International Journal of Basic and Applied Medical Sciences ISSN: 2277-2103 (Online)
An Online International Journal Available at http://www.cibtech.org/jms.htm
2012 Vol. 2 (2) May-August, pp.144-147/Rao and Padmini
Research Article

PRENATAL HISTOGENESIS OF KINDEY IN HUMAN FOETUSES

***Bhattam Narasinga Rao and Mantraratnam Pramila Padmini**
Department of Anatomy, Maharajahs Institute of Medical Sciences,Vizianagaram, Nellimarla
**Author for Correspondence*

ABSTRACT
The present study is taken up on histogenesis of foetal kidney in particular phases of fetal devlopment, and to establish the histological structure in relation with age of foetus. Invagination of nephric vesicle to form S or V-shaped bodies. Glomerulus is observed at 14thweek of gestation. Cortico-medullary junction and section of loops of Henle and distal parts of collecting tubules are seen at 16th week of gestation. Cortex has been differentiated as pars compacta & pars radiata at 18th week of gestation. Renal pyramids & renal columns are clearly demarcated at 24th week of gestation. Proximal convoluted tubule & distal convoluted tubule are distinct at 30th week of gestation. Macula densa is prominent at 38th week of gestation. The foetal kidneys attained, shape and cytoarchitecture of adult kidney by full term.

Key Words: *Cortex, Glomerulus, Macula Densa, Metanephros, Nephric Vesicle*

INTRODUCTION
According to etymology, medical term related to kidney is denoted by renal and nephros as prefixes. In latin renes means kidney; nephros is the ancient greek word for kidney, nephros (kidney encyclopedia). Datta (2007) stated that the mesonephric kidney persists as the permanent kidney in amphibians and most of the fishes. But in amniotes (reptiles, birds and mammals) it is succeeded by the metanephric kidney. Sainio and Ahokas (1999) observed that mesonephros is a vestige, transient renal organ that functions only during embryonic development. The anatomy, position and even cellular fate of the mesonephric kidney vary drastically among mammalian species. Development of the kidney starts when an outpouch of the wolffian duct, the ureteric bud, grows and invades a group of mesenchymal cells, the metanephric mesenchyme. The metanephric kidney serves an essential role in tissue homeostasis by regulating the balance of water and electrolytes in the plasma. It also excretes metabolic waste products and regulates the production of certain hormones (Merkel 2007). The present study is taken up on histogenesis of foetal kidney in particular phases of fetal devlopment, and to establish the histological structure in relation with age of foetus

MATERIALS AND METHODS
The present prenatal study of morpho-histogenesis of human foetal kidney is carried out in the department of Anatomy, Maharajah's Institute of Medical Sciences, Nellimarla. 50 aborted and unclaimed foetuses obtained from local private and government hospitals, The age of the foetuses ranged from 10 weeks to 40 weeks of gestation and is judged by the crown rump length as per Mossman and Boyd method. The study material of the human foetuses is categorized into three groups:

1st group - up to 12 weeks of gestation.
2nd group - from 13 to 24 weeks of gestation.
3rd group - from 25 to 40 weeks of gestation. 50 male foetuses are preserved with the injection of 10% formalin.

Histological study of human foetal kidney

5µ thickness of kidney tissue of 10 wks,12 wks, 14wks, 16 wks, 18 wks, 20 wks, 22 wks, 24 wks,26 wks, 28 wks,30 wks, 32 weeks,34 wks, 36 wks,38 wks and 40 wks of gestation are cleared in xylene and passed through descending grades of alcohol i.e., absolute, 90%, 80%, 70% and 50% and water and were stained using hematoxylin and eosin and mounted using DPX.

