

# Developmental Changes in Histology Of Human Fetal Kidney

Khayati Sant Ram<sup>1</sup>, Anshu Sharma<sup>2</sup>, Daisy Sahni<sup>3</sup>, Kunal Chawla<sup>4</sup>, Harsimran Jit Singh<sup>5</sup>

<sup>1</sup>Dept. of Anatomy, Post Graduate institute of medical education and research, Chandigarh, INDIA.

<sup>2</sup>Dept. of Anatomy, Government Medical College & Hospital, Chandigarh, INDIA

<sup>3</sup>Dept. of Anatomy, Post Graduate institute of medical education and research, Chandigarh, INDIA

<sup>4</sup>Dept. of Anatomy, Post Graduate institute of medical education and research, Chandigarh, INDIA

<sup>5</sup>Dept. of Anatomy, Post Graduate institute of medical education and research, Chandigarh, INDIA

## CORRESPONDING AUTHOR

Name: Khayati Sant Ram

Institution: Dept.: Dept of Anatomy, post graduate institute of medical education and research, Chandigarh, India

City: Chandigarh Country: India

E-mail: [khayati\\_santram@yahoo.com](mailto:khayati_santram@yahoo.com)

## ABSTRACT

The study was made on histology of human fetal kidney. The present study was carried out in the department of Anatomy, Government Medical College & Hospital, Chandigarh. The material for the study consisted of 30 spontaneously aborted human fetal specimens from 12<sup>th</sup> to 30<sup>th</sup> weeks of gestational ages. The kidneys were taken from fetal specimens for histological study. Slides were prepared. Hematoxyllin and eosin was done. It was observed nephrogenic zone decreased as gestation advanced, PCT and DCT were more prominent after 18<sup>th</sup> week of gestation. Cortico medullary differentiation was seen in later gestational period. It was thought that an understanding of histology of fetal kidneys would elucidate pathogenesis of abnormal kidney.

**KEY WORDS:-** kidney, cortex, medulla, nephrogenic zone, glomeruli, proximal convoluted tubule, distal convoluted tubule

## INTRODUCTION

Kidney plays a vital role in development of fetuses. Accurate assessment of gestational age of fetuses is essential for both clinical and medicolegal point of view. Prenatal development is a very crucial period for human development. It is important to know the normal developmental anatomy and histogenesis of urinary system for better understanding of various congenital renal conditions. Kidneys develop in intermediate mesoderm of human embryos in cranio-caudal direction. These are pronephric kidney, mesonephric kidney and metanephric kidney. Metanephros appears in lumbosacral segments, develop in 5th week. It develops from Ureteric bud which forms collecting part and metanephrogenic blastema forms secretory part.

Ureteric bud its distal end dilates and invades the caudal part of nephrogenic cord dorsal to mesonephric ridge. It repeatedly divides. It is capped with a metanephric blastema on further sub-division some parts of the blastema separate from the main mass and form clusters of cells on each side

of the tubule forms pear shaped hollow renal vesicles. First vesicle is formed at the end of 7th week. Cells at the proximal pole of the vesicles organize to form C-shaped or comma shaped body followed by cellular reorganization of tubular cells at distal end to form an 'S' shaped body or S-body. In the cleft of the S-body at the distal pole, formation of extra cellular matrix and penetration by capillaries targets at formation of future mesangial region. The proximal limb of the S-body organizes to form distal convoluted tubule while the intermediate limb enlarges to form loop of Henle and the proximal convoluted tubule resulting in entire development of a nephron<sup>1,2,3,4</sup>.

Many such nephrons are present in the fetal kidney due to multiple branching of the ampullary bud and induction of various mesenchymatous condensates to form nephron arcades. The permanent kidneys become functional in intrauterine life and urine produced by them is added to amniotic fluid from 10th week of gestation.

## MATERIAL AND METHOD

The present study was carried out in the department of Anatomy, Government Medical College & Hospital, Chandigarh. The material for the study consisted of 30

aborted human fetal specimens from 12<sup>th</sup> to 28<sup>th</sup> weeks of gestational ages. The specimens were provided by the department of Obstetrics & Gynaecology Government Medical College & Hospital, Chandigarh for routine fetal autopsy. All fetuses were result of the intra uterine death or spontaneous abortion. Consent for autopsy and brief antenatal, medical, past history from the mother was taken from the parents to perform the study. Histological slides were made and stained with Haematoxylin and eosin.

