Global Journal of Science Frontier Research: C
Biological Science
Volume 15 Issue 2 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

# Ultravist Studies on the Histology Patterns of the Kidney of Adult Wistar Rats

By Valentine C. Ikamaise, Theresa B. Ekanem, Kebe E. Obeten & Gabriel Udo-Affah
*University of Calabar, Nigeria*

*Abstract-* The aim of this study was to assess the effects of ultravist on the histological patterns of the kidney of the Wistar rat. Thirty (30) Wister rats weighing between 182-212kg/BW were divided into three groups of ten (10) animals each. Group A served as the control group, while group B and C served as experimental groups receiving low and high dosage of ultravist (iopromide) which is the Radiographic Contrast Medium (RCM) used for the experiment respectively. Collection of tissues was carried out on rats at intervals of 30 minutes, 60 minutes, 2 hours, 12 hours and 24 hours following administration of RCM on the experimental groups. The sampling from experimental and control groups were carried out simultaneously following administration of low and high dose of RCM to rats from experimental groups. The result obtained for ultravist after one hour administration presented in plates 2 and 4 showed alteration in the high dose animals while plates 3 and 5 showed marked alterations in the cellular morphology of the kidney of the low dose animals.

*Keywords:* *kidney, wistar rats, ultravist, hyper cellular mesangium.*

*GJSFR-C Classification :* *FOR Code: 069999*


*Strictly as per the compliance and regulations of :*

# Ultravist Studies on the Histology Patterns of the Kidney of Adult Wistar Rats

Valentine C. Ikamaise [α], Theresa B. Ekanem [σ], Kebe E. Obeten [ρ] & Gabriel Udo-Affah [ω]

*Abstract-* The aim of this study was to assess the effects of ultravist on the histological patterns of the kidney of the Wistar rat. Thirty (30) Wister rats weighing between 182-212kg/BW were divided into three groups of ten (10) animals each. Group A served as the control group, while group B and C served as experimental groups receiving low and high dosage of ultravist (iopromide) which is the Radiographic Contrast Medium (RCM) used for the experiment respectively. Collection of tissues was carried out on rats at intervals of 30 minutes, 60 minutes, 2 hours, 12 hours and 24 hours following administration of RCM on the experimental groups. The sampling from experimental and control groups were carried out simultaneously following administration of low and high dose of RCM to rats from experimental groups. The result obtained for ultravist after one hour administration presented in plates 2 and 4 showed alteration in the high dose animals while plates 3 and 5 showed marked alterations in the cellular morphology of the kidney of the low dose animals. The alterations included swollen or oedematous glomeruli, swollen epithelial cells, loss of Bowman's space and hyper cellular mesangium (proliferation of cells in the mesangium). The implication is that cells in this condition cannot perform the primary functions of secretion and excretion or maintaining the glomerular filtration rate within the normal range of arterial pressure of approximately 80 to 180 mmHg. The consequence of these changes in the cells may lead to a number of physiological manifestations such as acute renal failure.

*Keywords: kidney, wistar rats, ultravist, hyper cellular mesangium.*

## I. Introduction

Ultravist (iopromide) is an injectable radiographic contrast medium. A radiographic contrast medium (RCM) is a substances introduced into the body in order to make an organ, or the surface of an organ, or materials within the lumen of an organ visible on the radiograph. Mostly, the media are of greater radiographic density than the structures they outline; sometimes lower densities are introduced, usually air. (Speck, 1993; Thomsen & Morcos, 2000; Morcos, 2003)

The kidneys are bean-shaped organs that serve several essential regulatory roles in vertebrates. They remove excess organic molecules from the blood, and it is by this action that their best-known function is performed: the removal of waste products of metabolism. They are essential in the urinary system and also serve homeostatic functions such as the regulation of electrolytes, maintenance of acid–base balance, and regulation of blood pressure (via maintaining salt and water balance). They serve the body as a natural filter of the blood, and remove water soluble wastes, which are diverted to the bladder. In producing urine, the kidneys excrete wastes such as urea and ammonium, and they are also responsible for the re-absorption of water, glucose, and amino acids. The kidneys also produce hormones including calcitriol, erythropoietin, and the enzyme renin, the last of which indirectly acts on the kidney in negative feedback. (Cotran *et al.,* 2005).

