

## A descriptive study to analysis the ureteral length in adult population

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### Abstract

**Purpose:** The ureteral stent is an essential in various urological procedures. Therefore, choosing an ideal ureteral stent is central to minimizing the incidence of stent related complications. This study aim was to identify the average length of ureteral in adult population as it would help to opt for optimal stenting according to the variability of age and gender.

**Materials and methods:** It was a descriptive cross-sectional study at Teaching Hospital Jaffna and underwent to analysis the average length of ureteral among adults based on their CT urogram. This study was approved (Reg.No:S01/07/2021) on 30 September 2021 by the Ethics Review Committee of Teaching Hospital Jaffna and the patient informed written consent was received. A total number of 69 patients had been ordered for computed tomography urogram consecutively in last 4 months from 1<sup>st</sup> October 2021 to 31<sup>st</sup> January 2022. All ureterals with pathological conditions were excluded from this study. The actual and linear lengths were calculated by using the Radiant DICOM viewer 3.2.3.

**Results:** The gender distribution was men 69.6% and women 30.4%. Fifty seven (49.6%) were right ureterals and fifty eight (50.4%) were left ureterals. The average length of ureteral right and left were 23.03 ( $\pm 3.15$ ) cm and 23.48 ( $\pm 3.17$ ) cm respectively. The average length of right ureteral in male was 23.03 ( $\pm 2.85$ ) cm and left was 23.64 ( $\pm 3.16$ ) cm while it was estimated in female right 23.03 ( $\pm 3.82$ ) cm and left 22.98 ( $\pm 3.26$ ) cm. The multiple linear regressions showed that there is a no linear relationship between the ureteral length and age or gender.

**Conclusion:** The average actual length of ureteral of Jaffna adult population is 23.03 ( $\pm 3.15$ ) cm in right and 23.48 ( $\pm 3.17$ ) cm in left. The median ureteral length is 23.26 ( $\pm 3.15$ ) cm. Therefore, it is prudent to use 24cm ureteral stent to Sri Lankan population.

**Keywords:** Ureteral Length; CT Urogram; Ureteral Stent; Multiple Linear Regression

### 1. Introduction

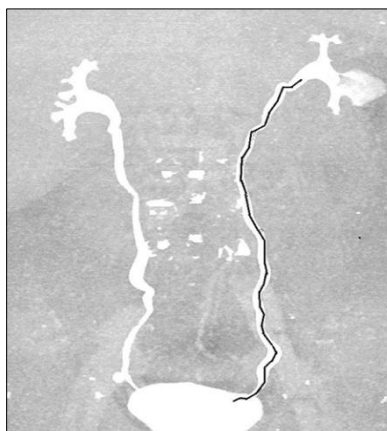
Ureteral stent is a versatile tool used by urologists in today's urological armamentarium [1]. However, the use of an inappropriately dimensioned ureteral stent is associated with clear side-effect profile and report on reduced quality of life [2]. A stent longer in length can result in unpleasant side effects, such as urinary frequency, urgency, incontinence, hematuria, bladder pain and flank pain. However, a stent shorter in length may increase the risk of migration to the ureteral, which results in complications that require retraction and replacement of the stent with further invasive surgical procedures. Therefore an accurate prediction of the ureteral length is required to determine the ideal stent length to ensure trouble-free drainage [3]. Accurate determination of ureteral length and appropriate stent length remains a challenge. Although measurement with a graduated ureteral catheter under cystoscopy direct vision is