The fetuses were divided into three groups according to the gestational age:-

GROUPS	GESTATIONAL AGE	NUMBER OF FETUSES
A	11-18 weeks	7
B	>18-25 weeks	11
C	>25 weeks	12

## RESULTS

### Group A (11-18 weeks)

Under light microscopy capsule was identifiable, it was thin made up of collagen fibres and fibroblasts. Beneath the capsule nephrogenic zone was present, the cells in this zone were oval, with eosinophilic cytoplasm and centrally placed nucleus. The cells were scattered and were in the groups (fig 1). Beneath this zone growing ureteric bud in form of ampulla was seen, the cells were cuboidal to columnar with centrally placed nucleus (fig 2). Hollow structures lined by single layer of cells were seen these were nephrogenic vesicles. Glomeruli were observed, they were in there developing stage, and between the developing glomeruli in the connective tissue developing tubules were seen. Tubules were lined by cuboidal cells with pale eosinophilic cytoplasm. Proximal and distal convoluted tubules were not differentiated. Medulla consisted of loose connective tissue with mesenchymal cells. Cortex and medulla cannot be differentiated at this age.

### Group B (>18-25 weeks)

Capsule was present. Nephrogenic zone was reduced compared to previous gestational age groups. Glomeruli were bilobed were more in number. Proximal and distal convoluted tubule was identified. PCT had irregular lumen lined by cuboidal cells with brush border with euchromatic nuclei. DCT had large lumen lined by cuboidal cells without brush border with euchromatic nuclei (fig 3). Medulla collecting tubules were seen, lined by columnar epithelium. Thick loop of henle was lined by cuboidal epithelium and thin segment was lined by squamous epithelium.

### Group C (>25 weeks)

In the cortex DCT and PCT were increased, connective tissue was less; many capillaries are seen adjacent to the glomeruli (fig 4). In medulla more number of collecting tubules, thin and thick loop of henle were seen. Thickness of cortex and medulla increased with increase in gestational age.

## DISCUSSION

In a study it was seen persistence of nephrogenic zone upto 3-6 months after birth suggesting that new nephron formation continues postnatally<sup>5</sup>. In our study nephrogenic zone was seen upto 28 weeks; nephrogenic cells had faint eosinophilic cytoplasm and dark staining oval nuclei indicating mitosis.

Few authors found nephrogenic zone was seen just beneath the capsule as a broad and continuous zone in earlier weeks of gestation but as fetal age increased the size of nephrogenic zone decreased and it was absent at 38 weeks of gestation indicating that after 38 weeks of gestation new nephrons were not formed.<sup>6,7</sup>

In our study immature renal corpuscles were seen in superficial part and more mature renal corpuscles were seen in deeper part of cortex. Immature renal corpuscles were seen in more number in early part of gestational period and they were present till 30 weeks.

Helena Maria et al<sup>8</sup> had found immature renal corpuscles till 35 weeks whereas Arne Ljungqvist<sup>9</sup> found rudimentary renal corpuscles even at full term. According to Moore<sup>3</sup> the number of glomeruli increased from 10th to 32nd week gestation. In our study the number of mature renal corpuscles went on increasing with increasing gestational age. The number of proximal and distal convoluted tubules went on increasing as gestational age advanced. In our study more number of mature renal corpuscles and tubules were seen in deeper part than in superficial part of cortex. These findings suggest that cortex of kidney differentiates from deeper to superficial part. Maria H et al<sup>8,10</sup> also had similar findings.

Ljungqvist A<sup>9</sup> found out that as gestational age increased the number of well differentiated tubules in medulla increased. But Ljungqvist A<sup>9</sup> had not mentioned regarding the time when collecting tubules and Henle's loop appeared in medulla. Tank et al<sup>10</sup> observed PCT and DCT at 17<sup>th</sup> week, Sudha P et al<sup>7</sup> found them at 18<sup>th</sup> week our study also had similar finding.

