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ORIGINAL ARTICLE

# The Caliber and Length of the Urethra in Asymptomatic Taiwanese Adult Females

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**Objective:** Currently, there are no data on the caliber and length of the urethra in Taiwanese adult females. The aim of this study was to determine the caliber and length of the urethra, and to evaluate their correlations with age, body height, body weight and body mass index (BMI) in asymptomatic Taiwanese adult females.

**Materials and Methods:** Twenty-three women with a mean age of 63.2 years (range, 41–82 years) were studied. All study subjects claimed to have no difficulty in voiding. Measurements were taken just prior to the scheduled cystoscopy under local anesthesia. We used a bougie à boule to measure the caliber of the urethra, and used a scaled cystoscope sheath to determine the length of the urethra. Correlations of urethral length and caliber with age, body height, body weight and BMI were analyzed using Spearman correlation.

**Results:** The mean age, body height and weight were  $63.2 \pm 12.4$  years,  $154.1 \pm 8.3$  cm and  $54.3 \pm 8.1$  kg, respectively. The mean adult female urethra was  $3.7 \pm 0.7$  cm long and  $7.5 \pm 0.6$  mm (i.e.,  $23.7 \pm 1.9$  French) in diameter. There were no statistically significant correlations of urethral length and caliber with age, body height, body weight and BMI (all  $p > 0.05$ ).

**Conclusion:** There was no correlation of urethral length and urethral caliber with age, body height, body weight and BMI in asymptomatic adult women. This study provides valuable normal data as the reference for clinical evaluation of voiding dysfunction, and defines urethral stricture and reconstructive surgery of the urethra in females.

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## 1. Introduction

Normal values of caliber and length for the urethra would help urologists to evaluate the function of the lower urinary tract in females (e.g., a small urethral caliber may cause a low maximum measured urine flow rate [Q<sub>max</sub>], and a short urethral length may be related to stress urinary incontinence). The normal caliber of the female urethra in children has been previously reported.<sup>1,2</sup>

Immergut et al.<sup>1</sup> used a bougie à boule to measure the urethral caliber under general anesthesia and their conclusions were as follows: (1) age was correlated as well with normal distal urethral or meatal size as age, height and weight combined; (2) the normal distal urethra and urethral meatus are essentially of the same caliber; and (3) the lumen of both areas increases in a stepwise progression, proportional to age, until the pubertal years when the distal urethra and meatus significantly increase,

perhaps in response to hormonal changes.<sup>1</sup> Graham et al.<sup>2</sup> used bougie à boule to measure urethral caliber. Most of the patients underwent urethral calibrations under general anesthesia. The average caliber of female children (newborn to 14 years old) was 14 French (F) (14.4).<sup>2</sup> Two reports about the normal caliber of the adult female urethra in Westerners have been published.<sup>3,4</sup> Hole<sup>3</sup> showed that the normal range of female urethral calibers was from  $\leq 18$  to  $\geq 26$  Charrière, and that urethral calibers are similar between patients without postoperative urinary frequency and dysuria and patients with postoperative urinary frequency and dysuria. Uehling<sup>4</sup> demonstrated that the mean urethral caliber in each of the adult age groups, with the groups divided by decades of age ranging from 20 to 90 years, was 22F. The normal length of the adult female urethra in Westerners is  $38 \pm 3$  mm as reported using magnetic resonance imaging.<sup>5</sup> However, there are no data on the caliber and length of the urethra in normal Taiwanese adult females. We determined the caliber and length of the urethra, and evaluated their correlations with age, body height, body weight and body mass index (BMI) in asymptomatic adult females.

## 2. Materials and Methods

This study included 23 women with a mean age of 62.3 years (range, 41–81 years). All study subjects had a good urine stream without voiding difficulty. These 23 female patients were scheduled for cystoscopy under the indication of a bladder tumor follow-up (seven patients), renal pelvis tumor follow up (one patient), check-up for microscopic hematuria (six patients), removal of a double J ureteral stent (three patients), preoperative survey of cervical cancer (one patient), right ureteral tumor follow-up (one patient) and other causes (four patients). The measurement was carried out just prior to the scheduled cystoscopy under local anesthesia using 2% lidocaine jelly. The urethral caliber was measured with a bougie à boule, beginning with smaller sizes. When substantial resistance to withdrawing the shoulder of the instrument was noted, the urethral caliber was considered to be 2F sizes smaller.<sup>4</sup> For example, if a 22F bougie à boule satisfactorily passed and a 24F bougie à boule required a stronger pull to withdraw it, the urethral caliber was considered to be 22F. The urethral length was measured with a scaled cystoscope sheath (Olympus, Tokyo, Japan) from the bladder neck to the urethral meatus. Correlation of urethral length and caliber with age, body height, body weight and BMI were analyzed using Spearman correlation. The correlation was considered statistically significant when  $p < 0.05$ .

