SEQUENTIAL HISTOLOGICAL STUDIES ON KIDNEYS OF UTTARA FOWL

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ABSTRACT

Present study was undertaken on 24 Uttara fowl. These birds were divided into four age groups of day old, 7 day, 28 day and 112 day with 6 birds in each age group. The tissue specimens from kidneys were processed and tissue sections (5 micron) were stained by using hematoxylin and eosin (H & E) stain. Study revealed that histologically, the kidneys were surrounded by a thin connective tissue capsule. Each lobe of kidney was divided in small, numerous pear shaped lobules. Each kidney lobule had outer large cortex and inner small medulla separated by a layer of connective tissue. With the advancement of age, the cortical region increased as compared to the medullary region as 3 or 4 lobules opened into a single medullary cone. The cortex had 3 regions *i.e*. subcapsular, mid cortical and juxtamedullary region. The medulla formed the apex portion of the pear-shaped lobule and was divided into two parts *i.e*. outer medulla and inner medulla. In the center of the cortical part of each lobule intralobular vein was present which opened into interlobular vein that ultimately opened into renal vein. Renal corpuscle, proximal tubule, distal tubule, and collecting tubule were arranged in a radiating manner around the intralobular vein. Near intralobular vein, intralobular artery was present which gave rise to several afferent arterioles. The afferent arteriole branched to form glomerular capillaries. These capillaries joined to form efferent arteriole which further branched to form inter tubular/peritubular capillaries. These capillaries entered into interlobular veins which finally opened into a cranial, middle and caudal renal vein draining cranial, middle and caudal lobes, respectively.

Key words: Uttara fowl, kidney, histology, renal corpuscles, interlobular vein

Introduction

India's poultry industry is one of the fastest growing segments in India. 'Uttara' fowl is native Indian variety of chicken found in Kumaon region of Uttarakhand state.

In hilly areas water consumption is low and accordingly there might be a chance of different demand of osmoregulation in local hill fowl i.e. Uttara fowl. Though some work on urinary system of domestic chicken (Casotti and Braun, 1996), Japanese quail (Sreeranjini *et al.,* 2010), emu (Michalek *et al.,* 2016) has been done. Work on different organs like, proventriculus (Sinha *et al*., 2018), gizzard (Sinha and Mrigesh, 2018), heart (Jaiswal *et al.,* 2017b), small intestine (Rana *et al.,* 2017) and large intestine (Pandit *et al.,* 2018) of Uttara fowl is done but still the knowledge on kidneys of Uttara fowl is lacking. Hence, the present work was undertaken and designed to study the microanatomy of kidneys in Uttara fowl.

Materials and Methods

A total of 24 apparently healthy Uttara fowl were obtained from the Instructional poultry farm, G.B.P.U.A & T, Pantnagar. These birds were allocated into 4 age groups i.e. day old, 7 days, 28 days and 112 days old with 6 birds in each group. Birds of their respective age group were utilized for gross and histological study. The tissue specimens from kidneys were collected and fixed in 10% neutral buffered formalin and fixed specimens were processed using standard prescribed histological staining techniques (Bancroft and Stevens, 1996). The staining of tissue sections (5 micron) was done by using hematoxylin and eosin (H & E) stain. Thereafter, the stained tissue sections were examined under the Nikon Microscope ECLIPSE 80i and photomicrography was performed.

Results and Disscusion

The kidneys of Uttara fowl were surrounded by a thin connective tissue capsule (Fig. 1, 2, 3 and 4). Abdul *et al.* (2012) in squab and mature racing pigeon and Al-Azawy (2005) in domestic fowls and geese also reported the presence of capsule having smooth muscle with some of the reticular fibers, while Hodges (1974) not mentioned the presence of the capsule in domestic fowls. The capsule of kidney was surrounded with perirenal fat and with the advancement of age the perirenal fat increased.

