:
  • Potentially research involving control of urethral sphincter
Outline

• Significance
• State of art knowledge
• Knowledge gaps
• Research gaps.
The Urinary Sphincter – Significance.

• Responsible for maintaining continence.
  • Allows the bladder to store urine
  • Allows for preservation of self
  • Allowed humans to become hunter

• Allows for procreation
  • Complex mechanism that separates urine from semen
  • Complex mechanism to control ejaculation.
Male Urethral Sphincter

Female Urethral Sphincter

Movement of Sphincter - Theory

• 1. Bladder neck moves downwards
• 2. Relaxation of the sphincter mechanism
• 2. Dilation of urethra with caudal movement
• 3. Detrusor contracts
• 4. Urine flows.

Innervation of pelvic organs. (CAT)

deGroat WC. Br J Pharmacology 2006:147;S25-40
Central innervation of the urinary sphincter

- Pudendal nerve has mixed contributions:
  - Somatic
  - Parasympathetic
  - Sympathetic

- There are cross connections between the pelvic nerves and pudendal.

- Interconnections in the Spinal cord at Sacral & Thoracic levels.
Peripheral Nerves Involved.

Hysterectomy
Oophorectomy
Colonic or rectal surgery
Open Aortic surgery
Hiatal Hernia
RPLND
Spine Surgery
Bladder
Ureter
Pelvic nerve (parasympathetic)
HGN
IMP
SHP
L1
T9
ACh
NA
β3 receptor (−)
M3 receptor (+)
α1 receptor (+)
Hypogastric nerve (sympathetic)
PP
PEL
S2
SN
RPLND
Pudendal nerve (somatic)
Urogenital diaphragm
ACh
Nicotinic receptor (+)
Urethra
Detrusor muscle
External urethral sphincter

Diabetes mellitus
Diabetes Insipidus

TURP
Radical Prostatectomy
B12 Deficiency
Birth Trauma
Brain centers / Nuclei involved

deGroat, Wc & Yoshimura N, Handbook of Clinical Neurology 2015 vol 130 61-
Normal voiding pattern
Potential Relief of DSD for SCI patients.

Fig. 3. Voiding induced by 20-Hz stimulation of the pudendal nerve in a chronic SCI cat (9 months). Total 23 ml was infused into the bladder and 18 ml was voided. The black bars under the bladder pressure trace indicate stimulation durations. Stimulation: 20-Hz frequency, 2 V intensity, 0.2 msec pulse width. Infusion rate: 2 ml/min.

Research gaps

• How is the micturition reflex actually started.
  • Thought a little drop of urine gets in urethra......?
  • Has urethral urothelium different receptors, permeability's, sensory function?

• What happens during prostatectomy?
  • How to patients stay dry – radical prostatectomy
    • TURP or similar procedures

• How does DESD keep patients with SCI dry.

• Why does the urethra scar so much – strictures