## 3. Results

The mean age was  $63.2 \pm 12.4$  years (range, 41–82 years). Body height and weight of the patients were

**Table 1** Correlations between urethral length and age, body weight, body height, and body mass index (BMI)

| Variable    | Correlation coefficient (95% CI) | $p^*$ |
|-------------|----------------------------------|-------|
| Age         | -0.036 (-0.442 to 0.382)         | 0.87  |
| Body weight | 0.193 (-0.238 to 0.561)          | 0.38  |
| Body height | -0.197 (-0.564 to 0.234)         | 0.37  |
| BMI         | 0.368 (-0.052 to 0.677)          | 0.08  |

\*Spearman correlation. CI = confidence interval.

**Table 2** Correlations between urethral caliber and age, body weight, body height and body mass index (BMI)

| Variable    | Correlation coefficient (95% CI) | $p^*$ |
|-------------|----------------------------------|-------|
| Age         | 0.281 (-0.148 to 0.621)          | 0.20  |
| Body weight | -0.110 (-0.500 to 0.317)         | 0.62  |
| Body height | -0.229 (-0.586 to 0.202)         | 0.29  |
| BMI         | 0.003 (-0.410 to 0.415)          | 0.99  |

\*Spearman correlation. CI = confidence interval.

$154.1 \pm 8.3$  cm and  $54.3 \pm 8.1$  kg, respectively. The mean adult female urethra was  $3.7 \pm 0.7$  cm long and  $7.5 \pm 0.6$  mm ( $23.7F \pm 1.9F$ ) in diameter. There were no significant correlations of urethral length and caliber with age, body height, body weight and BMI (all  $p > 0.05$ ; Tables 1 and 2).

## 4. Discussion

The mean normal caliber of the adult female urethra in Westerners is 22F and an 18–28F (mean  $\pm$  two standard deviations) urethral caliber is considered within the normal range.<sup>4</sup> In our series, the mean caliber of the female urethra in Taiwanese was 23.7F, and the range of mean  $\pm$  two standard deviations was 19.9–27.5F, which is similar to that of Westerners. In a series of Western adult females, the urethral length measured by magnetic resonance imaging was  $3.8 \pm 0.3$  cm.<sup>5</sup> In our series, the mean length of the female urethra in Taiwanese was  $3.7 \pm 0.7$  cm, which is similar to that of Westerners.

In a series of Western patients,<sup>4</sup> increasing patient weight had a significant linear relationship with a corresponding increasing urethral caliber. However, we did not find any significant correlations of urethral length and caliber with age, body height, body weight and BMI in our study (all  $p > 0.05$ ). This finding may be due to our relatively small patient numbers. Normal values for anatomic structure or laboratory data are often different in different races. For example, the prostate-specific antigen–total prostate volume relationship in Taiwanese men is similar to that in Japanese men but different from that in white men.<sup>6</sup> Our report is the first to determine the caliber and length of the urethra of normal Taiwanese adult

females. We believe that these data can provide a valuable reference for urologists when evaluating the voiding function of adult female patients in Taiwan.

According to the literature,<sup>7</sup> criteria for the female urethral stricture are not well defined. Defreitas et al.<sup>8</sup> reported that a detrusor pressure at maximum flow (pdet.Qmax) of >25 cmH<sub>2</sub>O with Qmax of <12 mL/s is suggestive of obstruction. Kuo<sup>9</sup> reported that when pdet.Qmax of ≥35 cmH<sub>2</sub>O combined with a Qmax of ≤15 mL/s was found, bladder outlet obstruction should be suspected. Blaivas and Groutz<sup>10</sup> defined their criteria for female bladder outlet obstruction as follows: (1) free Qmax ≤12 mL/s in repeated free-flow studies, combined with a sustained detrusor contraction and pdet.Qmax ≥20 cmH<sub>2</sub>O in a pressure-flow study; (2) obvious radiographic evidence of bladder outlet obstruction in the presence of a sustained detrusor contraction of at least 20 cmH<sub>2</sub>O and poor Qmax, regardless of free Qmax; and (3) inability to void with a transurethral catheter in place despite a sustained detrusor contraction of at least 20 cmH<sub>2</sub>O. These normal data can also provide a reference for urologists for defining and treating the female urethral stricture and reconstructive surgery of the urethra, such as reconstruction of the female urethra due to female urethral diverticula in Taiwanese females. However, since the patient numbers in our study were relatively small, a larger study is needed to confirm our results.

In conclusion, this study showed that there was no correlation of urethral length and urethral caliber with age, body height, body weight and BMI in asymptomatic adult women. This study also provides valuable normal data as a reference for clinical evaluation of voiding

dysfunction, and defines urethral stricture and reconstructive surgery of the urethra in females.

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