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EVALUATION OF PROSTATE COMPLIANCE USING PRESSURE/DIAMETER MEASUREMENTS OBTAINED DURING VOIDING FROM ULTRASOUND IMAGING.

Aims of Study

The treatment of micturition problems in many patients with spinal cord injuries (SCI) can be facilitated by the development of methods that will characterize the functional contribution of detrusor contractility and the facilitation of the outlet to allow the free flow of urine. In these patients contributory factors can be a large prostate particularly when associated with neuromuscular dysfunction such as dyssynergia. In this context we consider that the compliance of the prostate constitutes an important parameter facilitating flow because of its ability to dilate. To this end we have developed a way to evaluate changes in the compliance of the prostate. This can be made during voiding using ultrasound images obtained during routine diagnostic urodynamic evaluations.

Methods

A total of 36 consecutive SCI patients were evaluated with urodynamic studies and only the 9 patients who were capable of initiating micturition either voluntarily or by crede were included in the present study. The principle of this approach is based on the measurement of urethral diameter, at the mid point of the urethra, D_{detmax}, at the time of maximum. bladder pressure during voiding, P_{detmax}, and at the 50% point, P_{det50}, of the increasing bladder pressure, D_{det50}. These measurements were taken during urodynamic studies when ultrasound images of the prostate and urethra were obtained simultaneously with measurement of bladder pressure using a Hitachi ultrasound system with a linear array rectal probe interfaced to a Laborie Aquarius urodynamic system. Ultrasound images, digitized and indexed with urodynamic data, were archived on disk for offline analysis using NIH Image software. From sequences of 2D ultrasound images, defining the shape of the prostate and bladder neck during micturition, computer enhancement of the bladder/prostate/urethral interface was made to facilitate accurate measurement of the outline of the urethra. From these measurements of pressure and prostate imaging the anatomically mid point of the prostate was first identified as a fixed landmark. Using the digitized images, urethral diameter measurements were made to record the D_{detmax} and D_{det50}. The relative stiffness, β, calculated at the mid point of the prostate mesured during voiding, is defined as: $\beta=\ln(D_{detmax}/D_{det50})/D_{detmax}-D_{det50})/D_{det50}$.

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Results

The table shows the values of direct mesurements of pressure and diameter made on the basis of the urodynamic and digitized ultrasound visualizations, in a total of 9 SCI patients.

Urethral Diameter mm		Detrusor Pressure cmH2O		Relative Stiffness
Ddet50	Ddetmax	Pdetmax	Pdet50	β
10 2±0 8	13 3±1 7	64 3±2 01	35 1±4 3	1 83±0 09

Values given in the results are mean(SE).

Conclusion

Application of this approach has demonstrated that quantitative data on prostate compliance can be derived. Qualitative analysis of the ultrasound images show that the middle region of the prostate, the region selected to measure D_{det50} and D_{detmax}, is more easily compressed by the hydrostatic pressure of micturition than the proximal prostate. This observation suggests that there are regional differences in the compliance of the prostate In view of the possibility of regional variations in prostatic compliance, it is speculated that the identification of the contribution of these regions to micturition can provide useful information regarding pharmacological or surgical treatment. Furthermore important questions such as the effectiveness of alpha blockers in modulating the compliance of the prostate can be addressed using this approach.