Grossly each kidney was divided into 3 lobes *viz.* cranial, middle and caudal lobe. Histoarchitecturally no remarkable difference was observed between cranial, middle and caudal lobes of a kidney at a particular age group. Histological studies revealed that each lobe of kidney was divided in small, numerous pear shaped lobules demarcated from each other by presence of interlobular vein (1, 2 and 3). These lobules randomly distributed at different depths of a kidney (Fig. 1, 2, 3 and 4). This was in agreement with the studies of Deef (2015) in Coots and lesser moorhen; Michalek *et al.* (2016) in emus and Nabipour *et al.* (2009) in rock dove, collared dove and owl. Each kidney was divided in outer cortex and inner medulla (Fig. 1, 2, 3 and 4). According to Deef (2015) in coots and lesser moorhen; Casotti and Richardson (1993) in meliphagid honeyeaters; Abood *et al.* (2014) in harrier, chicken and mallard duck; Michalek *et al.* (2016) in emus and Nabipour *et al.* (2009) in rock dove collared dove and owl, the kidney was divided in cortex and medulla. In H & E staining, the stain taken by cortex was darker compared to medulla (Fig. 1, 2, 3 and 4). Same as reported by Poulson (1965) in birds. In Uttara fowl medullary region was separated from the cortical region

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by a layer of connective tissue (Fig. 1, 2, 3 and 4). Same as reported by Farner and King (1972) in birds. But Abdul *et al.* (2012) in pigeons; Ritchison (2008) in fowl and Nicholson (1982) in wild adult starling (*Sturnus vulgaris*) revealed that the nephrons lie at different depths of the kidney, so there was no line of demarcation between cortex and medulla. The cortex occupied a relatively larger area of renal parenchyma and a small portion was occupied by medulla (Fig. 1, 2, 3 and 4). Same was reported by Abood *et al.* (2014) in harrier, chicken and mallard duck; Michalek *et al.* (2016) in emus. With the advancement of age, the cortical region increased as compared to the medullary region. As the age advanced the cortical region of 3 or 4 lobules opened into a single medullary cone (Fig. 3 and 4).There was decrease in medullary cone per microscopic field with the advancement of age. This might be due to increase in kidney mass with the advancement of age which is in agreement with the studies of Goldstein and Braun (1989) in birds.

The cortex had 3 regions i.e. subcapsular region, mid-cortical region and juxtamedullary region. The subcapsular region had proximal tubule (PT), intermediate segment, distal tubule (DT), collecting tubule (CT) and a few renal corpuscles of short looped nephrons. The mid-cortical region had mainly the renal corpuscles of short looped nephrons, PT, DT, and CT while the juxtamedullary region had renal corpuscles of long looped nephrons, PT, DT and CT (Fig. 1 and 2). According to the texts of Getty (1975), the cortex of domestic fowl was formed by cortical regions of lobules which bear glomeruli of both cortical and medullary nephrons that join the proximal convoluted tubule by a very short neck. According to Dellmann and Eurell (1998) in mammals, the cortex was having 2 divisions i.e. the cortical labyrinth and medullary rays. The cortical labyrinth was having tortuous tubular components like proximal convoluted tubules, distal convoluted tubules, and renal corpuscle whereas the medullary rays composed of straight tubules aligned perpendicular to the surface and papilla or renal crest. In present study also two similar types of divisions were observed but here the portion having tubules arranged in the form of rays, formed the medulla (Fig. 3 and 4).

The medulla formed the apex portion of the pear-shaped lobule (Fig. 3 and 4). It also had two parts i.e. outer medulla and inner medulla. The outer medulla consisted of Henle's loop, collecting tubule and collecting ducts whereas the inner medulla consisted of collecting ducts, large collecting ducts or tertiary branch of ureter, secondary branch of ureter and primary branch of ureter (Fig. 3, 6, 7 and 8). According to Getty (1975) in bird and Casotti (2001) in house sparrows, the medulla consisted of Henle's loop of medullary nephrons and conical bundles of collecting tubules assembled into the pyramid cone shaped tufts of secondary branch of ureter. But as per the studies of Deef (2015) in coots and lesser moorhen, the medullary collecting ducts continued into a distal papillary duct which consisted of a simple columnar epithelium. In present study, tertiary branches of ureter later joined to form secondary branches which then joined to form primary ureter that ultimately opened to the main branch of the ureter (Fig. 7 and 8). These findings were in corroboration with the findings of Archana *et al.* (2015) in emus. But according to the studies of Echols (2015) in birds and Oliaii and Mobini (2017) in Japanese quail, all renal lobules drain into the same secondary branch of the ureter, which then joins a primary ureteral branch.

