Original article:

Measuring the Capacity of Urine in the Post Mortem Human Urinary Bladder in a Selected Medical College

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Abstract:

Background: Urinary bladder diseases are one of the clinical problems encountered in our daily practice. The incidence of these diseases rises with advanced age. These diseases are diagnosed clinically and confirmed by various non invasive as well as invasive procedures and wall abnormalities are the most important indicator to diagnose such diseases. All these conditions require medical and surgical intervention. Thereby knowledge regarding normal capacity of urinary bladder is essential to determine the physiologic variation of this organ. Therefore, full knowledge about gross and histological features of the urinary bladder has hard & fast implication for the investigation, diagnosis and further management. With this background the present study has been designed to evaluate the capacity of urine in postmortem human urinary bladder. ***Objectives*:** To identify the socio-demographic determinants and to determine the capacity of urine in post mortem human urinary bladder. ***Materials and Methods*:** This was a descriptive type of longitudinal study. Sample size was estimated by reviewing literatures and by expert opinion and 70 human postmortem urinary bladders fulfilling the inclusion and exclusion criteria were selected in this study. This study was conducted in the Department of Anatomy, Sylhet MAG Osmani Medical College, Sylhet in collaboration with the Department of Forensic Medicine, Sylhet MAG Osmani Medical College, Sylhet from 1st January 2015 to 31st December 2015. ***Results****:* The age of the cadaver ranged from 10 to 65 years with the mean age of 32.20 (SD ± 14.38) years; 15 (21.40%) cadavers were in the age group of 10-20 years, 36 (51.4%) cadavers were in the age group of 21-40 years and 19 (27.1%) cadavers were in the age group 41-65 years. There were 52 (74.3%) male and 18 (25.7%) female with a ratio of male to female was 2.89:1. The mean capacity was 35.23 (SD ± 7.48) ml. The mean capacity of the urinary bladder was 31.20 ml (SD ± 7.28); 37.92 ml (SD ± 7.31) and 33.32 ml (SD ± 6.13) in the age group of A, B and C respectively. The difference between group A and B was highly significant (p=0.004); between group B and C was significant (p=0.023); but not significant between group A and C (p=0.364). The mean capacity of urinary bladder of male and female did not differ significantly in age group A (p=0.117), group B (p=0.145) and group C (p=0.241). ***Conclusion:*** The gross capacity of urinary bladder was found increased with age up to certain limit then slightly decreased in the late age. But the capacity did not differ significantly between male and female.

Keywords: Urinary bladder; cadaver; postmortem

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Introduction: The urinary bladder, a hollow viscus with strong muscular wall, is characterized by its distensibility. It's the temporary reservoir of urine and varies in size, shape, position and relationships according to its content and the state of neighboring viscera. When empty, the adult urinary bladder is located in the lesser pelvis, lying partially superior to and partially posterior to the pubic bones[1].

The urinary bladder is a smooth muscle chamber composed of two main parts: (1) the body, which is the major part of the bladder in which urine collects, and (2) the neck, which is a funnel-shaped extension

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of the body, passing inferiorly and anteriorly into the urogenital triangle and connecting with the urethra. The lower part of the bladder neck is also called the posterior urethra because of its relation to the urethra[2].

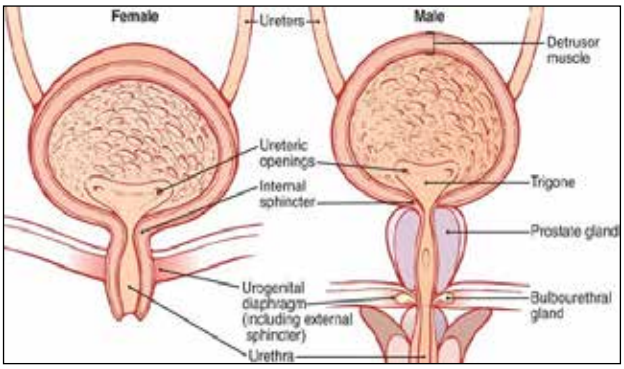

Figure: Anatomy of the urinary bladder in males and females (Hall, 2011)

