166

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DIFFERENCES IN THE SENSORY INNERVATION OF THE BLADDER BASE AND BLADDER NECK

Hypothesis / aims of study

There is growing interest in the afferent information that is being sent from the bladder to the central nervous system. As an integral part of this approach it is essential to know where the afferent fibres originate and identify the different types of sensory fibre. It has been shown that there are different types of sensory fibre in the lateral wall of the guinea pig bladder [1]. In this study we report different patterns of sensory innervation associate with the urothelium of the bladder base and bladder neck.

Study design, materials and methods

Bladders from seven male guinea pigs were fixed in 4% paraformaldehyde and processed for immunohistochemistry. Primary antibodies used were the antibodies to calcetonin gene related peptide (CGRP) and the neuronal marker PGP9.5 were used to identify nerves. Specific antibody binding was visualised using the appropriate secondary antibodies.

Results

Immunohystochemical staining of the bladder with PGP9.5 revealed PGP9.5-immunoreactivity (PGP9.5-IR) in the nerves of the sub-urothelium of the bladder base and bladder neck. In the bladder neck a subset of these nerves penetrate the urothelium (Figure 1B)

Further examination of the bladder base revealed numerous CGRP fibres in the suburothelial space of the lamina propria. The majority of these fibres did not penetrate the urothelium although the occasional fibre was seen (Figure 1C). In contrast, in the bladder base, almost all of the CGRP positive fibres were observed to penetrate the urothelium and run within the epithelial layer (Figure 1D) . These observations were made in all bladders examined.

Interpretation of results

If it is assumed that these CGRP positive nerves are sensory then these observations suggest a regional specialisation of the sensory nerves to the bladder base and bladder neck. The fact that the fibres penetrate and run within the urothelium in the neck suggests that these fibres are particularly suited to monitor urothelial functions possibly involving the release of neuro-modulators such as ATP, nitric oxide and acetylcholine. The fibres in sub-urothelial space may have other functions, possibly linked to the deformation of the lamina propria as the bladder fills.

Concluding message

There is a regional variation in the pattern of sensory innervation of the bladder. This suggests different functional roles for these fibres. It is therefore essential to take these regional and functional differences into account in future studies of afferent nerve activity and include this in our wider understanding of the integrated physiology of the lower urinary tract.

References

1. Cell and Tissue Res. 325: 33-45

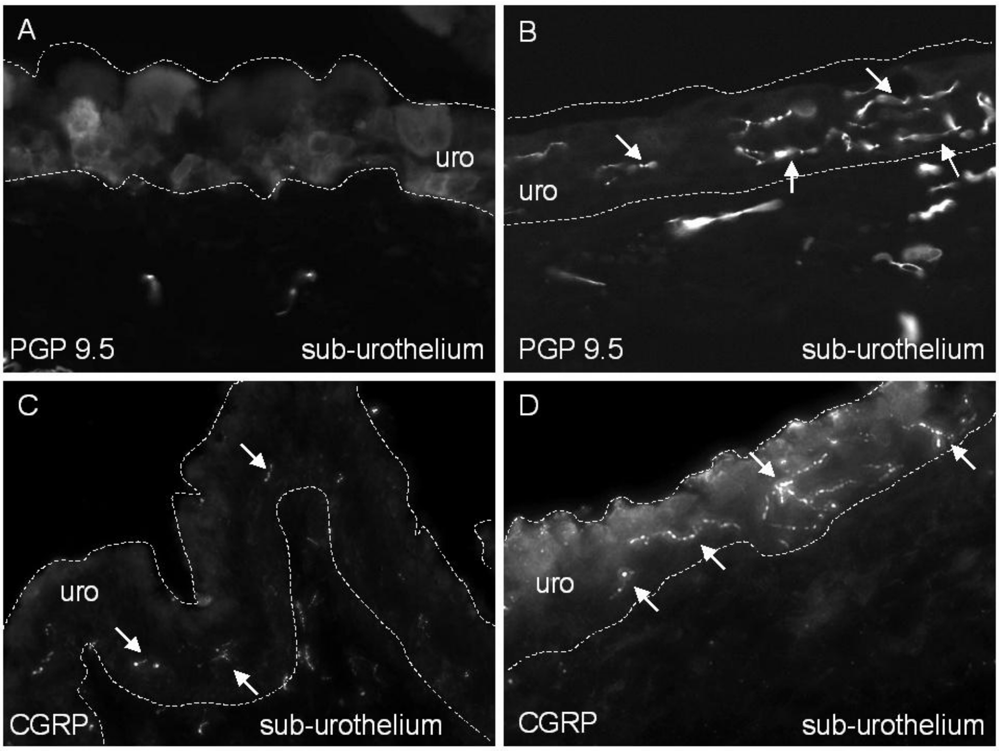

Figure 1 Regional differences in the innervation of the urothelium and the sub-urothelial layer.

Panel A and B are immunostained for the neuronal marker PGP 9.5. A is an example of the bladder base. There are few PGP9.5 positive nerves in the urothelium. B shows the urothelium of the bladder neck. In this area there are significantly more PGP9.5 positive nerves in the urethra (arrows).
Panel C and D are immunostained for CGRP. Panel C shows the bladder base, in this area few CGRP positive nerves are found in the urothelium (arrows), while in the bladder neck (panel D) there is a dense innervation of CGRP positive nerves in the urothelium (arrows).

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What were the subjects in the study?	**ANIMAL**
Were guidelines for care and use of laboratory animals followed or ethical committee approval obtained?	**Yes**
Name of ethics committee	**The Institutional Animal Care and Use Committee of Maastricht University**