Orginal Article

Histological Changes of Human Kidney with Age in Bangladeshi People

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Abstract

Kidney disease is one of the world's major public health problems and the prevalence of kidney failure is rising day by day. The structure and function of the kidney changes with advancing age. This study is to find out the histological architecture of kidney in Bangladeshi people related to age.

The study was descriptive type of cross-sectional study carried out in the Department of Anatomy, Mymensingh Medical College, Mymensingh, from July 2006 to June 2007.

For this study 30 pairs of postmortem human kidneys of age ranging from 3 years to 60 years were selected. The kidneys were collected from dead bodies autopsied in the morgue of Mymensingh Medical College.

The collected sample was divided into three age groups. They are as follows, group A (3-20 years), group B (21-40 years) and group C (41-60 years). All the samples were examined histologically by staining with Haematoxylin and Eosin stain.

It was found that the number of renal corpuscles per square millimeter of both right and left kidney showed significant difference between group A and B (P<0.00), group B and C (P<0.00) and group A and C (P<0.000) . Diameter of renal corpuscles and renal glomeruli in µm of both right and left kidney showed significant difference between group A and B (P<0.00), group B and C (P<0.00) and group A and C (P<0.000) .

Keywords: Kidney, renal corpuscles, glomeruli.

Introduction

Human kidney serve to convert over 1700 litres of blood per day into about 1 litre of highly specialized concentrated fluid called urine. In so doing, kidney performs some of the most critical function necessary for survival.[1]

The kidneys are a pair of essential organs, which excretes the final product of metabolic activities and excess water, both of these actions being essential for the control of concentration of various substances in the body fluid, for example, maintaining electrolytes and water balance approximately constant in the tissue fluid.[2]

Aging is a biologic process from which no living being is exempt and a universal effect of aging is the gradual loss of functioning cells from many organs and tissues. With advancing age there is a tendency to decrease in renal mass and an increase incidence of sclerotic glomeruli. Glomerular filtration rate and renal blood flow are also reduced in a linear pattern after the age of 30 years.[3]

The kidney is composed of many tortuous, closely packed uriniferous tubules, bound by a little connective tissue in which run blood vessels, lymphatics and nerves. Each tubule consists of two embryologically distinct parts : the secreting nephron and a collecting tubule.[2]

Secreting part includes nephrons which are the fundamental structural and functional unit of the kidney. In the human there are about 2 million nephrons in each kidney. They are responsible for the production of urine and correspond to the secretory part of other glands.[4]

Each nephron consists of two parts : The renal corpuscle (or malpighian corpuscle) serves as a passive filter, allowing substances up to a particular molecular weight to pass but preventing substances of a higher molecular weight from passing through and the renal tubules are concerned with selective reabsorption and excretion of substances.[5]

The renal corpuscle represents the beginning of the nephron. These are spheroidal, slightly flattened bodies that occur in large numbers in the cortical labyrinths. Their diameter in the adult is about 200 gm.[6] Each corpuscle consists of : i) Glomerulus-A tuft of capillaries and ii) Bowman's capsule-A double layered epithelial cup which is invaginated by the glomerulus.[4]

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The kidney cannot regenerate new nephrons. Therefore, with renal injury, disease or normal aging there is gradual decrease in nephron number. After age of 40, the number of functioning nephrons usually decreases about 10% every 10 years.[7]

Materials and Methods

This study was carried out on 30 pairs of postmortem human kidneys of age ranging from 3 to 60 years. The kidneys were collected from dead bodies autopsied in the morgue of Mymensingh Medical College.

Just after removal from the bodies, the kidneys were washed thoroughly and gently under running tap water. The kidneys were brought to the Department of Anatomy, Mymensingh Medical College. All fat and other associated tissues were removed from the surface of the kidneys. Each specimen was then put into 10% formol saline for fixation and preservation.

Small pieces of tissue was taken from relatively fresh kidneys. Size of the tissue was not more than 2 cm sq. and not more than 4-5 mm thick and were taken from cortical regions. Sections made were processed following standard histological procedure and were stained with Hematoxylin and Eosin stain. One good slide prepared from each tissue block was chosen for study.

Grouping of the samples

The collected sample was divided into three age groups. They are as follows, group A (3-20 years), group B (21-40 years) and group C (41-60 years).

Parameters studied

1. Number of the renal corpuscles per sq. mm.
2. Diameter of the renal corpuscles in m .
3. Diameter of the renal glomeruli in m .

Estimation of number of renal corpuscles per sq.mm

For studying the histological parameters, the tissue section on the slide was divided into three parts by drawing three lines on the cover slip from the centre of the tissue. The lines were made to radiate towards the periphery through the 10 O'clock, 2 O'clock, 6 O'clock positions. From each division, one microscopic field was chosen close to the centre as far as possible for the study. Thus from each slide three different fields were chosen for counting the number of renal corpuscles. 20 slides of group A, 24 slides of group B and 16 slides of group C were taken. Thus in total 60 slides from 30 pairs of kidneys were examined. The counting of the number of renal corpuscles was done within a counting circle specially devised for the purpose (Fig.1 a&b).

