Peer reviewed

Normal values for detrusor wall thickness in nulligravid women

Abstract

The aim of this study was to define detrusor thickness in nulligravid women in order to determine the incidence of detrusor hypertrophy in young asymptomatic and symptomatic women. The study recruited 67 nulligravid volunteers who underwent three-dimensional (3-D) pelvic floor ultrasound using Kretz Voluson 730 systems. Three measurements each were taken for trigone and dome. Results showed that average detrusor thickness at the trigone was 4.0mm (SD=0.7, range 2.7-5.5mm) and at the dome 2.7mm (SD=0.7, range 1.8-5.0mm). Average measurements for both sites showed a mean of 3.4mm (SD=0.5, range 2.5-4.4mm). Symptoms of bladder irritability were not associated with detrusor wall thickness. In this group of 67 nulligravid women, almost all measurements were below 5mm, even in those who reported frequency, nocturia or urge incontinence. Detrusor thickness of >5mm seems to be acquired and may be an effect, rather than a cause, of symptoms of bladder irritability.

This study was supported, in part, by a grant from the Betty Byrne Henderson Foundation, Brisbane, QLD.

Introduction

Detrusor muscle thickness has been shown to be associated with symptoms of the irritable bladder and urodynamically diagnosed detrusor overactivity 1. In the original reports, a sensitivity of 84% and a specificity of 89% was claimed for detrusor overactivity, when a cutoff of 5mm was used 1. It has been speculated that this is due to detrusor hypertrophy in women with bladder irritability, and it is plausible that multiple daily detrusor contractions against a closed sphincter would be expected to cause muscle hypertrophy over extended periods of time 2. This would imply that detrusor hypertrophy is a result rather than the cause of detrusor overactivity. However, in the male, detrusor overactivity is commonly thought to be the result of detrusor hypertrophy due to benign prostatic hyperplasia 3.

It is likely that cause-and-effect relationships may vary from patient to patient, and identifying aetiological factors may potentially be very helpful in individualising treatment. At the present time there are no data on the natural history of detrusor hypertrophy – the condition may be congenital or acquired, and symptoms may precede or follow the establishment of hypertrophy.

The aim of this study was to define detrusor muscle thickness in a cohort of nulligravid women in order to determine the incidence of detrusor hypertrophy in asymptomatic and symptomatic women and gain insights into the natural history of the condition.

Methods

A total of 67 nulligravid volunteers aged 17-41 years were recruited for two independent studies of pelvic floor dysfunction. They underwent three-dimensional (3-D) volume ultrasound of the pelvic floor using a Kretz Voluson 730 system with a 7-4MHz Volume transducer and automated image acquisition. They were with the help of using a standardised questionnaire, using the terms for lower urinary tract symptoms as defined by the International Continence Society. Ultrasound was performed after bladder emptying, with the patient in the supine position, as described previously 4.

The volume datasets were retrospectively analysed for detrusor wall thickness with the help of GE Kretz 4D View software (Versions 1.0 and 3.0) on a desktop computer. Measurements obtained with this software package have been shown to be equivalent to measurements taken in real time 4. Three measurements were taken for the trigonal area and the bladder dome for each participant (Figure 1 shows dome measurements).

A blinded test-retest series on detrusor wall thickness (bladder dome) performed in 67 women yielded an intraclass correlation...
coefficient (average measures, absolute agreement definition) of 0.82 (CI 0.63-0.91) which signifies excellent agreement.

Formal ethics approval had been obtained for the two parent studies from which the data were drawn, and all participants had provided written consent.

Statistical analysis was performed after normality testing (histogram analysis and/or Kolmogorov-Smirnov testing), using Minitab V13 [Minitab Inc, State College, PA, USA] and SPSS V12 [Chicago, Ill, USA]. Student’s t-test was used to compare means for normally distributed data. A p<0.05 was considered statistically significant.

Results

The average age of participants was 24.3 years (17.9-41.1 years). Symptoms of bladder irritability were reported by 17 (25%) participants, with frequency (n=12) being the most common. Nine of the participants reported stress incontinence, five reported nocturia and three reported urge incontinence. Average bladder neck descent on Valsalva was 19.1mm (SD=9.8). Average detrusor thickness was 4.0mm (SD=0.7, range 2.7-5.5mm) at the trigonal site and 2.7mm (SD=0.7, range 1.8-5.0mm) at the dome. This difference was significant (p<0.001). Average measurements for both sites showed a mean of 3.4mm (SD=0.5, range 2.5-4.4mm).

Symptoms of frequency, nocturia and urge incontinence were not associated with increased detrusor wall thickness measurements as illustrated in Table 1 for dome measurements. Mean detrusor wall thickness in women who were positive for any of the symptoms of bladder irritability was 2.8mm (SD=0.9). In asymptomatic women, average detrusor wall thickness at the dome measured 2.7mm (SD=0.6) and at the trigone 4.0mm (SD=0.6). The average for both sites was 3.4mm (SD=0.4).