The urinary bladder of a normal subject is uncomfortably distended by half a pint of fluid. When fully distended, the adult bladder projects from the pelvic cavity into the abdomen, stripping the peritoneum upwards from the anterior abdominal wall. The surgeon utilizes this fact in carrying out an extra peritoneal incision or suprapubic puncture into the bladder. In children up to the age of about 3 years, the pelvis is relatively small and the bladder is, in fact, intra-abdominal although still extra peritoneal [3]. It is an expandable, muscular container that serves as temporary reservoir of urine. The bladder is positioned immediately posterior to the pubic symphysis. In females, the urinary bladder is anteroinferior to the uterus and directly anterior to the vagina; in males, the bladder is anterior to the rectum and superior to the prostate gland. The urinary bladder is a retroperitoneal organ, since only its superior surface is covered with peritoneum [4]. In the adult, empty bladder lies entirely within the pelvis; its superior surface level with the superior margin of the pubic symphysis. As the bladder fills, it enters the greater pelvis as it ascends in the extraperitoneal fatty tissue of the anterior abdominal wall. In some individuals, a full bladder may ascend to the level of the umbilicus[5]. Urinary bladder diseases like congenital-ectopia vesicae, urachal cyst, urachal fistula; and cystitis, tuberculosis, stone, benign and malignant tumor are common medical or surgical conditions[6].

In infants and young children, the urinary bladder is in the abdomen even when empty. When the pelvic cavity enlarges, the bladder sinks and usually enters the greater pelvis by 6 years of age; however, it is not located entirely within the lesser pelvis until after puberty[7]. When empty, the urinary bladder exhibits an upside-down pyramidal shape. Filling with urine distends it superiorly until it assumes an oval shape[4]. The normal functions of the urinary bladder are urine storage and expulsion of urine at an appropriate time [8]. Aging is associated with declining function in nearly every physiologic system[9-11]. Symptoms in the lower urinary tract are more prevalent among the elderly[12, 13] and clinical urodynamic studies have demonstrated advancing age to be associated with a reduce bladder capacity, an increase same response in the bladder base of old and young rats[14]. Anatomical capacity of the bladder means the volume of urine just before the rupture of bladder. It amounts to about one liter or more[15].The desire to micturate, or pass urine, usually develops when the bladder contains 200-300 ml, this being well before the bladder is distended to any extent. The rate of filling also affects the amount which the bladder holds before the desire to micturate is stimulated. The capacity of the bladder is very variable: some people can retain half a without over distension. In the living subject the bladder almost always contains some urine[16].

In the adult, the volume of urine in the bladder that normally initiates a reflex contraction is about 300 to 400 ml. The sympathetic nerves to the bladder play no part in micturition, but in males they do mediate the contraction of the bladder muscle that prevents semen from entering the bladder during ejaculation[17].

The average capacity varies between 120 ml and 320 ml. Mean capacity being about 220 ml. Sense of filling of bladder first starts at a capacity of 100 to 150 ml. First desire for micturition usually appears at a capacity of 150 to 250 ml. Physiological capacity of distension of bladder without undue discomfort varies with age and psychic factors. In normal adult, it ranges between 250 and 450 ml, whereas in the newborn it is about 20 to 50 ml. Painful sensation starts when the amount of urine reaches above 450 ml. On collection of about 800 ml the micturition is beyond voluntary control[15]. Chaurasia, (2004) stated that the capacity varying from 120 to 320 ml. Mean capacity of the urinary bladder in an adult male is 220 ml. Filling beyond 220 ml causes desire to micturate, and the bladder is usually emptied when filled to about 250 to 300 ml. Filling up to 500 ml may be tolerated, but beyond this it becomes painful[18].

Standring, stated that the vesical capacity in male adults varies from 120-320 ml. Micturition commonly

occurs at about 280 ml. Filling to about 500 ml may be tolerated but beyond this pain is caused by tension in the wall leading to reflex contraction and the urgent desire to micturate[6].