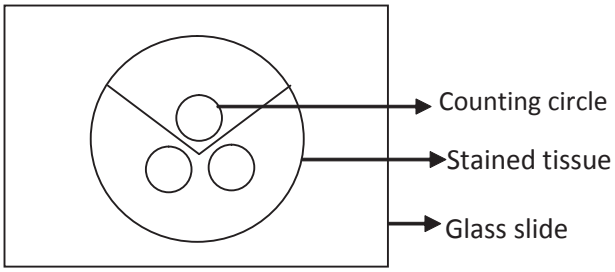


Fig. 1 (a) Showing microscopic fields for histomorphometric study.

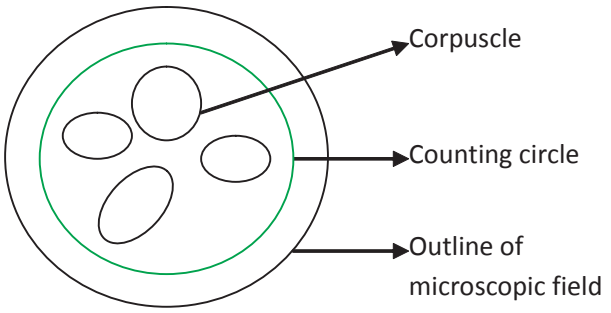


Fig. 1 (b) The Counting Circle.

Measurement of average diameter of renal corpuscles & glomeruli

From each slide, 3 different fields were chosen. From each of these fields, 3 different renal corpuscles were examined. The diameter of renal corpuscles and glomeruli were measured by using ocular micrometer.Two diameters were taken, one along the long axis of the section and the other perpendicular to its midpoint. The transvertical diameter was then calculated for each renal corpuscle and glomeruli by taking the mean of the two diameters. The average transvertical diameter was then calculated for each group.

Results

Number of the renal corpuscles per sq. mm.

In the present study, the mean (SE) number of corpuscles per sq. mm of right kidney was 4.79 0.12, 3.68 0.11, 2.48 0.15 and left kidney was 4.73 0.13, 3.60 0.12, 2.54 0.17 in group A, B and C respectively. For both right and left kidney, statistically the mean difference showed significant difference between group A and B, B and C at P<0.00 and group A and C at P<0.000 (Fig.2).

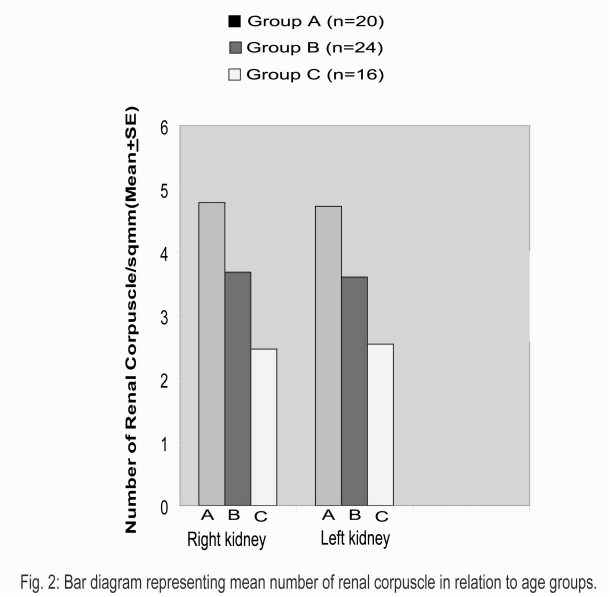


Fig. 2: Bar diagram representing mean number of renal corpuscle in relation to age groups.

Diameter of renal corpuscles in μm

The mean (SE) diameter of renal corpuscles in μm of right kidney was 155.82 1.68, 179.52 2.48, 202.50 2.67 m and of left kidney was 155.54 1.79, 180.87 2.38, 202.76 2.84 μm in group A, B and C respectively. Statistical analysis between group A and B and group B and C (P<0.00) and group A and C (P<0.000) for both right and left kidney was significant (Table 1, Fig.3).

