Master Thesis Presentation

Candidate:	Klaus Schürch
Title:	Investigation of Urinary Bladder and Ureter Contractions by Means of Electrophysiological Recording
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Investigation of Urinary Bladder and Ureter Contractions by Means of Electrophysiological Recording

Klaus Schürch

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Introduction

Overactive bladder (OAB) syndrome is a common and complex dysfunction of the lower urinary tract. It is characterized by urinary urgency often combined with frequent urination and at times, incontinence. There is a hypothesis, that the disease may be caused by an abnormal electrophysiological behavior of the bladder and/or ureters. However, because of their complexity, the electrical behavior of the urinary bladder and ureters is still not well known. The aim of this project was therefore to develop a dedicated setup for electrophysiological examinations of pig urinary bladders and ureters in order to investigate electrical tissue characteristics.

Materials and Methods

First, a life sustaining environment for ex vivo measurements was developed. It consists of an organ bath filled with HEPES buffered Tyrode's solution, which is bubbled with 100% oxygen and maintained at a constant temperature of 36°C. Subsequently, conventional needle electrodes were used together with a waveform generator and a highly sensitive biosignal amplifier to investigate pacing threshold (minimum amount of energy needed to trigger depolarization), refractory time, and signal propagation of bladder and ureter. A camera with a custom made software is used to gain time synchronized tissue movement information.

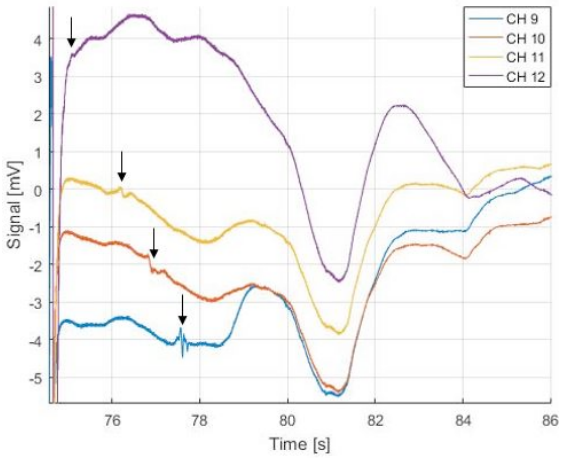

Figure 1 Electrophysiological signals of a pig ureter after induced electrical stimuli. Depolarization spikes are marked with arrows on the different needle electrode channels which are placed one centimeter apart from each other. Stimulation happens right before the first triphasic spike appears (marked with an arrow on CH 12).

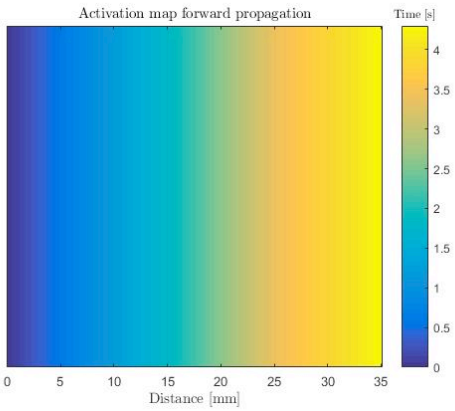

Figure 2 Activation map of detected tissue depolarization spikes shown in Figure 1. X-label is propagation distance, color bar symbolizes elapsed time until tissue depolarization signal arrives. Observed propagation velocity is not uniformly throughout the ureter sample.

Results

Refractory time and pacing threshold in the ureter have been identified. Moreover, signal propagation in the ureter was investigated. Propagation velocities between 5.2mm/s and 33.3mm/s could be observed with needle electrodes. Activation maps were drawn which show signal propagation starting from different origins. Induced electrical stimuli triggered anterograde as well as retrograde signal propagation within the ureter, with heterogeneous propagation velocities across the tissue.

Discussion

The developed setup enables investigation of bladder and ureter electrophysiology. First obtained results are well in the range of what has been reported previously and interestingly indicate non-uniform conduction throughout the ureter [1].

References

[1] Hammad et al., Propagation characteristics of the electrical impulse in the normal and obstructed ureter, BJU International, 36-42, 2011.

Acknowledgements

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