

Development of an in-vitro model of the lower urinary tract with physiological mechanical properties

Background Patients suffering from urinary retention are unable to empty fully the bladder and live with a constant feeling of having a partially full bladder. For severe conditions, urinary catheters are the most common therapy options to empty the bladder. However, their usage is associated to a very high incidence of urinary infections. We have recently tested an innovative solution to empty urinary bladders based on the impedance pump principle which was applied on ex-vivo porcine bladders and urethras (Figure 1). Impedance pumping generated urine flow by pinching externally the urethra (the outlet tube of the bladder) at specific frequencies such that direct contact with urine is avoided. Despite the high variability of the results, in terms of generated flow rate versus pinching frequency, the preliminary results of the ex-vivo experiments were very promising. The high inter-bladder variability of our ex-vivo experiments was due to differences among bladders e.g. size, mechanical properties etc.; while the inter-bladder variability was caused by tissue degeneration over time.

Aim Developing an in-vitro model, which mimics the physiological architecture and mechanical properties of the lower urinary tract (bladder and urethra). The model shall be made in silicone (or other non-rigid materials) and should serve as a well-controllable **testing platform for i) prototypes that apply the impedance pump principle to the urethra to support bladder emptying and for ii) urinary catheters. It should be connectable to a platform of the upper urinary tract that will be developed in parallel.**

Tasks:

- Create CAD models of the lower urinary tract (bladder and urethra).
- Development of in-vitro models of lower urinary tract.
- In-vitro model will be used to test the performances of impedance-pump-prototypes and conventional catheters

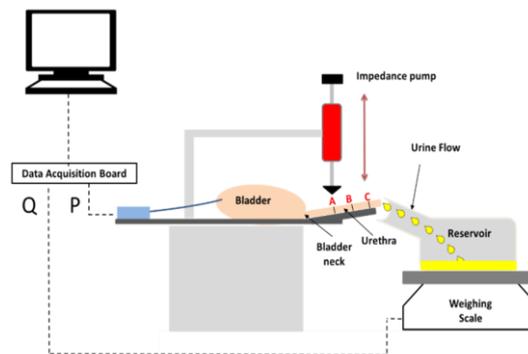


Figure 1 Ex-vivo setup of the lower urinary tract to test impedance pumping (Clavica et al., 2019)

Nature of the Thesis:

Planning/developing the in-vitro setup: 60%
Fluid mechanical analysis: 40%

Requirements:

Background in biomedical engineering
Strong interests in experiments
Programming knowledge (MATLAB, LabVIEW)

Supervisors:

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Research partners

Prof. Dominik Obrist
Prof Fiona Burkhard

Institutes:

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References:

Clavica, F., et al. (2019) 'Urine-Contactless Device to Empty Bladders: an Ex-Vivo Proof-of-Concept Study in Porcine Bladders' *Annual meeting of the International Continence Society (ICS), Gothenburg, Sweden 2019*

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