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► **To cite this version:**

Xavier Fritel, Arnaud Fauconnier, Alain Pigné. Circumstances of leakage related to low urethral closure pressure.. *Journal of Urology*, Elsevier, 2008, 180 (1), pp.223-6. 10.1016/j.juro.2008.03.048 . inserm-00356858

**HAL Id: inserm-00356858**

**<https://www.hal.inserm.fr/inserm-00356858>**

Submitted on 28 Jan 2009

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**Title**

Circumstances of leakage related to low urethral closure pressure

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## **Abstract**

Purpose: Our goal was to determine if urinary leakage in some circumstances is associated with intrinsic sphincter deficiency (ISD), defined by low maximum urethral closure pressure (MUCP  $\leq 30$  cm H<sub>2</sub>O) in women consulting for urinary incontinence

Methods: This retrospective analysis concerns 100 consecutive women who underwent complete urodynamic evaluations for complaints of urinary leakage.

Results: Logistic regression adjusted for age showed that leakage while running or during physical exertion, leakage while walking, and leakage with no obvious reason were all associated with ISD, while leakage on coughing or sneezing was not.

Conclusions: These results suggest that different mechanisms may govern incontinence during prolonged and during brief stress. Low MUCP may be a sign of abnormal fatigability of the sphincter.

Word count: Abstract: 119; Text: 1422

Key words: urinary incontinence, sphincter deficiency, muscle fatigue, urodynamic

Short title: Circumstances of leakage related to low urethral closure pressure

## ***Introduction***

Classically, the circumstances of urinary leakage (coughing, sneezing, running, walking, upright position, etc.) are categorized according to the supposed intensity of the stress, and the severity of incontinence is considered to be inversely proportional to the intensity of the stress required to induce leakage.<sup>1</sup> Urodynamic examination of sphincter function is based on the same principle: sphincter competence is assessed as a function of maximum urethral closure pressure (MUCP) or leak point pressure during coughing or Valsalva maneuvers.<sup>2</sup> This proportional relation between severity of incontinence and intensity of the stress provoking it presupposes a single mechanism of incontinence. It may be, however, that the different circumstances during which stress urinary incontinence occurs are also signs of different mechanisms and that some circumstances are preferentially associated with sphincter deficiency or with a defect of urethral support.

The objective of our work was to determine if there is any association between characteristics of urinary incontinence and the MUCP measurement. Our hypothesis was that sphincter deficiency might be associated with particular circumstances of leakage.

## ***Material and Methods***

We conducted our retrospective analysis on a sample of 100 consecutive women addressed for urinary incontinence. Criteria for inclusion were complaints of urinary incontinence with no significant pelvic organ prolapse and first assessment in our institution.

A standardized assessment was performed. Each woman was asked to complete a self-administered symptom-specific questionnaire previously developed to evaluate the circumstances of urinary leakage (appendix). The large list of circumstances of leakage included in our questionnaire was constructed gradually and empirically, based on the experience of the urodynamics laboratory opened in 1979 by the last author (AP). Women were asked whether they had leakage under each circumstance (yes or no) and could choose not to respond at all when the circumstance was not encountered (for example, no sexual activity, never runs).

Clinical evaluation included pelvic examination, urinary stress test, and pelvic organ prolapse staging. Standardized urethral pressure profilometry was performed with a 2 side-hole catheter filled with sterile water, bladder filled with 100 to 200 ml of water, patient in the lithotomy position. Urethral profilometry was measured at least twice and the lowest value was retained. Methods, definitions, and descriptions conform to the recommendations of the International Continence Society except where specifically noted.<sup>3</sup> Intrinsic sphincter deficiency (ISD) was defined by a MUCP less than or equal to 30 cm H<sub>2</sub>O.<sup>2</sup> Women with overactive detrusor were not excluded, but this urodynamic observation was seen in only 7 women.

Each circumstance of leakage was tested in 3 classes (Yes, No, I don't know) for age with analysis of variance (ANOVA). The circumstances of leakage (Yes, No, I don't know) were analyzed with logistic regression; the dependent variable was ISD. Because of statistical

colinearities, leakage due to coughing and to sneezing was combined in a single variable. The significance threshold for all tests was set at  $p < 0.05$ .

Our work complied with French statutes and regulations, which authorize retrospective observational surveys without advance approval of an institutional review committee. It had been submitted to the Ethic Committee of the French National College of Gynecologist and Obstetrician, CEROG-2008-003.