## CONCLUSION

Present study was done to know the normal histological changes in fetal kidney so that pathological changes can be ruled out. It was thought that an understanding of histology

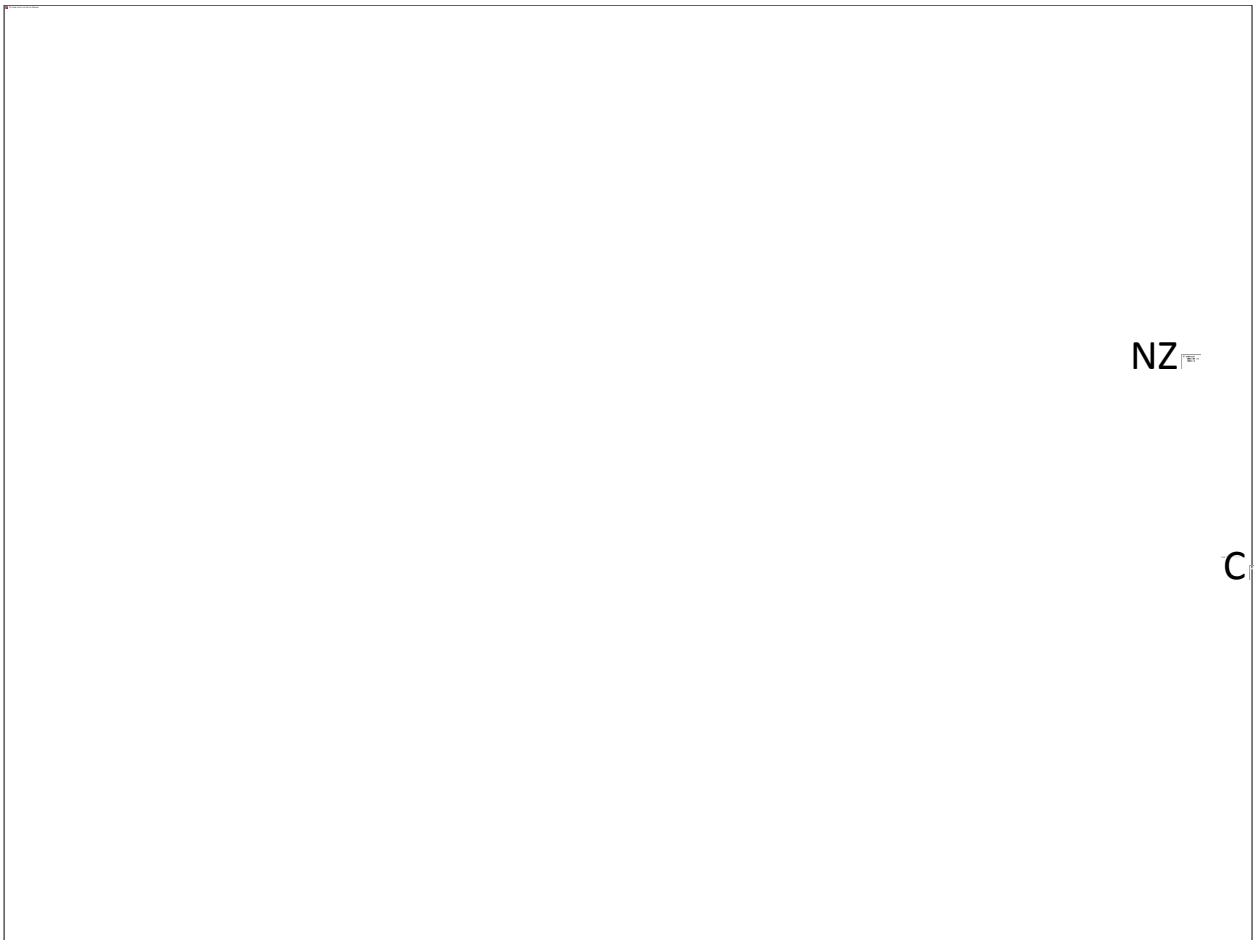
of fetal kidneys would elucidate pathogenesis of abnormal kidney.