RESULTS

At 10wk gestation: Cortex and medulla could not be differentiated in the peripheral region. There are number of nephric vesicles, formed by condensation of disorganized mesenchymal cells (Figure 1). At 12wk gestation: Cortex and medulla are well differentiated. Cortical area is more than the medulla. Cortex is containing number of metanephric vesicle and transporting segments of nephrons and is lobulated (Figure 2). At 14wk gestation:The nephric vesicles have invaginated to form V-shaped or S-shaped tubules with invagination of progenitors of blood vessels involved to form vascular components of glomerulus. The glomeruli are surrounded by complex of convoluted tubules (Figure 3). At 16wk gestation: The cortical areas appear to be decreased when compared to the medulla. Cortico - medullary junction is well differentiated . Medulla containing transverse section of loops of Henle and distal parts of collecting tubules is observed. Collecting tubules are lined by cuboidal epithelium (Figure 4).

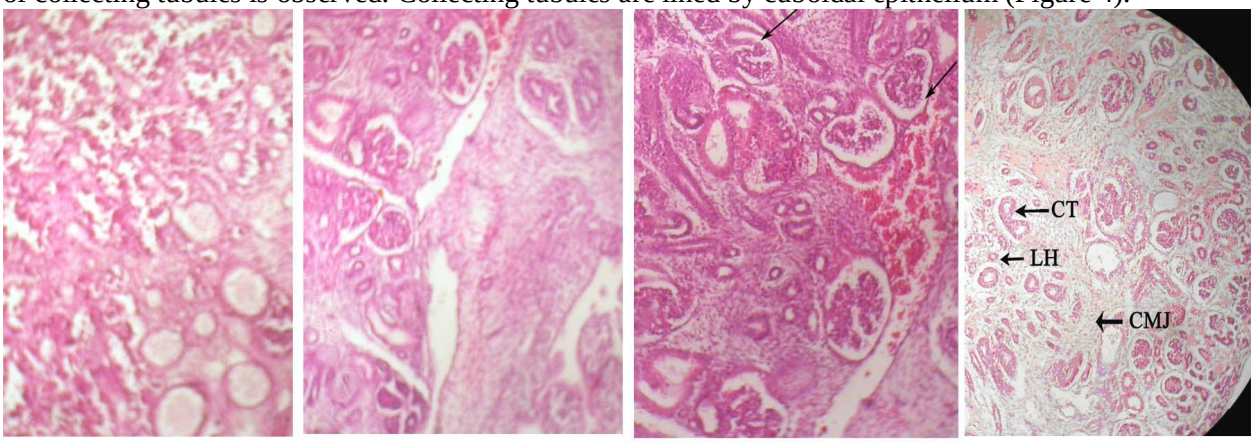

Fig.1 **Fig.2** **Fig.3** **Fig.4**

Fig:1 Showing nephric vesicle at 10th week of gestation, H&E x 100

Fig:2 Showing cortex and medulla at 12th week of gestation, H&E x 100

Fig:3 Showing v-shaped and s-shaped tubules at 14th week of gestation, H&E x 100

Fig:4 Showing cortico-medullary junction, loops of Henle and collecting tubules at 16th week of gestation, H&E x 100

At 18wk gestation, Cortex is differentiated into pars compacta and pars radiata. Pars compacta containing glomeruli and Bowman's capsule, proximal and distal convoluted tubule. Pars radiata containing collecting tubules (Figure 5). At 20wk gestation, view of kidney showing cortex and medulla. The collecting ducts are leaving the cortex and are seen terminating into ducts of bellini, which inturn are opening into the minor calices. Kidney is still lobuled (Figure 6). During 24wk gestation, Medulla containing renal pyramids and renal columns are distinct. The renal pyramids containing longitudinal sections of loops of Henle and ducts of bellini are observed. The renal columns containing few renal corpuscles and sections of blood vessels are observed. The juxtamedullary glomeruli are larger and are arranged in two to three rows. (Figure 7). Cortex is still lobulated (Figure 8) at 26 wks gestation.