## **Results**

Table 1 summarizes the patients' characteristics. There was an inverse association between age and MUCP ( $MUCP = 130.95 - 1.45 * \text{age}$ ;  $R^2 = 0.51$ ;  $p < 0.0001$  z test). ISD was more frequent in women with hysterectomies (50 versus 17%,  $p = 0.009$  Chi<sup>2</sup> test) or after menopause (39 versus 2%,  $p < 0.0001$  Chi<sup>2</sup> test) but these differences were no longer significant after adjustment for age. There was an association with age and some circumstances of leakage “exercise or sports” ( $p < 0.0001$  ANOVA), “running or physical exertion” ( $p = 0.0004$  ANOVA), “laughing” ( $p = 0.010$  ANOVA), “all the time” ( $p = 0.013$  ANOVA), “at night during sleep” ( $p = 0.015$  ANOVA), and “sexual intercourse” ( $p < 0.0001$  ANOVA). Other circumstances were not significantly associated with age. Accordingly, we adjusted only for age throughout the rest of the analysis.

When odds ratios (ORs) were adjusted for age (Table II), leakage in the following circumstances was significantly associated with ISD: “running or physical exertion”, “walking”, and “without obvious reason”. On the other hand, leakage on “coughing or sneezing” was not significantly associated with ISD.

## ***Discussion***

Our work shows that after adjustment for age, only some circumstances (“running or physical activity”, “walking”, and “without obvious reason”) were associated with sphincter insufficiency. Although these results may seem intuitive, they seem to challenge the existing classifications according to supposed intensity of stress.<sup>1, 4, 5</sup>

The originality of the present study is to have developed a specific questionnaire to differentiate the different circumstances in which leakage occurs. This differentiates it from other available questionnaires that consider a limited number of stress circumstances combined in a single question. For example, the Bristol Female Low Urinary Symptom questionnaire asks: "Does urine leak when you are physically active, exert yourself, cough or sneeze?" and the Urinary Distress Inventory inquires: “Urine leakage related to physical activity, coughing, or sneezing?”.<sup>6, 7</sup> It is also original in having looked for a correlation between the different leakage circumstances and urodynamic mechanisms.

One limitation of the analysis of these circumstances is how to interpret the absence of response, which may be associated with sedentary lifestyle, age, abstention precisely because of the leakage induced by the stress, or misunderstanding. Unfortunately, the retrospective nature of our study did not allow us to explore the reason for lack of response. Our questionnaire can also be criticized for its empirical construction over time rather than according to standard psychometric methods.<sup>8</sup> The circumstances were in fact compiled from 20 years of experience in a university laboratory and through the observation of women with this condition, which represents the first phase of questionnaire construction.<sup>9</sup>

ISD was not associated with leakage due to urinary urgency. Moreover, it was not associated with leakage while coughing or sneezing, circumstances that are nonetheless included in the definition of stress urinary incontinence according to the ICS (“the complaint of

involuntary leakage on effort or exertion, or on sneezing or coughing”) and numerous questionnaires. This result suggests a different mechanism for leakage during continuous and prolonged stress, such as running or walking and for leakage during brief stress, such as coughing or sneezing.

The method by which we collected symptoms did not allow us to categorize stress according to its intensity or duration. Even though we can assume that the increase in vesical pressure is greater when coughing than when walking, we lack information for a more precise classification. It would have been interesting as well to be able to measure urethral mobility in order to assess whether any leakage was associated with mobility in our population. This result should be linked to the differences observed between Valsalva and coughing leak point pressure (VLPP and CLPP) measurements.<sup>10</sup> Our hypothesis is that incontinence with rapid stress may be linked to urethral mobility and may be proportional to the intensity of the stress, while incontinence during prolonged stress may be associated with muscle fatigability and proportional not only to intensity of stress but also to its duration or repetition. This hypothesis may be confirmed by examining the leak point pressure associated with each circumstance. Work on the subject is rare for the obvious reasons that it is difficult to reproduce most leakage circumstances in the laboratory and therefore equally difficult to measure the leak point pressure while running or walking. The study by Peschers et al did not find any association between fatigability and urethral mobility.<sup>11</sup> Amarenco and Kerdraon observed a 40% reduction in MUCP on average in 10 women among 18 consulting for stress urinary incontinence when they were asked to cough six times in a row.<sup>12</sup> This diminution in MUCP was followed by a return to the previous value after several seconds of resting. The sphincter insufficiency measured by MUCP may be a sign of abnormal fatigability of the urethral sphincter, associated with the thinning of the slow muscle fibers that compose it. Rapid muscle fibers may then be the only ones to ensure stress continence. As they cannot maintain their

contraction for a long time, sphincter insufficiency becomes symptomatic during prolonged stress, such as walking and running.

### ***Conclusions***

In the case of MUCP that is low for age, urinary leakage occurs most often during prolonged stress such as walking or running. On the other hand brief stresses, such as coughing or sneezing, are not associated with MUCP low for age. We hypothesize that the mechanisms involved in incontinence differ for brief and for prolonged stresses and that low MUCP may be a sign of muscle fatigability. A larger prospective study is required to confirm these hypotheses.

We received no exterior funding for this study.

We thank Jo Ann Cahn for her editorial assistance.

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