

IDENTIFICATION OF FUNCTIONAL MODULES IN THE GUINEA PIG DETRUSOR

Aims of Study

The bladder wall shows several structural features in common with the gut. Gastrointestinal smooth muscle is arranged into neuromuscular modules, which are an important determinant of the organ's functional properties, and a similar arrangement in the detrusor has been hypothesised [1]. The current study examined the integrated activity of the bladder wall to ascertain whether localised activity can be discerned, consistent with a modular arrangement, or whether the bladder behaves as a 'functional syncytium'.

Methods

Female CBC pigmented guinea pigs (n=19) were killed by concussion and the urinary bladder and urethra removed *en bloc*. A polythene cannula was secured at the bladder neck with a silk ligature and connected through a three-way tap to a pressure transducer and a 1 ml syringe to allow variation of intravesical volume. Intravesical pressure was recorded with Newcastle Photometric Systems hardware and software. The bladder was placed in a modified organ bath containing Tyrode's saline bubbled with 95% oxygen, 5% carbon dioxide (30 ml, 33-6°C, pH 7.4). Drugs were placed directly into the organ bath. Movements in the bladder wall were monitored with a video camera and analysed with proprietary software (ImagePoint 2.0).

Results

Patterns of activity varied according to the contained volume. At low volumes, bladders were relatively quiescent. A slight increase in volume resulted in transient phasic 'microcontractions' in a single locus, other regions of the bladder maintaining constant length or undergoing stretch. In some cases it was possible to observe multiple areas of microcontraction, each shortening at different frequencies. Such activity resulted in changes in shape of the bladder. At high intravesical volumes, adjacent regions were observed to contract consecutively, giving the appearance of waves of contraction passing over the bladder surface. Motion analysis confirmed that shortening of the distance between adjacent points was only seen in localised areas, outside which adjacent points either maintained or increased their separation. Each pattern of activity was associated with low amplitude (<4 cm H₂O) phasic changes in the intravesical pressure ('microtransients'). In some cases, intramural microcontractions were observed which were not reflected in the pressure trace, but microtransients always occurred in the presence of microcontractions. Raising the intravesical volume increased the amplitude and frequency of microtransients through recruitment of additional microcontraction areas. Exposure to carbachol, even at concentrations as low as 30 nanomolar, led to complex responses, comprising basal and superimposed phasic pressure changes, accompanied by contraction waves. Contraction waves led to substantial shape change, indicating the entire detrusor was not contracting simultaneously.

Conclusions

The findings indicate that the bladder is intrinsically capable of localised spontaneous contraction, supporting the concept of functional detrusor modules. The observation of contraction waves shows that autonomous areas are able to communicate at higher levels of excitation, so any change in peripheral excitation could result in widespread contraction of the bladder. Consequently, purely peripheral mechanisms could make a substantial contribution to detrusor overactivity and urge incontinence. The potential significance, physiologically and clinically, is indicated by the observation of localised activity in the human bladder [2]. The mechanisms generating and co-ordinating the activity are not yet apparent, but the ease of experimental demonstration described in the current study represents a readily accessible route by which they might be established.

REFERENCES

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- [2]. Van Os Bossagh P, Coolsaet BL, Van Duyl WA, De Bakker HV. Micromotions in chronic pelvic pain (CPP). *Int Urogynecol J* 2001; 12: 99-106