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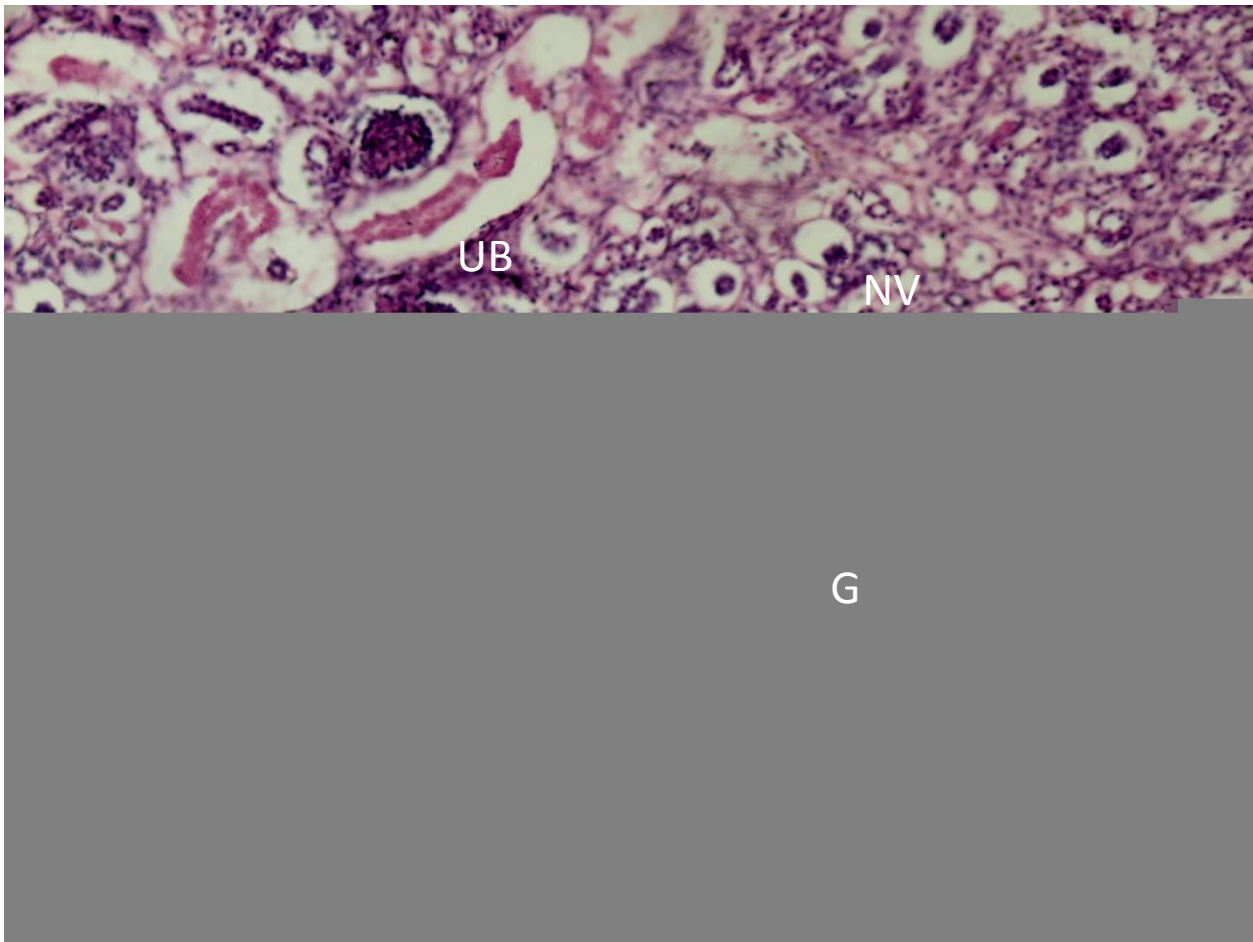
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## **Acknowledgement**