In the center of the cortical part of each lobule intralobular vein was present. Proximal tubule, DT, and CT were arranged in a radiating manner around the intralobular vein. In between these tubules, renal corpuscles were present. The renal corpuscles of short looped and long looped nephrons were arranged in a circular fashion around the intralobular vein. Near intralobular vein, intralobular artery was present which gave rise to several afferent arterioles. At the periphery of each lobule interlobular vein was present (Fig. 1, 3 and 4). These interlobular veins opened into renal veins (Fig. 3). These findings were in accordance with findings of Farner and King (1972) in birds. Also according to the studies of Abdul *et al.* (2012) in pigeons and Bohle and Christensen (1985) in fowl,

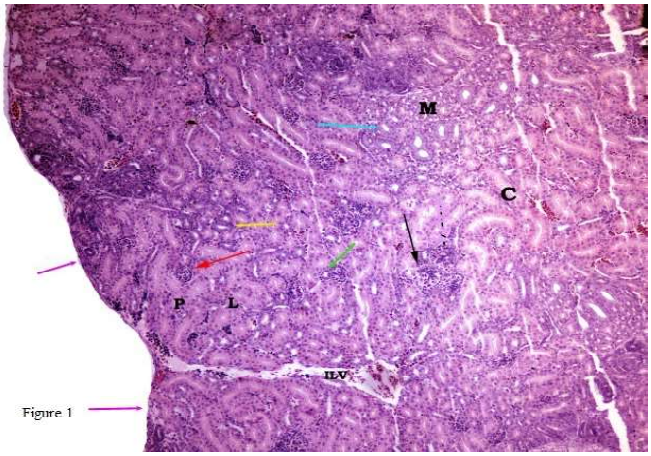

Fig.1: Photomicrograph showing capsule (pink arrow), cortex (C), medulla (M) lobule (L), interlobular vein(ILV juxtamedullary(Black arrow) and mid cortical (red arrow) renal corpuscle, proximal tubule (P), distal tubule (green arrow), collecting tubule (yellow arrow) and Henle's loop (blue arrow) in day old Uttara fowl (H&E x 100).

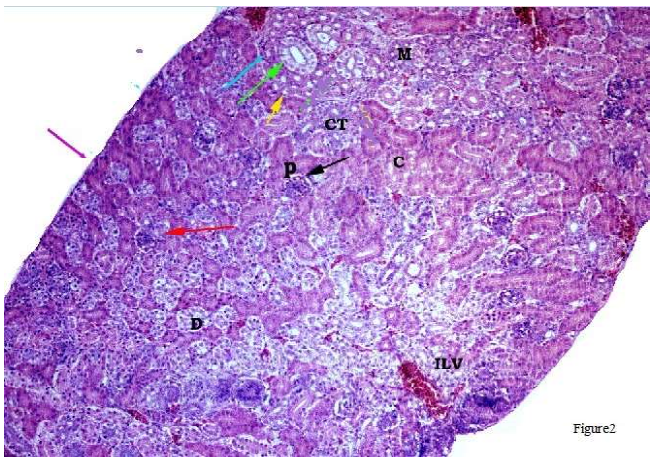

Fig. 2: Photomicrograph showing capsule (Pink arrow), cortex (C), medulla(M), interlobular vein (ILV), juxtamedullary (Black arrow) and mid cortical (red arrow) renal corpuscle, proximal tubule (P), distal tubule (D), collecting duct (Green arrow), Henle's loop (blue arrow), collecting tubule(CT) and line of demarcation between cortex and medulla (Yellow arrow) in day 7 Uttara fowl (H&E x 100).