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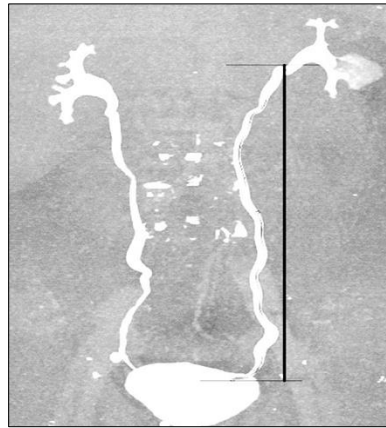
considered the gold standard for determining true ureteral length, this is rarely done in practice as it is time consuming and often requires repeat instrumentation [4]. Another method using imaging modalities is useful and simple to determine the appropriate ureteral stent length. However, actual stent measurement requires additional radiation exposure. Correlations with the patient's height are generally used to estimate the ureteral length. However, the reliability of this method as an estimate of ureteral length has not been confirmed. Moreover the methods for choosing an appropriate stent length by using a formula based on the patient's height are derived mostly from the data of western population, who are relatively taller than Asians. Whether these data are applicable to Asians is unclear [5]. There is no standard and simplified method for determining the appropriate ureteral stent length that prevents a decline in urination-related quality of life. Moreover, in some hospitals, assorted lengths of ureteral stents are not stocked, and preoperative prediction of ureteral stent lengths is often needed [3]. The aim of the present study was to develop and internally validated Sri Lankan average ureteral length for appropriate ureteral stent insertion. This preliminary descriptive study is the first step in establishing average ureteral length in Jaffna population. Teaching hospital Jaffna is a tertiary care institution providing medical services in Northern Province. A large number of patients undergo CT urogram and stenting procedure when compared to other hospitals in the northern part of Sri Lanka. This average predictive value based on clinical and radiological factors can be used as a scientific evidence helps to determine the optimal length of ureteral stent. Thus reduces the symptoms and improve the quality of life.

## 2. Material and methods

It is an institutional based descriptive cross sectional study on analysis of average length of ureteral among adults who admitted to Teaching hospital Jaffna. A total number of 69 patients had undergone computed tomography urogram consecutively in last 4 months from 1<sup>st</sup> October 2021 to 31<sup>st</sup> January 2022 and ureterals with pathology were excluded in this study. Patients with pathological ureterals such as hydro ureteral and ureterals with congenital anomalies, previously operated ureterals and improper opacification of contrast agent in the ureteral were excluded. The ureteral length was measured using the Radiant DICOM viewer 3.2.3. The actual length of ureteral was measured by using curved measurement in three-dimensional CT urogram images by rotating the reference images in various directions (Figure 1). The linear length was measured in coronal CT images by measuring the straight line from pelvic ureteral junction to vesico ureteral junction (Figure 2). The pelvic ureteral junction was defined as the point where the caliber of the renal pelvis narrowed to match the caliber of the proximal ureteral, and the vesico ureteral junction was defined as the point where the distal ureteral could be seen entering the bladder wall. Calculations were made with simple statistical formulae. Data Extraction Form which includes serial no, sex, Age, actual and linear length of both ureterals was used to collect the details from database of department of radiology at Teaching hospital Jaffna. For statistical analysis, the sample was categorized according to gender (male and female) and age distribution. Multiple linear regressions were used to analyze the correlation between average ureteral length and socio demographical factors (age and gender). P values lower than 5% ( $p < 0.05$ ) were considered significant. All analysis were made using SPSS software version 21.0. This study was approved by the Ethics Review Committee of Teaching hospital Jaffna.



**Figure 1** Ureteral length using three dimensional CT urogram measured by tracing the ureteral from the ureteral pelvic junction to the ureteral vesical junction with the trackball or mouse



**Figure 2** Linear length was measured in coronal CT images by measuring the straight line from pelvic ureteral junction to vesico ureteral junction

### 3. Results

A total of 69 patients who has undergone CT urogram consecutively from April to July 2021, including 48 men (69.6%) and 21 women (30.4%) were enrolled in this study. Fifty seven (49.6%) were right ureterals and fifty eight (50.4%) were left ureterals. (Table 1)

**Table 1** Patients' characteristics

variables		Number (%)
Side	Right	57 (49.6%)
	Left	58 (50.4%)
Sex	Male	48 (69.6%)
	Female	21 (30.4%)

The mean actual right and left ureteral length were 23.03 ( $\pm 3.15$ ) and 23.48 ( $\pm 3.17$ ) cm, respectively. The mean linear right and left ureteral length were 21.85 ( $\pm 2.76$ ) and 22.31 ( $\pm 3.05$ ) cm, respectively. The actual mean length of right ureteral in male was 23.03 ( $\pm 2.85$ ) cm and left was 23.64 ( $\pm 3.16$ ) cm. The linear mean length of right ureteral in male was 21.78 ( $\pm 2.61$ ) cm and left was 22.36 ( $\pm 3.02$ ) cm. The actual mean length of right ureteral in female was 23.03 ( $\pm 3.82$ ) cm and left was 22.98 ( $\pm 3.26$ ) cm. The linear mean length of right ureteral in female was 22.00 ( $\pm 3.14$ ) cm and left was 22.19 ( $\pm 3.28$ ) (Table 2)