Dienhart, stated that when filled, the bladder contains about 500cc of urine and rises up into the abdominal cavity and Snell, (2012) stated that the adult has a maximum capacity of about 500 ml[19].A healthy bladder is free of bacterial infection or tumors and stores urine without discomfort at low pressure with intermittent signals of filling [20]. Normal functional bladder capacity in adults ranges from approximately 300 to 400 ml[21,22]. Although the International Continence Society defines urinary frequency as the perception by the patient that he /she voids too often[23]. Epidemiological studies suggest that the normal micturition at approximately 8 micturitions per day and 1 or fewer episodes per night[24]. Gender actually has no direct influence on bladder capacity. Bladder capacity and therefore urine output rate remain the same in both genders, under normal physiological conditions[25,26]. Current study suggested that bladder capacity itself is not affected by gender or body mass index. However, there is an effect of unfavorable circumstances on urine holding capacity by bladder under voluntary control[27].

Material and methods:

This was a descriptive type of longitudinal study. 70 human urinary bladders were collected from the unclaimed dead bodies autopsied in the Department of Forensic Medicine in Sylhet MAG Osmani Medical College during the study period meeting the inclusion and exclusion criteria included in the study. **Inclusion criteria**: Dead bodies autopsied within 36 hours of death.

Exclusion criteria: Considerable signs of decomposition and any gross urinary bladder disease. Sample size was estimated by reviewing literatures and by expert opinion and 70 human postmortem urinary bladders fulfilling the inclusion and exclusion criteria were selected in this study. Data were collected by using pre-designed data sheet prepared for the study. The data sheet was pre-tested and face validated by consulting with experts. This study was done in the Department of Anatomy, Sylhet MAG Osmani Medical College, Sylhet in collaboration with the Department of Forensic Medicine, Sylhet MAG Osmani Medical College, Sylhet. Purposive sampling technique was applied to collect sample with the inclusion and exclusion criteria. Particulars of dead bodies were collected from police inquest report and chalan. Urinary bladder was collected after standard procedure of autopsy. Then the specimen was fixed and preserved in 10% formalin. To measure the capacity of urinary bladder, 50 ml syringe with water was taken. The urinary bladder was squeezed to make empty and then two ureters was clumped. At first water was drawn by the syringe and injected through the internal urethral orifice. It was continued until backflow of water through the internal urethral orifice occurred. At the point when back flow started, the procedure was stopped. This amount of water which was pushed inside the bladder before backflow started was measured in milliliter (ml) and recorded. This amount was mentioned as capacity of urinary bladder. The collected samples were divided into 3 groups depending on age.

Group - A: 10 - 20 Years.
Group - B: 21 - 40 Years.
Group – C: 41 -65 Years.

Each group was subdivided into two groups depending on their sex. Data were processed manually and analyzed with the help of SPSS (Statistical package for social sciences) Version 21.0. Quantitative data were expressed as mean and standard deviation; and comparison were done by appropriate test (unpaired "t" test). A probability value (p) of less than 0.05 was considered statistical significant.

Ethical Consideration: Prior to the commencement of the study, an approval of the research protocol was obtained from the Ethical Committee of Sylhet MAG Osmani medical college, Sylhet. (Memo no: SOMC/2016/329; Date: 30/01/2016)

RESULTS:

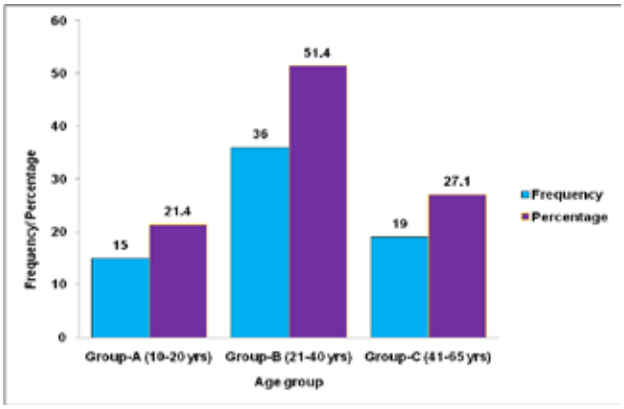

Figure-01 Distribution of the cadaver by age group (n=70)

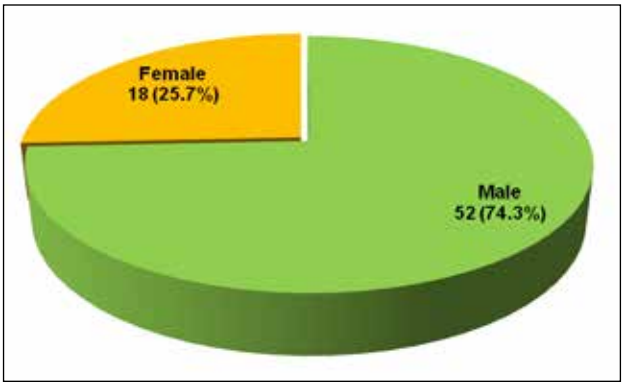

Figure-02 Distribution of the cadaver by sex (n=70)