Located at the rear of the abdominal cavity in the retroperitoneal space, the kidneys receive blood from the paired renal arteries, and drain into the paired renal veins. Each kidney excretes urine into a ureter, that empties into the bladder.

The use of RCM could be traced to 1896 and over the years, various types and classes were developed to include ionic monomers, non-ionic monomers, ionic and non-ionic dimmers, and others (Speck, 1993; Marshal, $2006_a$).The parent molecule from which RCM for injection is derived is benzene, a toxic water-insoluble liquid. Addition of other elements to obtain a desired RCM may have made the compound less toxic, but hypersensitivity reactions to all groups of RCM for injection are reported stemming from the osmolality of the contrast, the frequency of the injection, the dose and the viscosity of the agent. Ionic dimmers and non-ionic monomers are better tolerated by the body with fewer adverse effects than the ionic monomers (Raport and Levitan, 1974; Katayama et al, 1990; Hoffmann et al, 2000; Marshall, $2006_{a\,\&\,b}$).

Most studies carried out to investigate the safety and risk of contrast media are clinical trials on patients to establish physiological manifestations of effects of contrast medium where observations and classifications of adverse effects are established. These studies revealed the occurrence of adverse effects but observed that reactions are unpredictable and intravenous injection carries a higher risk than intra-arterial injection. Others observed that some reactions are unrelated to the concentration or dose of contrast medium.(Burns et al, 1981; Hoffmann et al, 2000; Meth and Maibach, 2006).

This study therefore, was designed to assess the effects of ultra vist at the cellular level by looking at

*Author α: Department of Radiography and Radiological Science, University of Calabar, Calabar, Nigeria.*
*Author σ ρ ω: Department of Human Anatomy, University of Calabar, Calabar, Nigeria. e-mail: fredobeten@yahoo.com*

the histological patterns of the kidney for cellular alteration or damage following administration of ultravist (non-ionic RCM) which is currently in use in Nigeria. This may contribute to the understanding of aetiology which will enhance predictability of expected effects following ultravist administration.

## II. Materials and Methods

Thirty (30) Wister rats and a brand radiographic contrast medium namely; ultravist (iopromide) were used for the experiment. The body weights of all rats used were determined. The rats were separated into 3 groups with 10 rats in each group. Two groups were experimental groups, and a group was used as a control group. Rats of a particular group were identified with marks. Each group was kept in a separate cage throughout the experimental period. From all groups, collection of tissue was carried out on rats at intervals of 30 minutes, 60 minutes, 2 hours, 12 hours and 24 hours following administration of RCM on the experimental groups. The sampling from experimental and control groups were carried out simultaneously following administration of low and high dose of RCM to rats from experimental groups.

The dose of RCM for each rat was calculated using thisformula – Dosage=$\frac{V_c \times W_r}{W_{man}}$

*Where* $V_c$ = *Volume of contrast medium*
$W_r$ = *Weight of rat*
$W_{man}$ = *Weight of a standard physiological man (70kg)*

The doses of 60ml and 100ml on a physiological 70kg man are considered low and high doses in RCM administration. Therefore, a volume of 60ml and 100ml respectively were used for the calculation of low and high doses for the rats.

The rats were sacrificed by cervical dislocation and placed on a dissecting board in the supine position for laparotomy. The kidney tissue was removed from the animal with great speed by the use of forceps and scissors.The kidney tissue was fixed in Bouin's fluid after extraction in separate tubes for 24 hours before dehydration, clearing, embeddingand sectioning at 5 micrometer thick using rotary microtome.Thirty (30) minutes following ripening and staining of slides with Haematoxyl in and Eosin (H&E) samples were rinsed and viewed under microscope. The glomerulus, bowman capsule, nucleus, mesangium and the cytoplasm were observed. Histological changes between the experimental and control groups and between the two different brands of contrast media on the photomicrographs were noted. The result obtained for urografin (diatrizoate) shall be reported in another article.