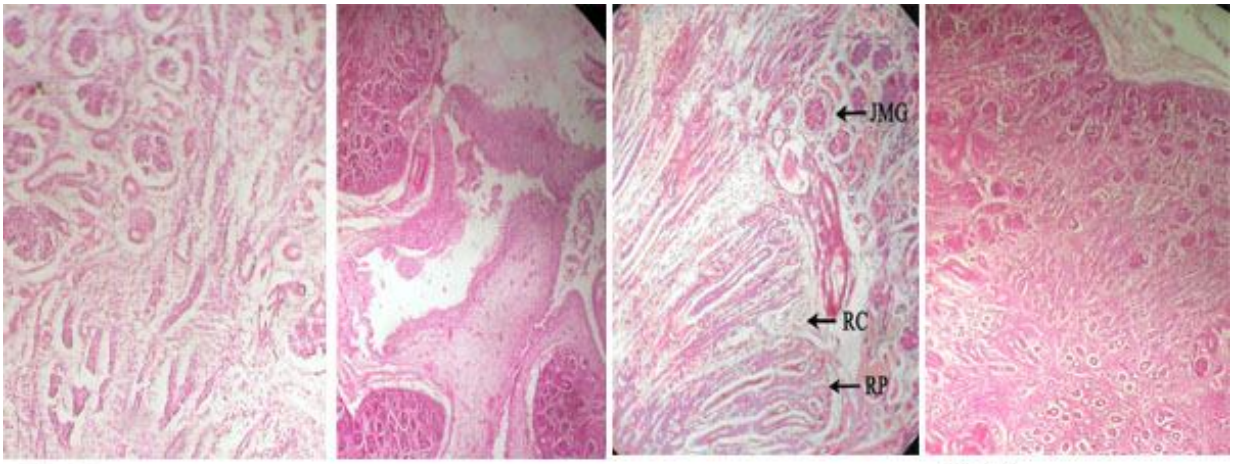

Fig:5 **Fig:6** **Fig:7** **Fig:8**

Fig:5 Showing pars compacta and pars radiata at 18th week of gestation, H&E x 100
Fig:6 Showing cortex, medulla, and, minor calices at 20th week of gestation, H&E x 100
Fig:7 Showing renal pyramids, renal columns and juxtamedullary glomeruli at 24th week of gestation, H&E x 100
Fig:8 Showing lobulation of cortex at 26th week of gestation, H&E x 100

Glomerular size appear to be decreased and tubules are C-shaped. The cortex appear to be very much compact by different generation of renal corpuscle (Fig.9) at 26wk gestation. At 30wk gestation, the proximal and distal tubules are distinct. Proximal convoluted tubule containing ciliated columnar epithelium with a small luminal diameter and distal convoluted tubule lined by non-ciliated columnar epithelium with large luminal diameter is observed. (Fig.10).At 36wk gestation: The cortical arch containing renal columns and medullary rays are well distinct .(Fig.11).At 38wk gestation, Macula densa, formed by the epithelial cells of distal convoluted tubule and afferent arteriole is very much prominent. (Fig.12)

DISCUSSION

The kidney develops in 2nd month from the metanephros , the caudal portion of the nephrogenic cord, which is derived from intermediate mesoderm. The ureter and the intrarenal collecting system develop from the ureteric bud (metanephic diverticulum). Interesting features of development of the kidney include a rostal-caudal wave of development, transformation of mesenchyme (nephrogenic cord) into epithelial tissue (nephrons) and formation of transient nephrons in the mesonephros, which plays a role in genital system development. (Kidney encyclopedia) .Takano K. et al (2007) in their study of devlopment of glomerular endothelial cells in human foetuses observed different developmental stages. They observed that the glomeruli are V-shaped at 13-19wk of gestation & they became S-shaped at 20-24wk of gestation. Later, during further development C-shaped glomeruli are seen at 25-29wk of gestation.In the present study, V-shaped or S-shaped glomeruli are observed during 14th wk of gestation. These observations are similar to findings of the above authors. Anant Dinesh et al (2006) in their study of morphological & morphometrical study of human renal development observed that The cortical area with glomeruli showed increase up to 13th to 18th wk and then there is a gradual fall. The corticomedullary junction was well defined by 18th to 25th wks of gestation. The cortex and medulla are clearly demarked.

