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# STANDARDISATION OF URETHRAL PRESSURE MEASUREMENT:

# Report from the Standardisation Sub-committee of the International Continence Society

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## 1. INTRODUCTION

Urethral pressure measurements are in use to assess urethral closure and voiding function. The lack of general agreement on an explicit definition of urethral pressure and standardisation of the methodology for measurement has limited the utility of urethral pressure measurements. This report defines urethral pressure and recommends standards for measurement methodology to facilitate communication between investigators and to improve the quality of clinical practice and research. The document can be integrated with earlier reports of the International Continence Society (ICS) Committee on Standardisation with special reference to the collated 1988 report [Abrams et al. 1989] and the ICS recommendations on good urodynamic practice [in preparation].

## 2. DEFINITION OF URETHRAL PRESSURE

Urethral pressure is defined as *the fluid pressure needed to just open a closed (collapsed) urethra [Griffiths 1985].* This definition implies that the urethral pressure is similar to an ordinary fluid pressure i.e. is a scalar (does not have a direction) quantity with a single value at each point along the length of the urethra

- the concept of urethral pressure is only useful if the urethra collapses easily at attainable pressures to zero cross-sectional area, as is normally the case. The use of a catheter introduces a non-zero cross-sectional area (given by the probe) and changes the natural shape of the lumen. The effect on the measured urethral pressure is small for highly distensible/collapsible tubes [Griffiths 1985].

Microtip or fiber-optic catheters do not measure the urethral pressure directly but the normal stress component on the surface of the transducer. This stress is due to the interaction between the urethral tissue and the transducer surface. It depends in part on the stiffness of the catheter and the form of the probe. It may cause directional variations in the measured "urethral pressure" when the catheter is rotated within the lumen. From the definition it follows that directional variations are artefacts

## 3. METHODOLOGY/TECHNIQUES

Urethral pressures can be measured at individual locations within the urethral (point pressures) or along the whole length of the urethra (urethral pressure profile). Registration may be over at short period of time or over a protracted period (ambulatory). Measurement can be carried out at different bladder volumes and different subject positions (a) with the subject at **rest**, (b) during **coughing** or **straining,** and (c) during the process of **voiding**.

The intravesical pressure ($P_{ves}$) is by definition piezometric. The simultaneous recording of both intraurethral ($P_{ura}$) and intravesical ($P_{ves}$) pressure enables calculation of urethral closure pressure i.e. $P_{ura}$ - $P_{ves}$.

3.1 *Specify*

a. Type of measurement (point – profilometry – ambulatory)
b. Period of time over which the measurement was recorded
c. Constant (given by the probe) or variable cross sectional area of the urethra (i.e. inflation of a balloon)
d. Patient position
e. Bladder volume
f. Manouvers (coughing, valsalva, other)
g. Withdrawal speed (for profilometry)
h. Infusion medium and rate of infusion (for fluid perfused catheters)

3.2 *Technique*

i. Type of catheter
j. Size of catheter
k. Catheter material – flexibility
l. Orientation of a directional sensor
m. Sensor position fixation (for point pressures or during coughing/straining)
n. Zeroing of pressure sensors.
   i) <u>External transducers – and fluid-filled catheters</u>: superior edge of the symphysis pubis, (piezometric). To correct for viscous pressure losses within the catheter zero of pressure should be set as the reading in air when the fluid is flowing.

   ii) <u>Microtip transducers</u>: atmospheric pressure (there is no fixed reference point). When calculating closure pressure the difference in vertical height between the two microtips transducers should be taken into account.

   When calculating closure pressure using multisensor microtips, any difference in vertical height between the “bladder” transducer and urethral transducer(s) should be taken into account.

o. Recording apparatus.
   Describe type of recording apparatus. The frequency response of the total system should be stated. Equipment with a sampling rate of 18 Hz can satisfactory record cough produced pressure changes in the urethra [Thind et al. 1994].

3.3 *Methods of measuring the urethral pressure*

Catheters ought to be as thin and flexible as possible.

a) <u>Infusion [Brown and Wickham 1969] method</u>
   The measured quantity can be very close to the local urethral pressure, provided that the urethra is highly distensible [Griffiths 1980]. If an aqueous liquid is used and the external pressure transducer is at the right level, piezometric urethral pressures are obtained.

b) Balloon method

A cylindrical balloon, which requires pressure of a few cm of water to be inflated to its maximum diameter, mounted concentrically on a catheter. A too long balloon in comparison with the axial distances tends to average out differences in pressure along the length of the urethra as well as pressure variations. Urethral planimetry enables a more point specific measurement (e.g. of a 2mm long segment of the urethra) when using a balloon [Lose et al. 1988]. A true hydrostatic pressure is measured. If the catheter is liquid-filled and external pressure transducer at the right level, piezometric pressures are obtained.

c) Microtip /fiber-optic catheters

Weight or bending or inhomogenitics in urethral wall tissue can lead to local directional tissue/transducer interaction which will superimpose the desired urethral pressure signal, thus, the recorded quantity is a qualitative measurement which emphasis on changes in pressure rather than absolute values. To minimize the directional artefacts the catheter should be as flexible as possible ("like cooked spaghetti"). Failing this, a lateral orientation of the (side-mounted) transducer is to be preferred as it minimizes bending. Placement of the microtip transducer inside a balloon enables measurement of a true hydrostatic pressure [Lose et al. 1988].

### *3.4 Reliability*

The investigator should provide reliability data or indicate their absence.

## 4. CLINICAL MEASUREMENTS AND PARAMETERS

The parameters in common use are previously defined by the ICS Standardization Committee [Abrams et al. 1988].
At the present moment the clinical utility of urethral pressure measurement is unclear. There is no urethral pressure measurement which:

a) discriminate urethral incompetence from other disorders
b) provide a measure of the severity of the condition
c) provide a reliable indicator to surgical success and
d) return to normal after successful intervention.

Thus, urethral pressure measurement is still first and foremost a research tool.

The urethral pressure and the urethral closure pressure are idealised concepts which aim to represent the ability of the urethra to prevent leakage. There is no doubt that the urethral pressure is of significant importance for the continence mechanism. However, it remains a challenge to define the optimal way to characterize the urethral closure mechanism in terms of pressures.

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