

Start	End	Topic	Speakers
15:30	15:35	Introduction	Becky Clarkson
15:35	15:50	A brief history of the role of the brain in bladder control	Bertil Blok
15:50	15:55	Questions	All
15:55	16:10	MRI and beyond: how brain bladder research works and how you can do it too!	Becky Clarkson
16:10	16:15	Questions	All
16:15	16:30	Incorporating State-of-the-Art techniques into brain-bladder research	Mathijs de Rijk
16:30	16:35	Questions	All
16:35	16:50	What are the clinical implications? Brain research in individuals with neurogenic lower urinary tract dysfunction	Rose Khavari
16:50	17:00	Discussion	Becky Clarkson Rose Khavari Bertil Blok Mathijs de Rijk

### **Description**

#### **Background**

The role of the brain in regulating body systems is at the forefront of current medical research, especially as neuroscientific knowledge has advanced and imaging techniques have improved. The Brain-Bladder Connection provides a particularly interesting subsection of this study; the continence mechanism has both reflex and executive control elements. Using the knowledge gained from animal models and human imaging studies, a working model of lower urinary tract control has been posited. However, the complex and varied nature and presentation of LUTS provides fertile ground for research into the brain mechanisms associated with failures in the continence mechanism, which in turn promise more insight and validation for our working model. As more brain-targeted therapies become feasible, it is becoming more pressing to identify key targets in the brain to treat LUTS which will add to our armory of bladder-targeted therapies.

#### **Key learning points**

- Understand the basics of how the brain controls the bladder in humans

The first session (BB) will provide an introduction to how the brain controls the bladder, and the methods used to acquire this knowledge, from animal models to PET, SPECT and MRI studies.

- Have a preliminary understanding of how brain-bladder research is carried out in order to develop their own study design

The second session (BC) will provide an overview of the types of brain bladder research that are currently being carried out. This will include the range of imaging techniques and their applications (e.g. structural, functional, resting state MRI etc), the selection of study participants (e.g. age, disease, sex), the choice of task to observe (e.g. filling, voiding). This will help the learner to apply these tools and techniques in their own field.

The third session (Mdr) will provide an overview of how state of the art technologies (e.g. ultra-high field MRI) can be implemented to address more complex aspects of brain function, and how some of these techniques used in animal models can translate to human subject study design.

- Have an understanding of how this research can impact understanding of bladder control in clinical settings

The fourth session (RK) will address how investigation of the role of the brain in individuals with neurogenic lower urinary tract dysfunction can impact knowledge and understanding of LUTS related to other pathologies. This will address the utility and value of this knowledge in a clinical setting.

#### **Take home messages**

The role of the brain in bladder control is important, but not well understood, especially its role in LUTS.

Brain-bladder research is varied and can be tailored to many different sub-specialties, all of which will add to the understanding of LUT control.

Modern and emerging technologies provide a number of possible ways to integrate brain bladder research into current practices.

Steps forward in brain-bladder research provide potential targets for brain-focused, non-invasive treatments for LUTS

#### Additional References

Groenendijk IM, Mehnert U, Groen J, Clarkson BD, Scheepe JR, et al. (2021) A systematic review and activation likelihood estimation meta-analysis of the central innervation of the lower urinary tract: Pelvic floor motor control and micturition. PLOS ONE 16(2):e0246042.

<https://doi.org/10.1371/journal.pone.0246042>

Clarkson BD, Karim HT, Griffiths DJ, Resnick NM. Testing a new, intensified infusion-withdrawal protocol for urinary urgency provocation in brain-bladder studies. *Neurourol Urodyn*. 2021 Jan;40(1):131-136. doi: 10.1002/nau.24559. Epub 2020 Oct 29. PMID: 33118637; PMCID: PMC7902294.

de Rijk MM, van den Hurk J, Rahnama'i MS, van Koeveeringe GA. Parcellation of human periaqueductal gray at 7-T fMRI in full and empty bladder state: The foundation to study dynamic connectivity changes related to lower urinary tract functioning. *Neurourol Urodyn*. 2021 Feb;40(2):616-623. doi: 10.1002/nau.24602. Epub 2021 Jan 7. PMID: 33410553; PMCID: PMC7986391.

Khavari R, Elias SN, Pande R, Wu KM, Boone TB, Karmonik C. Higher Neural Correlates in Patients with Multiple Sclerosis and Neurogenic Overactive Bladder Following Treatment with Intradetrusor Injection of OnabotulinumtoxinA. *J Urol*. 2019 Jan;201(1):135-140. doi: 10.1016/j.juro.2018.07.066. PMID: 30076906; PMCID: PMC6309940.

#### **Aims of Workshop**

This workshop will provide a basic introduction to the role of the brain in bladder control. It will discuss translational approaches to brain-bladder research, methods for human subject research and clinical implications of brain-bladder research in neurodegenerative diseases.

#### **Educational Objectives**

The role of the brain in bladder control is one of the least well understood aspects of continence. It has been gaining popularity over the last decade and, as the medical field deepens its focus on the brain's role in all aspects of health, increasing understanding of these mechanisms through research and dissemination of new knowledge is imperative. This workshop will be valuable to those who have little background in the brain as it will provide an overview of brain-bladder control and how this translates into useful clinical knowledge. The workshop also aims to empower those who already have an interest in this research to develop their own studies and contribute to this field.

#### **Learning Objectives**

1. Understand the basics of how the brain controls the bladder in humans
2. Have a preliminary understanding of how brain-bladder research is carried out in order to develop their own study design
3. Have an understanding of how this research can impact understanding of bladder control in clinical settings.

#### **Target Audience**

Urology, Urogynaecology and Female & Functional Urology, Pure and Applied Science

#### **Advanced/Basic**

Basic

#### **Suggested Learning before Workshop Attendance**

Abrams, P, Cardozo, L, Wagg, A, Wein, A. (Eds) *Incontinence 6th Edition* (2017). ICI-ICS. International Continence Society, Bristol UK, ISBN: 978-0956960733.

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