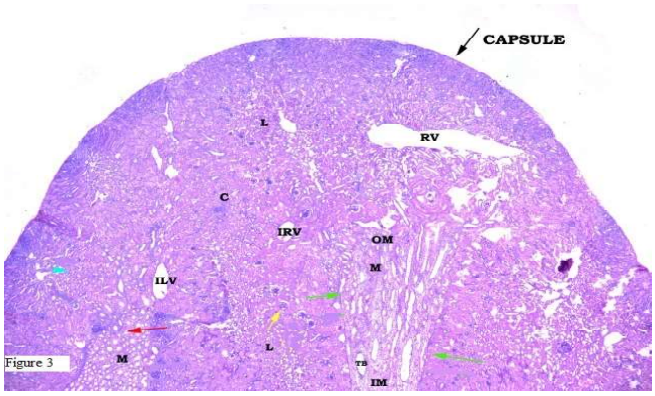

Fig. 3:Photomicrograph showing capsule, medulla (M), cortex (C), renal corpuscle (blue and yellow arrow, renal lobule (L), tertiary branch of ureter (TB), loop of Henle (red arrow), intra lobular vein (IRV), interlobular vein (ILV), renal vein (RV)and line of demarcation between cortex and medulla (green arrow) in day 28 Uttara fowl (H&E x 40).

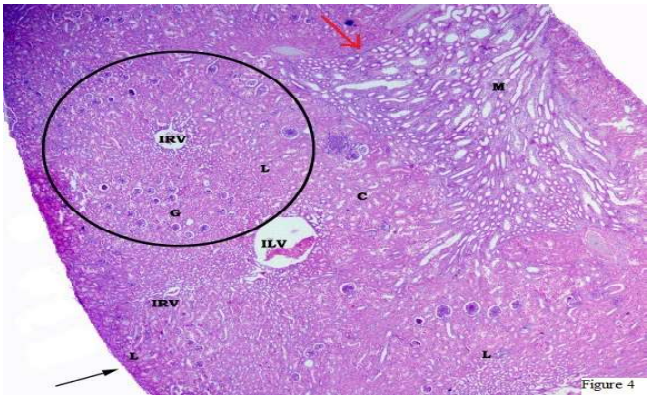

Fig.4: Photomicrograph showing renal corpuscle arrangement around intralobular vein (shown as circle) in a lobule (L), interlobular vein (ILV), cortex (C), glomeruli (G), capsule (black arrow), medulla (M) and line of demarcation between cortex and medulla (red arrow) in day 112 Uttara fowl (H&E x40)

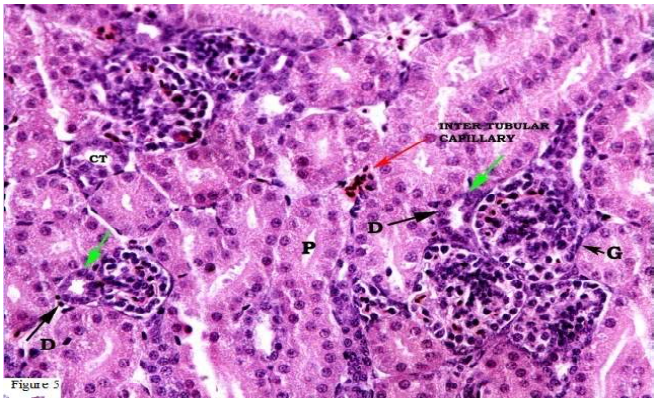

Fig. 5: Photomicrograph showing proximal tubule (P), distal tubule (D), collecting tubule (CT), glomeruli (G), inter tubular capillaries (red arrow) in day old Uttara fowl (H&E x 400).

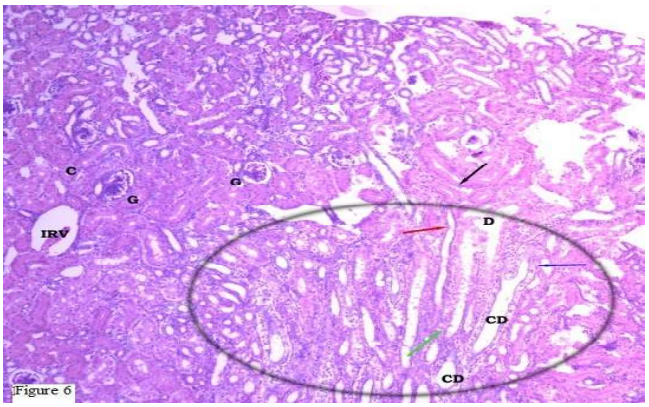

Fig.6: Photomicrograph showing cortex (C), outer medulla, glomeruli (G), proximal tubule (black arrow), descending thin (red arrow) and ascending thick (green arrow) limb of Henle's loop, distal tubule (D), collecting ducts (CD) and collecting tubule (blue arrow) in day 28 Uttara fowl (H&E x 100).

