Introduction

The prostate is partly glandular; partly fibro muscular organ. It is the largest accessory sex gland in the male reproductive system. It produces a thin milky fluid containing citric acid and acid phosphatase that is added to the seminal fluid at the time of ejaculation. Pathological process in prostate gland occurs commonly in association with aging and includes inflammation, atrophy, hyperplasia and carcinoma. Estimation of volume of prostate may be useful in a variety of clinical settings. A cross-sectional descriptive study was designed to see the changes in volume of the prostate with advancing age and done in the Department of Anatomy, Dhaka Medical College, Dhaka from August 2006 to June 2007. The study was performed on 70 post-mortem human prostates collected from the unclaimed dead bodies that were under examination in the Department of Forensic Medicine, Dhaka Medical College, Dhaka. The samples were divided into three age groups; group A (10-20 years), group B (21-40 years) and group C (41-70 years). Volume of the sample was measured by using the ellipsoid formula. The mean ± SD volume of prostate was 7.68 ± 3.64 cm³ in group A, 10.61 ± 3.99 cm³ in group B and 15.40 ± 6.31 cm³ in group C. Mean difference in volume between group A and group C, group B and group C were statistically significant (p < 0.001). Statistically significant positive correlation was found between age and volume of prostate (r = + 0.579, p < 0.001).

Materials & Methods

Human prostate samples were collected from unclaimed dead bodies which were under examination
in the Department of Forensic Medicine of Dhaka Medical College, Dhaka from August 2006 to April 2007. After legal formalities, the samples were collected from the medico-legal cases within 24-36 hours of death prior to signs of putrefaction. During collection, appropriate age and cause of death were noted from the morgue’s record book. The samples were brought to the Department of Anatomy, Dhaka Medical College, Dhaka. The samples were tagged immediately, which was bearing a code number for subsequent identification. Soon after collection, each sample was gently washed in tap water on a dissection tray. Blood and blood clots were removed as far as possible. The samples were fixed in 10% formol saline solution and divided into three groups (Table 1), according to Begum (1991).* This research work was approved by the Ethical Review Committee of Dhaka Medical College, Dhaka.

Measurement of volume:
Volume of the prostate was measured by applying ellipsoid formula which requires measurement of three prostatic dimensions. Dimensions were first determined in the axial plane by measuring the transverse and antero-posterior dimensions at the estimated point of widest transverse dimension. The longitudinal dimension was measured in the sagittal plane. The ellipsoid volume formula\(^5\) was then applied as follows:

\[ \text{Volume} = \text{height} \times \text{width} \times \text{length} \times 0.52 \]

The volumes were expressed in mean with standard deviation (SD) and comparison among the different age groups was made using ANOVA. The correlation coefficient was used to determine the association between age and volume of prostate. The SPSS version 11.0 was used.

Results
The mean ± SD volume of prostate was 7.68 ± 3.64 cm\(^3\) in group A, 10.61 ± 3.99 cm\(^3\) in group B and 15.40 ± 6.31 cm\(^3\) in group C. The highest mean ± SD was in group C and lowest in group A. Mean difference in volume between group A and group C, group B and group C were statistically significant (p < 0.001). Statistically the difference between group A and group B was not significant (Table 1). Positive correlation was present between age and volume of prostate which was also statistically significant (r = + 0.579, p < 0.001; Fig 1).

Discussion
Moore\(^11\) studied 129 individuals aged between 20 to 90 years. He found that the volume of prostate was 10.22 ± 1.09 cm\(^3\), 11.72 ± 0.799 cm\(^3\), 10.88 ± 0.788 cm\(^3\), 12.03 ± 0.804 cm\(^3\), 12.06 ± 1.01 cm\(^3\), 11.94 ± 1.11 cm\(^3\) and 13.70 ± 1.39 cm\(^3\) in 3rd, 4th, 5th, 6th, 7th, 8th and 9th decades respectively. This finding was compatible with the present study. Jakobsen, Torp-Padersen and Juul\(^12\) examined patients between 30 and 50 years and observed their mean prostate volume between 23.9 to 25.7 ml. Gearhart et al.\(^13\) observed that the mean prostatic volume was 20.7 ± 8.2 cm\(^3\). Benaim et al.\(^14\) studied a series of 100 men aged 40-80 years and found the prostatic volume ranged from 22.1 to 41.5 ml. Chicharro-Molero et al.\(^15\) observed 1104

