INFLUENCE OF BLADDER FILLING RATE ON THE RESPONSE OF PRIMARY BLADDER AFFECTENTS

Hypothesis / aims of study
The aim of conventional clinical urodynamics is to reproduce symptoms whilst making precise measurements in order to identify the underlying cause for the symptoms, and to quantify the related pathophysiological processes (1). Although urodynamics are widely used, little is known how this artificial bladder filling influences the behaviour of bladder afferent nerves, which might be different from natural filling (2). This study investigates the influence of filling rate on single unit bladder afferent activity in rats.

Study design, materials and methods
From the dorsal root L6, afferent pelvic nerve activity toward bladder filling was recorded electrophysiologically in rats. The activity was amplified, filtered, displayed on an oscilloscope and digitally recorded. Dorsal rootlets containing up to four clearly different afferent units were analysed. Single fiber afferent activity was extracted by means of a spike recognition program (Spike 2). Three different filling rates were studied: 40 (physiologic), 200 and 400 (supra-physiologic) µL/min (3). In total, the response of 37 single units was studied.

Results
The activity of 24 unifiber afferents was studied at 200 and 400 µL/min. In all units, the pressure response curve was identically S-shaped. A typical example is given in figure 1. However in all units and at each pressure, the afferent firing rate was significantly higher at lower filling rate.

The activity of 13 unifibers was studied at 40 and 200 µL/min. Two different patterns of response activity were noted. In 7 fibers the response curve at both rates was similarly S-shaped, and at each pressure, the afferent firing rate was higher at the lower filling rate. However in 6 fibers, the pattern of afferent response activity was clearly different between both filling rates. At the lower physiologic filling rate, the response activity peaked and diminished at further filling and higher filling pressures. However when these afferents were subjected to a supra-physiologic filling rate, the response changed into an S-shaped curve, reaching a maximal response at higher filling pressures. A typical example is given in figure 2.
**Interpretation of results**

In clinical urodynamics, supra-physiologic filling rates are mostly used to reproduce symptoms and to evaluate bladder behaviour by simulating a bladder filling cycle. However, our results demonstrate that the bladder afferent response during such tests is not always consistent with physiologic bladder filling rates. Using supra-physiologic filling rates, as in conventional urodynamics, the response characteristics of some afferent fibers is changed compared to a physiologic filling rate, which is the natural stimulus for bladder afferents. Supra-physiologic filling rates may inefficiently stimulate bladder afferents and even change the afferent nerve response characteristics. This may account for the difference in perception of bladder filling during conventional cystometry compared to natural filling. Since afferent feedback is linked to a detrusor contraction during voiding, a change in afferent activity may also influence the efferent activity.

**Concluding message**

At different supra-physiologic filling rates, the pattern of pelvic afferent nerve response is similar, but with higher activity at lower filling rates. However, the response characteristics are changed compared to a physiologic filling rate. These data are the first trying to explain the differences in bladder behaviour during conventional cystometric bladder filling compared to normal natural bladder filling.

**References**

(1) [Neurourol Urodyn 21(3): 261, 2002]
(2) [Br J Urol 73:242, 1994]
(3) [Am J Physiol 250: F1086, 1986]