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Research Article

Morphometry of the pelvic ureter in north East Indian population

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Abstract: Morphometric features of the pelvic ureter such as length and obliquity of the intravesical part are important in etiology of vesico ureteric reflux (VUR). Although differences in morphometry of the ureter may underlie the observed sex disparity in the frequency of vesicoureteric reflux, there is scarcity of comparative data on the organization of the pelvic ureter. This study aimed at determining sex differences in the structure of the pelvic ureter. This was a descriptive cross sectional study carried out at the Department of Anatomy, Agartala Govt medical College, Agartala and Regional Institute of Medical Sciences, Imphal. Eighty-eight ureters from adult cadaver (48 male and 40 female) were studied. Length and angle at which intravesical ureter lies to the bladder was measured in millimeters and degrees respectively. Data were analyzed using SPSS (Version 16.0) for means and standard deviations. The mean intravesical length of pelvic ureter in males was 18.72 mm compared to 14.67 mm in females (p – value of <0.001). The angle at which ureters lay to the bladder was 27.32° in males and in females 28.68° (p – value of 0.018). The pelvic ureter displays sex differences in morphometry with the intravesical segment being longer with a more oblique course in males. These features could underlie the higher female predisposition to VUR.
Keywords: ureter, length, angle, vesicoureteric reflux.

INTRODUCTION

The pelvic ureter is part of ureter which extends from the pelvic brim to the urinary bladder. It is the lower half of ureter and consists of a juxta and intravesical segments with the latter having an oblique course through the bladder wall and measuring 10-19 mm long in adults[1]. The intravesical part is responsible for the active and passive components for prevention of vesicoureteric reflux [2, 3] (VUR). The intravesical segment as a result of its oblique course through the bladder wall[4] giving rise to a valvular mechanism at the vesicoureteric junction (VUJ)[3]; [5]Refluxing ureters, have therefore been shown to have a shorter intravesical length and a less oblique intravesical course[6]. Accordingly, sex differences in morphometry of the intravesical ureter may underlie the higher frequency of vesicoureteric reflux in females as opposed to males[7,8]; However, comparative morphometric data on the pelvic ureter and its length and sex differences are scarce and this study therefore aimed at comparing the length and angle of implantation of the intravesical ureter between males and females. Such Morphometric study has not been done in this part of India, so this study will give a baseline data in the pelvic ureter of this region.

MATERIALS AND METHODS

Material for this study was obtained from 88 adult cadaveric hemipelvises (48 male; 40 female) at the Department of Anatomy, Agartala Govt Medical College, Agartala and Regional Institute of Medical Sciences, Imphal. Prosections with any form of urinary bladder abnormalities such as bladder wall trabeculation and nodulation or ureteric pathology were excluded from the study. Measurements of intravesical length and angle at which the ureter lies to the bladder were taken by two observers and averages obtained for the two sets of values after removing the peritoneum and other connective tissue. Then the bladder was opened horizontally to find the internal ureteric meatus and interureteric ridge. For intravesical length, a probe was inserted through the internal ureteric orifice and length of the intravesical ureter was marked and measured using a rule to the nearest 0.5 mm. The angle at which the ureter lies to the bladder (Q) was measured using a protractor as an angle subtended between a horizontal plane through the interureteric ridge and a diagonal axis passing through the intravesical ureter (Figure 1). A vernier caliper, a sliding scale and a goniometer was used for measuring the length and angle.

Data were analyzed using SPSS version 16.0.for means ± standard deviations. Student's t test, at 95% confidence interval was used to test for significant differences in the intravesical ureter length and the angle at which the intravesical ureter lies to the bladder with regards to sex. A p – value of < 0.05 was considered significant. Pearson's correlation test was used to test for association between mean length and mean angle. A Two-tailed test was used to test for significance of the correlation co-efficient. A p – value < 0.01 was considered significant. The data are presented in tables and bar diagram.

RESULTS

Ninety four ureters from forty seven individuals were available for this study. Six were excluded from the study due to difficulty in identification of internal ureteric orifice and due to obvious pathologies of the ureters and bladder. Eighty eight were therefore studied. The pelvic ureters, in all cases, were bilateral muscular tubes extending from the pelvic brim to the urinary bladder wall. The ureters coursed within the pelvic cavity to pierce the posterior wall of the urinary bladder and traverse the bladder wall to terminate at the internal ureteric orifice.

The mean length of the intravesical ureter was 16.87 mm (standard deviation 3.459, range 9 mm-24 mm.) It was longer in males with a mean value of 18.72 mm (standard deviation of 3.266, range 9 mm-24 mm.) compared to 14.67 mm (standard deviation of 2.198 and range 10 mm-19 mm) in females (Figure 2). This difference in length between the sexes was statistically significant (p-value < 0.001) (Table 1).The ureter entered the bladder at a mean angle of 27.32° (standard deviation of 4.762°, range 20°-40°). In males, this angle was narrower with a mean of 26.2° (standard deviation of 5.241°, range 20°-40°) in comparison to females mean 28.68° (standard deviation of 3.741°, range 20°-39°) (Figure 2). The difference in angle Q between sexes was statistically significant (p-value 018) (Table 2).