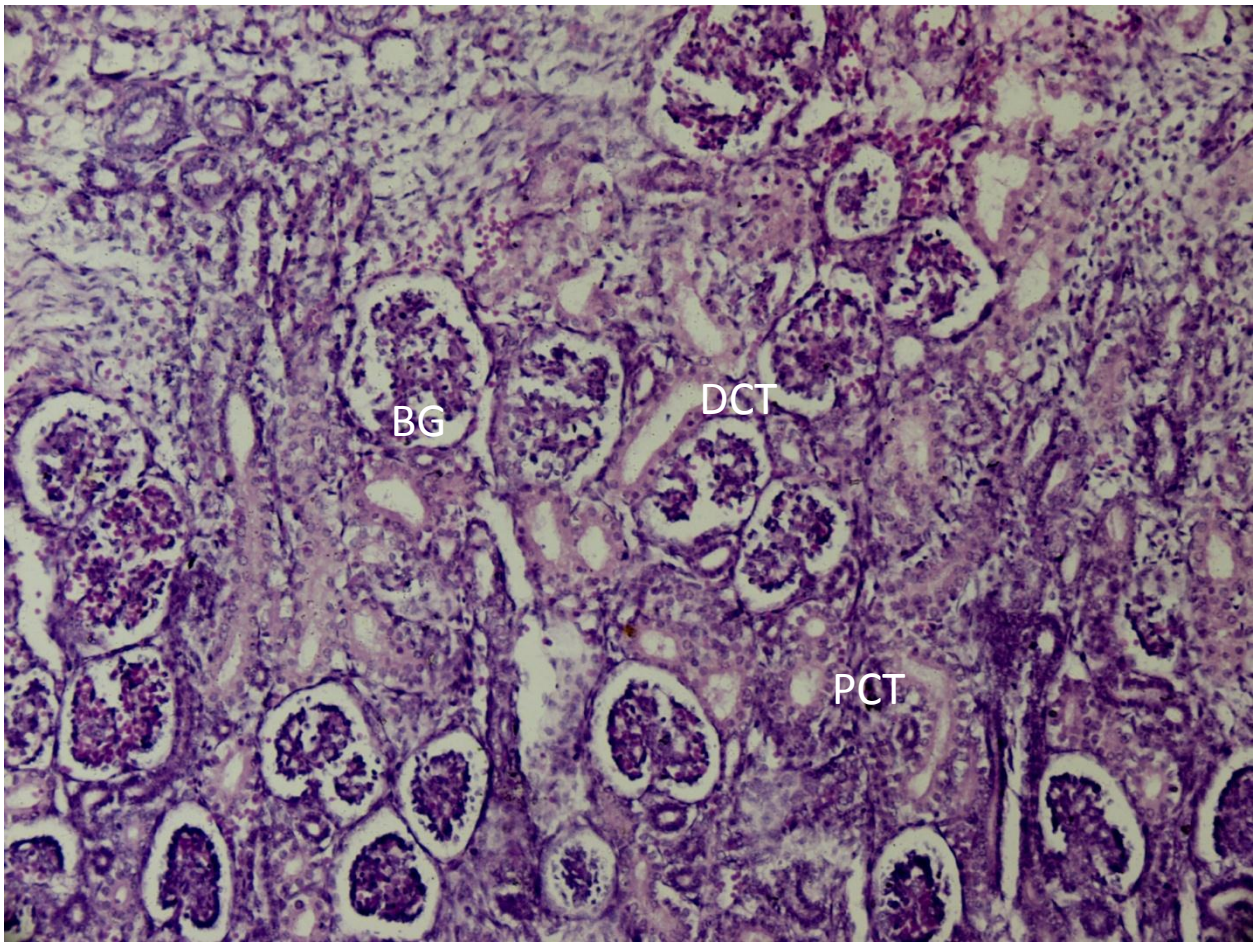
I would like to acknowledge Mr. Pardeep Singh for his assistance in photography.