Table 1 Diameter of renal corpuscles in μm

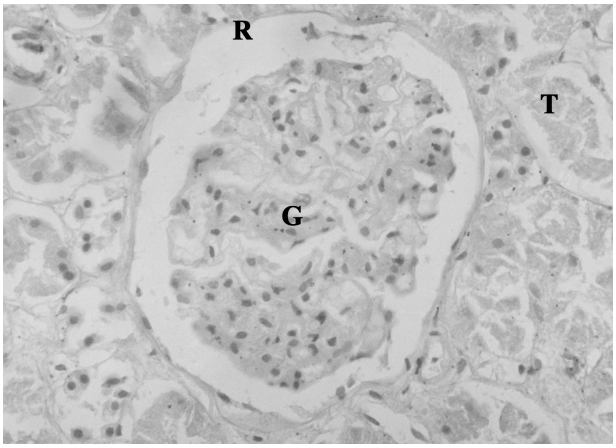
Group	n	Diameter ofrenal corpusclesin μm (Mean ± SE)	
		Right kidney	Left kidney
A	20	155.82±1.68	155.54±1.79
B	24	179.52±2.48	180.87±2.38
C	16	202.50±2.67	202.76±2.84

P Value
A vs B, HS P<0.00 P<0.00
A vs C, HS P<0.000 P<0.000
B vs C, HS P<0.00 P<0.00

HS = Highly significant.

n = Number of specimen
Group A : Age 3-20 years
Group B : Age 21-40 years
Group C : Age 41-60 years

Fig. 3 : Photomicrograph from group B showing glomeruli (G), renal corpuscle (R) and tubular sections (T). Haematoxylin-Eosin stain (H-E) 40.



Diameter of glomeruli in μm

The mean (SE) diameter of glomeruli in μm of right kidney was 101.81 2.72, 132.66 2.37, 127.94 3.12 m and of left kidney was 101.51 2.53, 132.79 1.99, 128.08 3.33 μm in group A, B and C respectively. Statistical analysis between group A and B and group B and C (P<0.00) and group A and C (P<0.000) for both right and left kidney was significant (Table 2).

Table 2 Diameter of glomeruli in μm.

Group	n	Diameter of glomeruli in μm (Mean ± SE)	
		Right kidney	Left kidney
A	20	101.81±2.72	101.51±2.53
B	24	132.66±2.37	132.79±1.99
C	16	127.94±3.12	128.08±3.33

P Value
A vs B, HS P<0.00 P<0.00
A vs C, HS P<0.000 P<0.000
B vs C, HS P<0.00 P<0.00

HS = Highly significant.
n = Number of specimen

Group A : Age 3-20 years
Group B : Age 21-40 years
Group C : Age 41-60 years

Discussion

In the present study, the number of renal corpuscles per sq.mm and diameter of renal corpuscles were similar with that Nahar's[8] study. Diameter of glomeruli were similar with that Hassan's9 study.

From the present study it was found that the average number of renal corpuscles per sq. mm area was gradually decreased along with the increase of age. The diameter of renal corpuscles increases and the diameter of glomeruli gradually decreases with advancing age.

Anderson and Brenner (1986) commented that, aging is a biologic process, the effect of which is the gradual loss of functioning cells from many organs and tissues. There is a progressive loss of functioning cells that do not have the ability to divide even in those persons who are fortunate enough to be spared from disease related tissue changes. So, nephrons as well as nerve and muscle cells are gradually lost during a normal lifetime. They suggested that the number of functioning glomeruli declines roughly with the changes in the renal weight with age.[3]

Dunnill and Halley stated that the total number of glomeruli in both kidneys were 2.10 106. The number remained at approximately same in all cases until the age of 36 years, after this the number declines.[10]

Moore concluded that the normal human kidney from birth to the age of 40 years contained .800 106 glomeruli with a range of (0.60 to 1.2) 106. After the age of 40 years he showed there was a steady loss of nephrons.[11]

Darmady et al (1973) studied 105 human kidneys from term to 101 years and observed that after the third decade sclerosing glomeruli were present in all ages and at the same time there was reduction in the size of glomeruli and number of nephron with age.[12]

Goyal (1983) studied with 100 human postmortem kidneys from 1 to 70 years of age. The number of the glomerular tuft/unit area decreased and the size of malpighian corpuscles increased significantly with advancing age.[13]

McLachlan (1978) reported that between fourth and seventh decades, glomerular number becomes a half.[14]

Williams et al (2005) described that there were one to two million of renal corpuscles in each kidney, the number was falling with age.[2]

The results of the present study were co-related with the statements of the above workers about the relative changes in number and diameter of renal corpuscles and diameter of glomeruli with different age groups.

Conclusion

On the background of the availability of the data, regarding histological study on human kidney supplied by various standard textbooks and journals, it is found that very few research works has been performed on Bangladeshi people. The observations and results of the present study are expected to provide an idea about the histological changes of the kidney in relation to age of Bangladeshi people and these findings will standardize the various measurements obtained by other observers in this country. Finally it may be concluded that per unit values of histological parameters of kidney become remarkably changed with age specially after 40 years. The findings showed that the number and diameter of glomerulus decreased gradually with increased age and the diameter of renal corpuscles increased with increased age. Due to limitation of time all age groups were not covered. Sample size was small but if the sample size was large, then the results might be more specific. Further studies with larger sample size covering wider age group and covering both sexes of same age group are recommended for future study.

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