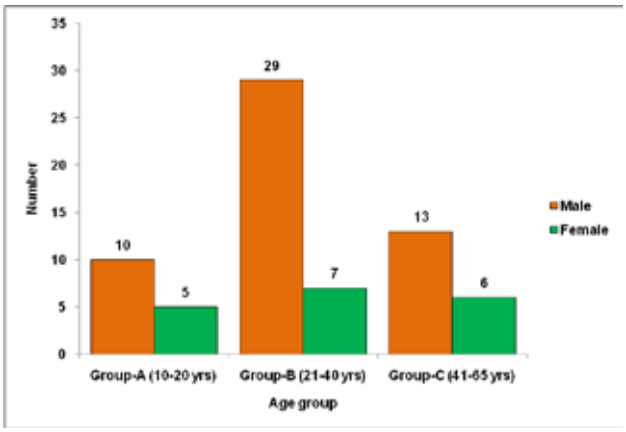

Figure- 03 Distribution of sex of the cadaver according to age group (n=70)

In this study, age group-A (10-20 years) constituted 10 male and 5 female cadavers, age group-B (21-40 years) constituted 29 male and female 7 cadavers and age group-C (41-65 years) constituted 13 male and female 6 cadavers.

Table 1: Distribution of capacity of the urinary bladder

Parameters of urinary bladder	Range	Mean	Standard deviation
Capacity (ml)	16.00-50.00	35.23	± 7.48

Table- 2: Distribution of capacity of urinary bladder by different age group (n=70)

Age group (number of specimen)	Capacity of urinary bladder (ml)		
	Mean	Standard deviation	Range
Group-A (n=15)	31.20	± 7.28	16.0-40.0
Group-B (n=36)	37.92	± 7.31	25.0-50.0
Group-C (n=19)	33.32	± 6.13	25.0-46.0

Group-A: 10 to 20 years; Group-B: 21 to 40 years; Group-C: 41 to 65 years.

Comparison between		t-value	p-value	Level of significance
A	B	t=-2.994	p=0.004	Highly significant
A	C	t=-0.920	p=0.364	Not significant
B	C	t=2.341	p=0.023	Significant

*unpaired t test was applied to analyze the data.

The mean capacity of the urinary bladder was 31.20 ml (SD ± 7.28) (range 16.0-40.0 ml) in the age group of 10 to 20 years; 37.92 (SD ± 7.31) (range 25.0-50.0 ml) in the age group of 21 to 40 years and 33.32 ml (SD ± 6.13) (range 25.0-46.0 ml) in the age group of 41 to 65 years. The difference between group A and B was highly significant (t=-2.994; p=0.004); between group B and C was significant (t=2.341; p=0.023); but between group A and C was not significant (t=-0.920; p=0.364).

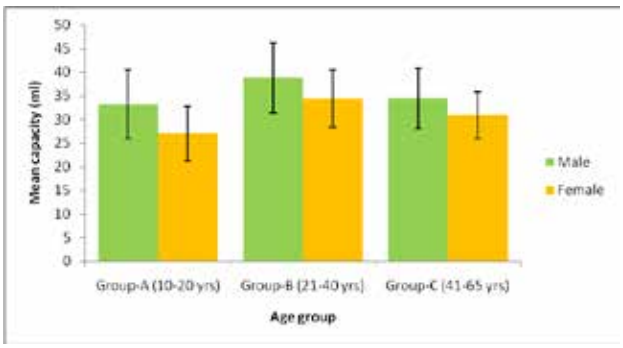

Figure-04: Distribution of capacity of urinary bladder by different sex (n=70)

This study revealed that the mean capacity of urinary bladder of male of age Group A (33.30 ± 7.26 ml), Group B (38.79 ± 7.40 ml) and Group C (34.46 ± 6.46 ml) and that of female of Group A (27.00 ± 5.83 ml), Group B (34.29 ± 6.07 ml) and Group C (30.83 ± 4.92 ml) did not differ statistically significant where for Group A (t=1.679; p=0.117), Group B (t=1.490; p=0.145) and Group C (t=1.215; p=0.241).