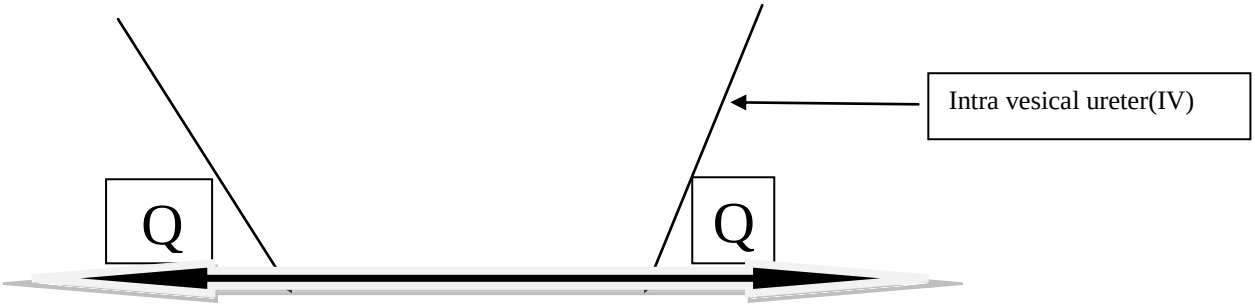

Figure 1. Schematic diagram showing a hemi-section of the posterior bladder wall at the trigone. The angle Q was measured in between the horizontal (↔) and diagonal axes subtended for intravesical ureter (IV).

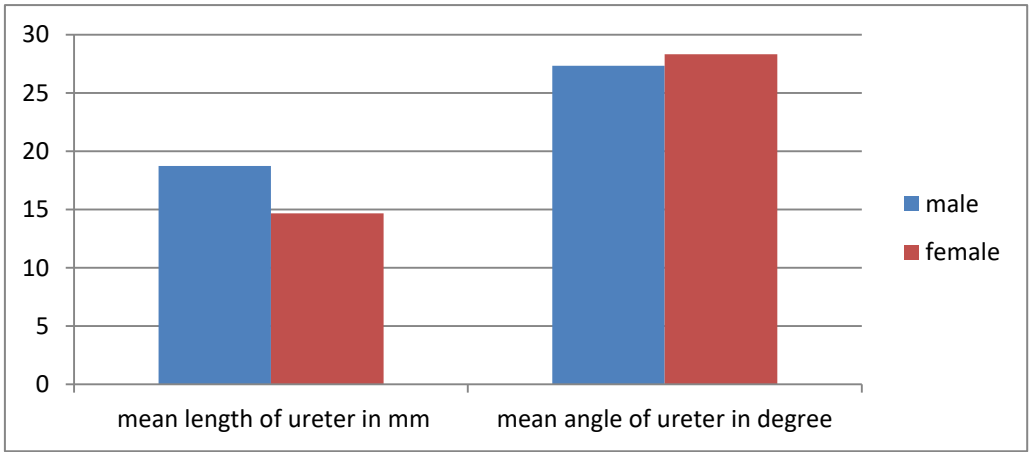

Figure 2: Bar diagram showing the differences in male and female pelvic ureter length and angle.

Pearson's correlation test was applied to test for correlation between mean length and angle and a value of –0.333 was found. The strength of this correlation was statistically significant (p – value 0.002).

Table 1: Intra vesical ureter length

	Sex	Number	Mean	Standard deviation	Range	P value
Length of intravesical ureter	M	48	18.72mm	3.266	9-24mm	<0.001
	F	40	14.67mm	2.198	10-19mm	

Table 2: Angle at which the ureter entered the bladder (Q).

	Sex	Number	Mean (degree)	Standard deviation	Range	P value
Angle of the ureter to the bladder	M	48	27.32º	5.241	20-40º	< 0.018
	F	40	28.68º	3.741	20-39º	

DISCUSSION &CONCLUSION

Morphometry of the pelvic ureter has been implicated in etiology of vesico-ureteric reflux[5]. This condition has demonstrated disparity based on sex[7]. This study therefore proceeded to describe differences in the pelvic ureter structure that probably underlie this disparity. Indeed observations in the current study revealed differences in morphometry of the pelvic ureter between males and females.

The mean length was 16.87 mm. This value is within the range of 10-19 mm reported by Hutch et al[1]. It is however lower than 23 ± 0.6 mm reported by Roshaniet al[9]. Similarity with Hutch's findings can probably be attributed to use of the same methodology. On the other hand, the difference between findings of the current study and those of Roshaniet al[9] may be explained by the nature of the specimens used and the methodology, that is fresh autopsy ureters bathed in physiological saline as opposed to formalin fixed samples used in the current study and Endoluminal ultrasonography (ELUS) for measurement of length. Length of the intravesical ureter constitutes part of the passive anti reflux mechanism[9]. In males, this length averaged 18.72 mm compared to 14.81 mm in females. Relatively shorter intravesical lengths have been reported in refluxing ureters[5,10]. This could imply that a shorter intravesical ureter in females compared to their male counterparts accounts for their predisposition to VUR.

The mean angle at which the intravesical ureter lies to the bladder in the current study was 27.32°, a value was much higher than 11 ± 0.5° reported by Roshaniet al[9]. The latter calculated this angle as a function of bladder wall thickness and intravesical ureteric length. A notable observation of the current study was that females had a wider angle implying a more oblique course of the intravesical ureter as opposed to males.

The oblique course of the intravesical ureter forms part of the passive anti reflux mechanism[11]. This is achieved through neutralization of the force tending to separate the ureteral roof from floor. This force is due to the increased surface of the bladder wall due to distension with urine[12]. Consequently, the wider angle is less efficient at preventing VUR[6].

A negative correlation was found between length and angle Q of the intravesical ureter hence an increase in length would result in a decrease in angle Q. A literature report has correlated the propensity to reflux in the Pax2. 1Neu+/– mouse with a shortened intravesical ureter that has lost its angulated entry into the bladder wall[10]. In combination with a shorter intravesical length, a wider angle Q could, in part, explain the predisposition of females to VUR.

The limitations of this study included tissue shrinkage that occurs in cadaveric specimen. This may have affected measurements taken. However, the shrinkage factor was the same for all specimens included as only cadaveric specimen were used in this study.

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