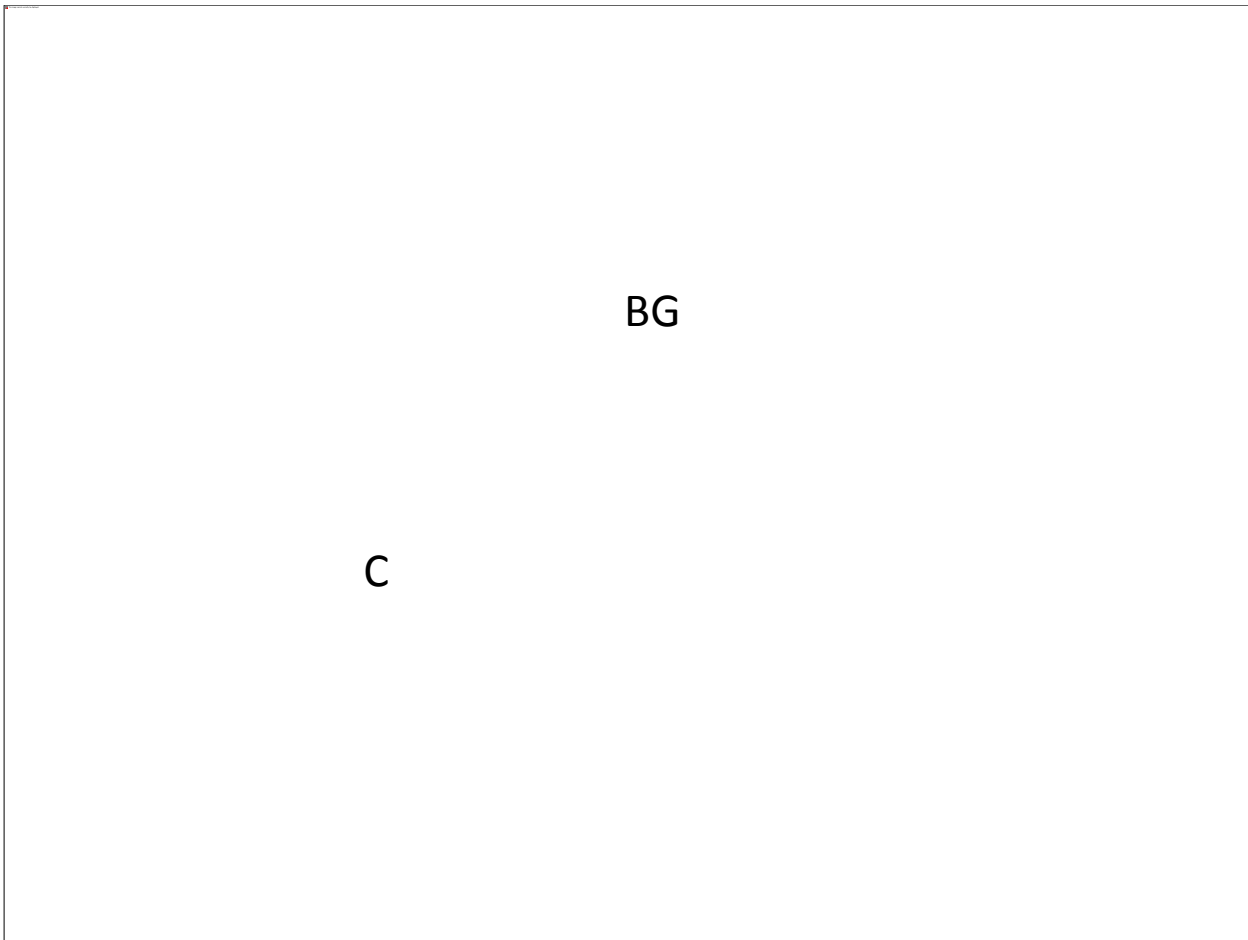
**Fig 1 :- Nephrogenic zone(NZ)beneath the capsule with undifferentiated cortex and medulla at 16<sup>th</sup> week of gestation. H&E 40X**



**Fig 2:-Nephrogenic vesicle (NV) and Ureteric bud (UB) in the cortex with mature and immature glomeruli (G) formation at 18<sup>th</sup> week of gestation. H&E 60X**



**Fig 3:- Bilobed Glomeruli (BG). Proximal (PCT) and distal convoluted tubule (DCT) were well identified at 22 weeks gestation. H&E 60X**



**Fig 4:- Increased capillaries (C) are seen adjacent to bilobed glomeruli at 26 weeks gestation. H&E 60X**