Discussion:

This descriptive type of longitudinal study was conducted to determine the capacity of urine in post mortem human urinary bladder in the Department of Anatomy, Sylhet MAG Osmani Medical College, Sylhet in collaboration with the Department of Forensic Medicine, Sylhet MAG Osmani Medical College, Sylhet during the period from January 2015 to December 2015 with a view to find out the gross & histological variations of post mortem human urinary bladder. For this purpose, 70 human postmortem urinary bladders were selected. All the specimens

were examined to detect morphological parameters. The outcome of the study has been discussed below:

In this study, the age of the cadaver ranged from 10 to 65 years with the mean age of 32.20 (SD ± 14.38) years. The study also showed that 15 (21.40%) cadavers were in the age group of 10-20 years, 36 (51.4%) cadavers were in the age group of 21-40 years and 19 (27.1%) cadavers were in the age group 41-65 years. This result was correlated with the study of Sultana[28] that showed 23.3% of cadavers were in the age group of 9-20 years, 46.7% of cadavers were in the age group of 21-40 years and 30.0% of cadavers were in the age group 41-70 years.

In the present study, there were 52 (74.3%) male and 18 (25.7%) female with a ratio of male to female was 2.89:1. This result was consistent with the study of Sultana that showed 71.7% of cadavers were male and 28.3% of cadavers were female with a ratio of male to female was 2.53:1[28].

The capacity of the urinary bladder in this study ranged from 16.00 to 50.00 ml with the mean 35.23 (SD ± 7.48) ml. In this regards Datta[15] and Chaurasia[18] stated that the mean capacity is 220ml. The difference may be due to difference in the procedure of the measurement of the capacity of the urinary bladder. In the present study, samples were collected from cadaver and there was loss of elasticity of urinary bladder wall and the capacity was lower than the above mentioned studies.

In the present study, the mean capacity of the urinary bladder was 31.20 ml (SD ± 7.28) in the age group of 10 to 20 years; 37.92 ml (SD ± 7.31) in the age group of 21 to 40 years and 33.32 ml (SD ± 6.13) in the age group of 41 to 65 years. The difference between group A (10-20 years) and B (21-40y ears) was highly significant (p=0.004); between group B (21-40years) and C (41-65 years) was significant (p=0.023); but between group A (10-20years) and C (41-65 years) was not significant (p=0.364). This result was supported by Sultana[28] that the mean capacity of urinary bladder was 30.71 ± 10.89ml in the age group A (9-20 years), 55.0 ± 20.97ml in the age group B (21-40 years) and 40.27 ± 9.46ml in the age group C (41-70 years) and it was also observed that the mean capacity of the urinary bladder increased with age up to certain age then slightly decreased in the late age. The mean difference of capacity of the urinary bladder between group A (9-20 years) and group B (21-40 years); group B (21-40 years) and group C (41-70 years) were statistically highly significant but difference between group A (10-20 years) and group C (41-70 years) was statistically not significant. Datta[15] and Chaurasia[18] stated that the mean capacity is 220ml. Standring[6] and Snell[7] stated that the maximum capacity of the urinary bladder is about 500ml or more. Here the above authors did not mention the procedure of measurement of capacity of the urinary bladder. They may have measured capacity of urinary bladder in living body with the help of ultrasound. But in the present study the mean value of the capacity is much less than the mentioned value because this study was based on sample collected from cadaver and for this, elasticity of urinary bladder was lost.

This study also revealed that the mean capacity of urinary bladder of male of age Group A (33.30 ± 7.26 ml), Group B (38.79 ± 7.40 ml) and Group C (34.46 ± 6.46 ml) and that of female of Group A (27.00 ± 5.83 ml), Group B (34.29 ± 6.07 ml) and Group C (30.83 ± 4.92 ml) did not differ statistically significant where for Group A (p=0.117), Group B (p=0.145) and Group C (p=0.241). This result was supported by Sultana that mean value of the capacity of the urinary bladder was higher in male than that of in female in all age groups but difference was not significant (p>0.05 each)[28].