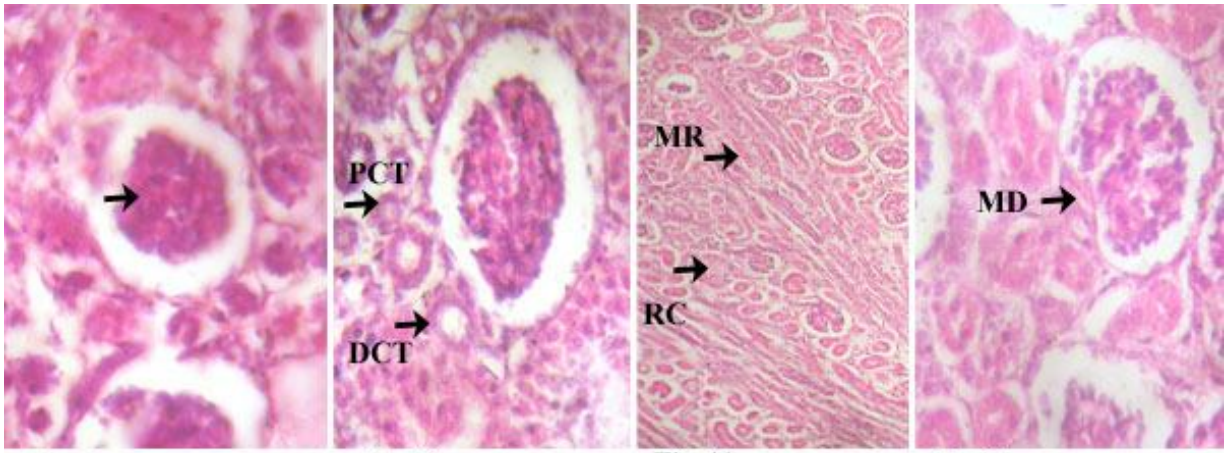

Fig:9 Fig:10 Fig:11 Fig:12

Fig:9 Showing renal corpuscles at 26th week of gestation, H&E x 400

Fig:10 Showing proximal convoluted tubule and distal convoluted tubule at 30th week of gestation, H&E x 400

Fig:11 Showing renal columns and medullary rays at 36th week of gestation, H&E x 100

Fig:12 Showing macula densa at 39th week of gestation, H&E x 400

The Juxtamedullary glomeruli are arranged in 2 to 4 rows at 24wk of gestation along with collecting duct and loops of Henle. The pyramids are well defined at 28wk of gestation.In the present study, the cortical area is more up to 14wk of gestation and later it showed gradual decrease. Cortico-medullary junction is differentiated by 12wk of gestation and is well defined by 16th wk of gestation. Collecting duct and loops of Henle are observed by 16th wk of gestation. The juxtamedullary glomeruli are larger and are arranged in 2 to 3 rows in 24wk of gestation. The pyramids and renal columns are markedly distinct by 24wk of gestation. The observation of the present case showed a minor difference with the studies of other authors. This may be due to difference in the number of foetuses studied.

REFERENCES

Anant Dinesh, Anant Mishra and Kaul J.M (2006) Morphological and Morpho-metrical Study of Human Renal Development During Mid-Gestation Period. *Journal of Anatomical Society of India* **55**(2) 07 –12

Merkel CE & Karner CM & Carroll TJ (2007) Molecular regulation of kidney development *Pediatric Nephrology* 22:1825-1838

Datta AK (2007). *Essentials of Human Embryology.* 5th Edition: 215

Sainio K, Raatikainen-Ahokas (1999) Mesonephric kidney-a stem cell factory. *International Journal of Development* **43**(5) 435-9

Takano K, Kawasaki Y, Imaizumi T, Matsuura H, Nozawa R, Tannji M, Suyama K, Isome M, Suzuki H, Hosoya M. (2007) Devlopment of glomerular endothelial cells,podocyte and mesangial cells in the human fetus and infant; *Tohoku Journal of Experimental Medicine* **212**(1) 81-90