<table>
<thead>
<tr>
<th>Age group</th>
<th>n</th>
<th>Volume (in cm(^3))</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-20 (A)</td>
<td>9</td>
<td>7.68 ± 3.64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.37 14.82)</td>
</tr>
<tr>
<td>21-40 (B)</td>
<td>32</td>
<td>10.61 ± 3.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.68 19.97)</td>
</tr>
<tr>
<td>41-70 (C)</td>
<td>29</td>
<td>15.40 ± 6.31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.57 26.43)</td>
</tr>
</tbody>
</table>

* Comparison of groups using ANOVA: A vs B, p = ns; A vs C, p<0.001; Parenthesis indicates ranges

* This research work was approved by the Ethical Review Committee of Dhaka Medical College, Dhaka.
men older than 40 years in a Spanish community and found the volume ranged from 23.4 to 41.9 ml. Zackrisson, Hugosson and Aus\(^1\) found that prostatic volume was 19.2 ± 4 cm\(^3\) in men aged 20-29 years and 35 ± 12.5 cm\(^3\) for men aged 60-69 years. Overland \(\text{et al.}\)\(^2\) studied 611 Norwegian men aged 60-69 years and found the volume ranging from 26.5 to 31 ml. Loeba \(\text{et al.}\)\(^3\) studied serial pelvic magnetic resonance imaging performed in 278 men without prostate cancer and found that the median age was 58 years and median prostate size was 28 cm\(^3\) at study entry. At a median follow up of 4.3 years prostate size increased in 61.9% and remained stable or decreased in 38.1% of men. The median rate of volume change was 0.6 cm\(^3\) per year (range: 9.9 to 62.1 cm\(^3\)), corresponding to a median growth rate of 2.5% per year (range: 29.2 to 176.4%). During follow up 64.6% of men with an initial prostate size less than 40 cm\(^3\) had prostate growth compared to only 50.9% of men with an initial prostate size of 40 cm\(^3\) or greater. These findings\(^4-11\) were also of a higher value than that of the present study. The discrepancy may be due to the fact that the present study was conducted on the formalin fixed viscera of the cadaver subjects resulting in a shrinkage and giving a lower value; whereas, the higher prostate volume reported by others were undertaken either by imaging or after excision of living bodies. Another important point may be that most of the study samples were collected from the autopsied bodies of road traffic accidents causing a massive blood loss, hypovolumic shock, reduced tissue perfusion and volume reduction. Moreover, racial variation may contribute to the smaller size of the prostate. Compared with the developed or western people Bangladeshis have a lower body mass index and likely to have lower sized body organs including that of the prostate.

**Conclusion**

The present study showed the volume of the prostate according to the age group. It revealed – more is the age larger is the volume. The age group only over 40 years had a significantly larger prostate, indicating a significant increase in prostate size only in the aging male Bangladeshi population. Further studies may be undertaken in living humans with a view – a) to determine the prostate volume of different age group; b) to delineate the age when the prostate starts increasing in size and c) to identify the risk factors related to enlarged prostate both benign and malignant.

**Acknowledgement**

We acknowledge Directorate General of Health Services (DGHS), Government of the People’s Republic of Bangladesh for the research grant through the HNPSP. We are also grateful to Dr Md Motahar Hossain, Prof of Anatomy, IMC; Dr Abu Sadat Md Nurunnabi, Lecturer in Anatomy, DMC; Dr Sabiba Mahbub, Asst Prof of Anatomy, TMMC, Gazipur for their help in this work.

**References**