So the mean capacity of the urinary bladder was 31.20 ml (SD ± 7.28); 37.92 (SD ± 7.31) and 33.32 ml (SD ± 6.13) in the age group of A, B and C respectively. The difference between group A and B was highly significant (p=0.004); between group B and C was significant (p=0.023); but not significant between group A and C (p=0.364). The mean capacity of urinary bladder of male and female did not differ significantly in age group A (p=0.117), group B (p=0.145) and group C (p=0.241).

Conclusion:

The capacity of the urinary bladder increased with age up to certain limit then slightly decreased. The mean capacity did not differ significantly between male and female. As this study was non-randomized and single centered**,** more study should be conducted involving multicentre and larger sample size to draw the current situation of the national demography and to reach a definite conclusion.

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Authors' Contribution:

Idea owner: Dr. Mahmuda Khatoon

Study design: Dr. Mahmuda Khatoon, Professor Dr. Zakia Sultana and Dr. Mohammad Kamruzzaman Mazumder

Data gathering: Dr. Mahmuda Khatoon, Dr. Farzana Mansura, Dr. Mahmuda Sultana and Professor Dr. Zakia Sultana.

Data Analysis: Dr. Mahmuda Khatoon & Dr. Mohammad Kamruzzaman Mazumder

Writing and submitting manuscript: Dr. Mahmuda Khatoon, Dr. Meherunnessa Begum, Dr. Mohammad Kamruzzaman Mazumder, Dr. Qazi Salim Yazdi, Dr. Farzana Mansura, Dr. Mahmuda Sultana and Professor Dr. Zakia Sultana.

Editing and approval of final draft: Dr. Mahmuda Khatoon, Dr. Meherunnessa Begum, Dr. Mohammad Kamruzzaman Mazumder, Dr. Qazi Salim Yazdi, Dr. Farzana Mansura, Dr. Mahmuda Sultana and Professor Dr. Zakia Sultana.

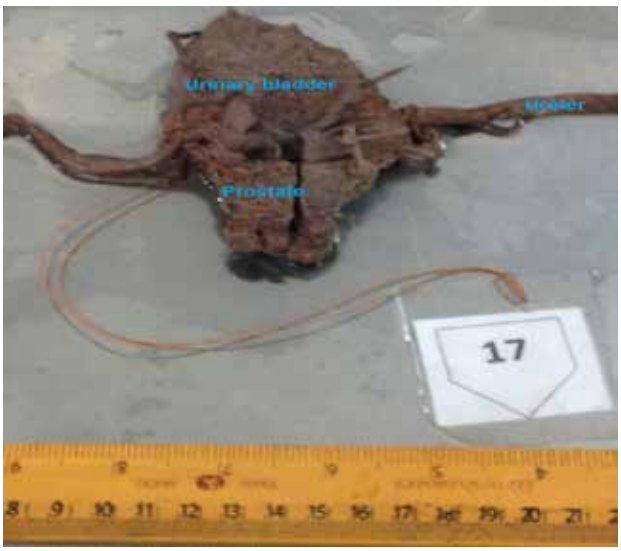

Photo 1: Male urinary bladder with ureter and prostate

Photo 2: Female re-productive organ with urinary bladder

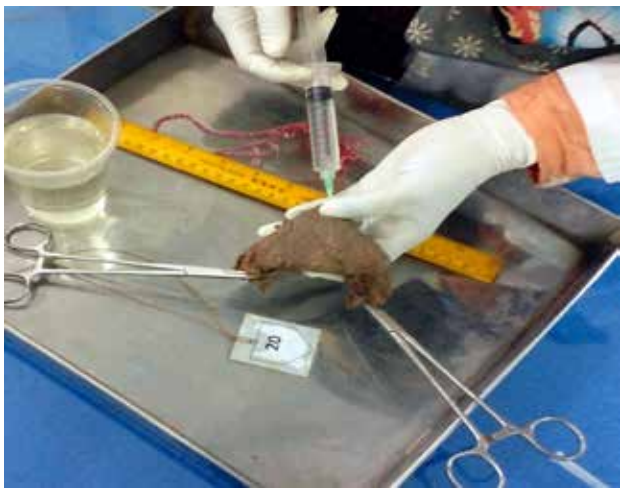

Photo 3: Measurement of the capacity of urinary bladder

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