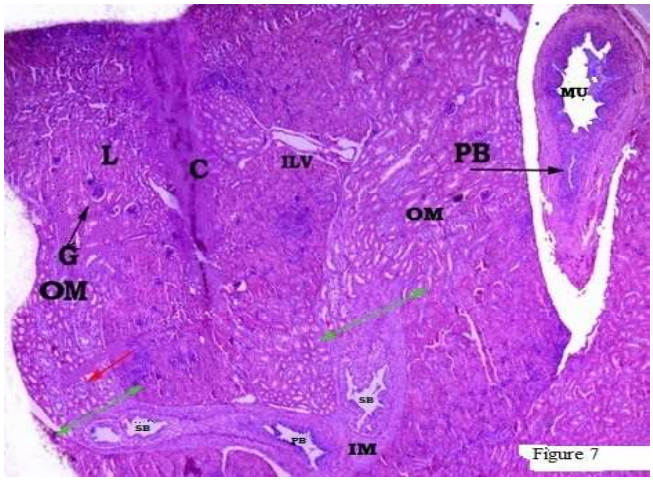

Fig.7: Photomicrograph showing primary ureter (PB), interlobular vein (ILV), secondary ureter (SB), main ureter (MU), cortex (C), Outer medulla (OM), inner medulla (IM), lobule (L), collecting duct (red arrow) and glomeruli (G) in 28 day Uttara fowl (H&E x 40).

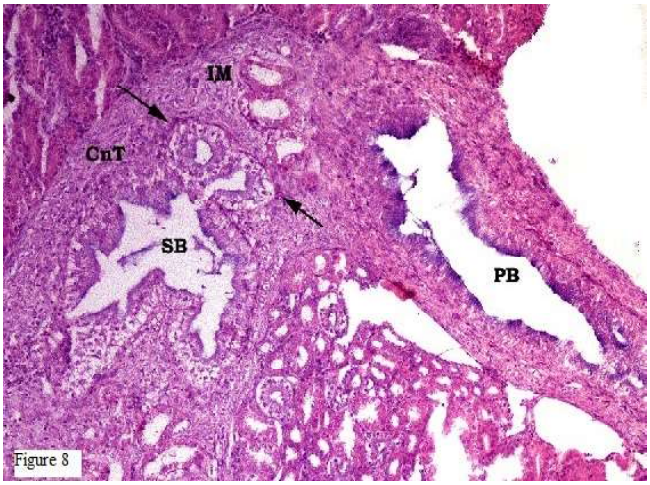

Fig.8: Photomicrograph showing primary ureter(PB), secondary ureter (SB), tertiary ureter(black arrow) and connective tissue (Cnt) in inner medulla (IM) of 28 day Uttara fowl (H&E x 100).

each lobule was demarcated in its outline by ramifications of interlobular veins of renal portal system. According to Getty (1975), the periphery of each lobule is surrounded by small terminal branches of renal portal veins, and Dellmann and Eurell (1998) stated that the branches of an interlobular afferent vein or portal vein lie at the periphery of lobule opposite to the collecting tubules, intralobular artery and interlobular veins.

The afferent arteriole branched into glomerular capillaries within the glomerulus and by joining of these capillaries efferent arteriole was formed. The lumen of efferent arteriole was narrower as compared to afferent arteriole. It exited from glomerulus and branched to form intertubular capillaries (Fig. 5). Similar was reported in birds (Farner and King, 1972). These capillaries entered into intra lobular veins which joins the interlobular veins which finally opened into a renal vein (Fig. 3). With the advancement of age there was increase in intralobular veins per lobules per microscopic field. The size of lobule also increased as indicated by the presence of less number of lobules per microscopic field with the advancement of age (Fig. 3 and 4).

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