Six participants, two of them positive for symptoms of the overactive bladder, showed measurements of over 5mm at the trigone, and not one asymptomatic woman had detrusor wall thickness measured at over 5mm at the dome.

Discussion

Increased detrusor wall thickness, as measured by vaginal or introital ultrasound, has been shown to be associated with symptoms of the irritable bladder or detrusor overactivity on urodynamic testing 

1-2, although these findings have been disputed 

6. In this study, translabial ultrasound was used in order to measure detrusor wall thickness at the trigone and the bladder dome as previously described 

4. The anterior dome was not measured – this can be difficult even with transvaginal ultrasound and is almost impossible when using the non-invasive technique of translabial ultrasound.

In a group of 67 healthy, nulligravid women, we obtained detrusor wall thickness values almost exclusively below the published cut-offs for detrusor hypertrophy (5mm) when dome measurements alone, or the average of dome and trigone, were considered. This did not just apply to asymptomatic women, but also to the few individuals in this group who were reporting symptoms of irritable bladder.

Therefore, it appears likely that increased detrusor muscle thickness is an acquired rather than congenital condition; this conclusion is supported by recent reported data showing that detrusor wall thickness at the dome (as opposed to trigonal measurements) is age dependent 

1. In men, a bladder wall thickness of 5mm appeared to be the best cut-off measure to diagnose the presence of outlet obstruction, but not the presence of detrusor instability 

6. The most likely explanation for the observations in our study is that increased detrusor wall thickness in women is caused by muscle hypertrophy over an extended period of time, due to isometric contractions of the presence of symptom

<table>
<thead>
<tr>
<th>Presence of symptom</th>
<th>Yes (SD)</th>
<th>No (SD)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urge incontinence (n=3)</td>
<td>3.2 (0.9)</td>
<td>2.7 (0.7)</td>
<td>0.20</td>
</tr>
<tr>
<td>Frequency (n=12)</td>
<td>2.7 (0.9)</td>
<td>2.7 (0.6)</td>
<td>0.98</td>
</tr>
<tr>
<td>Nocturia (n=5)</td>
<td>2.8 (0.9)</td>
<td>2.7 (0.7)</td>
<td>0.81</td>
</tr>
<tr>
<td>Any symptom (n=17)</td>
<td>2.8 (0.9)</td>
<td>2.7 (0.6)</td>
<td>0.59</td>
</tr>
</tbody>
</table>

Figure 1: Measurement of detrusor wall thickness in a 21-year-old nulligravid volunteer, obtained on translabial ultrasound in the sagittal plane, after bladder emptying. In this case the average dome measurement was 3.7mm, with single measurements of 3.47mm, 3.9mm and 3.65 mm.

Table 1. Detrusor wall thickness vs the symptoms of irritative bladder in young nulligravid women. In total, 17 women reported symptoms of bladder irritability.
detrusor against a closed outlet. This would imply that detrusor hypertrophy in women is more likely to be the effect rather than the cause of symptoms of the irritable bladder.

This study has not addressed the issue of whether detrusor wall thickness is of any use in the clinical investigation of women with pelvic floor disorders and bladder dysfunction. However, it appears that detrusor hypertrophy is not uncommon in that group of patients, even if the significance of such a finding is disputed. One of the more basic steps of evaluating a given finding is to determine whether the observation is evidence of a congenital or an acquired condition; clearly, our study suggests the latter.

From basic anatomy, we know that the trigone and dome develop from different embryologic structures. The trigone is the least distensible part of the bladder wall, as well as being the thickest. We found that detrusor wall thickness at the trigonal site was significantly higher than at the dome but generally still lower than 5mm. Bladder wall thickness at the trigone and dome correlate with each other, but it seems that changes towards detrusor hypertrophy generally are more pronounced at the dome. A recent study suggested that the observed association with age for detrusor wall thickness at the dome was not observed for trigonal measurements, implying that detrusor hypertrophy as a function of time may be less of an issue for trigonal bladder muscle.

In this study, the average detrusor wall thickness at the dome in young nulligravid women was 2.7±0.6 mm. This is slightly lower than the normal values of anterior bladder wall thickness (3.0±1.0mm) in the study of Oliver et al, and much lower than measurements obtained by Yang et al in asymptomatic women. The reason for this may be a correlation of age and bladder wall thickness as mentioned above; the mean age of our population was 14.1 years below the average age in the study by Oliver et al, and 24.4 years lower than in the original work by Yang et al. In healthy children, the median thickness of the detrusor wall was reported as 1.2mm (0.4-3.0mm).

Conclusion

In conclusion, detrusor wall thickness over 5mm in women seems to be an acquired condition and may be an effect (rather than a cause) of symptoms of bladder irritability.

References