**Table 2** Average and linear length of ureteral based on sex

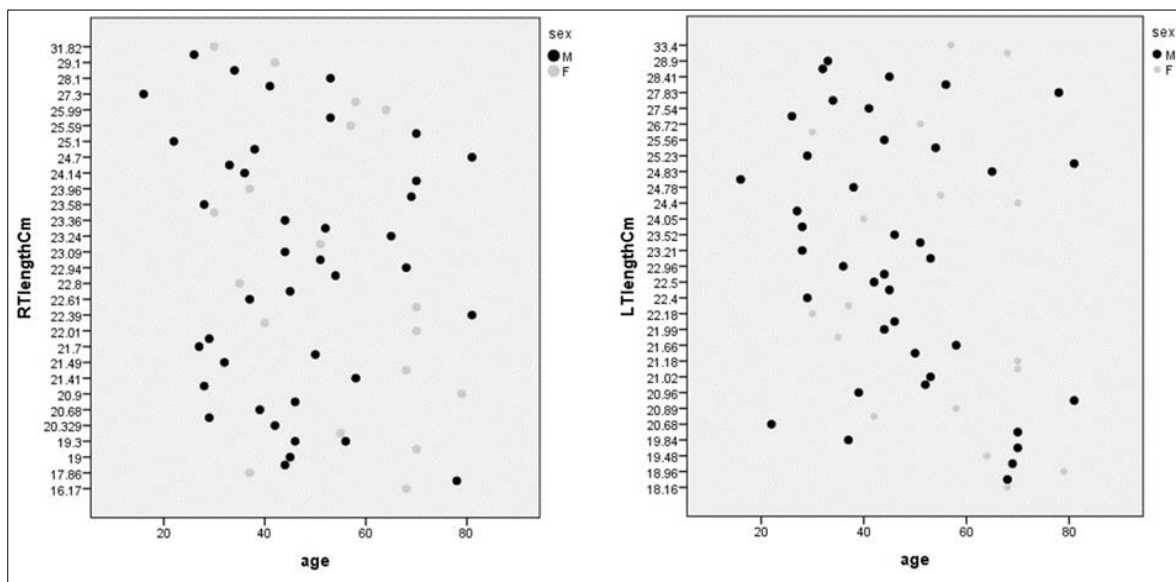
Side		Sex	Mean length(Cm) ( $\pm$ SD)	Mean Length (Cm) ( $\pm$ SD)
Right	Actual	Male	23.03 ( $\pm 3.15$ )	23.03 ( $\pm 2.85$ )
		Female		23.03 ( $\pm 3.82$ )
	Linear	Male	21.85 ( $\pm 2.76$ )	21.78 ( $\pm 2.61$ )
		Female		22.00 ( $\pm 3.14$ )
Left	Actual	Male	23.48 ( $\pm 3.17$ )	23.64 ( $\pm 3.16$ )
		Female		22.98 ( $\pm 3.26$ )
	Linear	Male	22.31 ( $\pm 3.05$ )	22.36 ( $\pm 3.02$ )
		Female		22.19 ( $\pm 3.28$ )

The correlation and association between socio demographic factors and ureteral length was analyzed by multiple linear regression. There is a no linear relationship between the ureteral length and the socio demographic factors (Table 3)

**Table 3** The correlation and association between ureteral length and socio-demographic factors

Variables	Correlation		Association	
	Right length	Left length	Right length	Left length
Age	-0.256	-0.187	0.053	0.160
Gender	0.002	-0.090	0.990	0.500

This scatter plot graph shows that there is no relationship between right and left ureteral length, age and sex (Figure: 03)



**Figure 3** Distribution pattern of ureteral length with age and gender

#### 4. Discussion

This study was conducted to identify the average length of ureteral among adults who admitted to Teaching hospital Jaffna and its variability with sex and gender. Our present study found that the actual mean length of right ureteral was 23.03 ( $\pm 3.15$ ) cm and left was 23.48 ( $\pm 3.17$ ) cm. There is no significant difference between right and left ureterals. A same retrospective descriptive study which was done in Colombo South Teaching Hospital, Kalubowila with Ninety five consequently performed CT urograms, revealed that the average actual length of ureteral of Sri Lankan adult patient is 22.1 cm on the right side and 22.6 on the left [6]. At the same time in a retrospective study conduct in Korea a total of 508 ureterals of 254 healthy patients were included. The mean left and right LLCT (ureteral length in healthy Koreans using reformatted computed tomography) were  $21.1 \pm 1.8$  and  $20.3 \pm 1.9$  cm [3]. Another south Asian institutional based retrospective study from Japan included a total of 127 patients whose ureterals had previously been assessed by both intravenous urography (IVU) and CT scan. In these patients, 53 (41.7%) right and 74 (58.3%) left ureterals were analyzed. The median and mean ( $\pm$  SD) actual ureteral lengths were 24.0 and 23.3 ( $\pm 2.0$ ) cm, respectively. It was observed that even though the ureteral length was in a range among countries it could be influenced by the sample size we have selected. In the above studies also there is no significant difference between right and left ureterals [7]. In Sri Lanka commonly used ureteralic stent is 26cm. If we apply this result to the clinic, it is prudent to use 24cm ureteral stent to Sri Lankan population. However there are patients with exception, that they may have longer ureteral than this mean length. For that we should consider the appropriate ureteral length. In future we plan to do a prospective study that aims to develop validated preoperative predictive formula for predicting the individualized actual ureteral length [8].

A noteworthy finding in our study was that the actual mean length of right ureteral in male was 23.03 ( $\pm 2.85$ ) cm and left was 23.64 ( $\pm 3.16$ ) cm. The actual mean length of right ureteral in female was 23.03 ( $\pm 3.82$ ) cm and left was 22.98 ( $\pm 3.26$ ) cm. There is no significant difference between the length of male ureteral and female ureteral. In above Kalubowila Teaching hospital study they concluded as for females the average actual length of right ureteral was 21.9cm and for left was 22.9cm. For males average actual length of right ureteral was 22.3cm and for left was 22.4cm [7]. Similarly a study on ureteral length in adult cadavers conducted in Brazil from April 2009 to January 2012 and analyzed its correlation with anthropometric measures. They dissected 115 ureterals from 115 adult corpses. As a result median ureteral length didn't vary between sexes or according to height. It was observed no correlation among ureteral length and all considered anthropometric measures in all analyzed subgroups and in general population. There were no significant differences between right and left ureteral measures [9].

In our study, multiple linear regressions showed that there is no linear relationship between the ureteral length and age or sex. A retrospective study in which the Data were gathered from various research centers from North and South America. Continuous data were studied using descriptive statistics. Anthropometric variables (age, body surface area, body weight, obesity, and stature) were utilized as predictors of ureteralic lengths. As same as our study they have suggested that there is not sufficient evidence to conclude that anthropometric variables can reliably predict ureteralic lengths, since Out of the five anthropometric variables studied, three of them: body frame, stature, and weight, each with a  $P < 0.0001$ , were significant. Two of the variables: age ( $R^2 = 0.01$ ;  $P = 0.20$ ) and obesity ( $R^2 = 0.03$ ;  $P = 0.06$ ), were found to be poor estimators of ureteralic lengths [10].

We acknowledge the following limitations in our study. First, our results did not include the ureteral stent-related symptoms, actual stent position and anthropometric measurement such as height in the clinical setting. To overcome these limitations, in future we plan to do a prospective study that includes large number of samples and includes anthropometric measurements, stent related symptoms and actual stent position. Second, selection bias may have occurred, because we assessed only patients who underwent CT urogram. In future we should consider other methods of measuring ureteral length such as measurement with a graduated ureteral catheter under cystoscopic direct vision and reformatted CT.

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## 5. Conclusion

The average actual length of ureteral of Jaffna adult population is 23.03 cm on the right side and 23.48cm on the left. The median ureteral length is 23.26 ( $\pm 3.15$ ) cm. So, it is prudent to use 24cm ureteral stent to Sri Lankan population.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

There is absolutely no conflict of interest between the authors as everybody is aware of the work and participated adequately.

### *Statement of informed consent*

This study obtained informed consent from all individual participants included in the study.

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