## III. Results

Plate 1 showed a photomicrograph of the renal cortex of a control Wistar rat with prominent glomeruli, distinct bowman capsule, prominent cellular mesangium and the cell consists of distinct basophilic nuclei and moderately eosinophilic cytoplasm. The cells are closely packed with sparse interstitium consisting of blood vessels.

Plate 2 showed a photomicrograph of a renal cortex of Wistar rat at 30 minutes after injection of 0.29 ml (high dose) of ultravist with swollen oedematous glomeruli with marked loss of Bowman's space. There is hyper cellular mesangium (proliferation of cells). The cortical renal tubules are lined by swollen epithelial cells. The cells have prominent basophilic nuclei with abundant of eosinophilic cytoplasm.

Plate 3 showed a photomicrograph of the renal cortex of Wistar rat 30 minutes after injection of 0.19 ml (low dose) of ultravist. The glomeruli are swollen with loss of Bowman's space. There is hyper cellular mesangium. The cellular outlines are indistinct.

Plate 4 showed a photomicrograph of the renal cortex of Wistar rat 1 hour after injection of 0.26 ml (high dose) of untravist. There is swollen glomeruli with obliterated Bowman's capsule. Hyper cellular mesangium and cortical renal tubules are lined by swollen epithelial cells with prominent nuclei. The intervening interstitium is sparse.

Plate 5 showed a photomicrograph of the renal cortex of Wistar rat 1 hour after injection of 0.16 ml (low dose) of ultravist. The glomeruli are prominent with distinct Bowman's space showing mild swelling. The mesangium is cellular. The renal cortical tubules are lined by mildly swollen epithelial cells with prominent nuclei. The lumen of the cortical tubule is distinct with sparse interstitium.

Plate 6 showed the photomicrograph of the renal cortex of Wistar rat 2 hours after injection of 0.27 ml (high dose) of ultravist. There are prominent glomeruli with well demonstrated Bowman's capsules and herpercellularmesangium. The cortical tubules are lined by cuboidal epithelial cells which are mildly swollen with prominent nuclei.

Plate 7 showed a photomicrograph of the renal cortex of Wistar rat 2 hours after injection of 0.16 ml (low dose) of ultravist. The glomeruli are prominent with less distinct Bowman's capsules. Hyper cellula rmesangium and moderately swollen glomeruli. The renal cortical tubules are lined by swollen cuboidal epithelium. Some tubules have distinct luminal space.

Plate 8 showed a photomicrograph of the renal cortex 24 hours after injection of 0.30 ml (high dose) of ultravist with prominent glomeruli, distinct Bowman's space. Some of the renal cortical tubules are lined by prominent cuboidal epithelial cells.

## IV. Discussion

The result obtained for ultravist (non-ionic monomer – iopromide) after one hour administration presented in plate 2 to plate5 showed marked

alterations in the cellular morphology of the kidney. The alterations included swollen or oedematous glomeruli, swollen epithelial cells, loss of Bowman's space and hyper cellular mesangium (proliferation of cells in the mesangium). The implication is that cells in this condition cannot perform the primary functions of secretion and excretion or maintaining the glomerular filtration rate within the normal range of arterial pressure of approximately 80 to 180 mmHg. The consequence of these changes in the cells may lead to a number of physiological manifestations such as acute renal failure. Gill ($2006_a$) reported that Acute Renal Failure (ARF) is induced by contrast agents within the duration less than 72 hours after contrast agents' administration. According to him the contrast induced ARF occurs because the contrast agent trigger a rise to more than 25% of the serum creatinine value or has increased the serum value of above 44$\mu$ml/L (0.5mg/dl).

The results presented in plate 6 to plate 8 for ultravist injection after the duration of 1 hour demonstrate prominent glomeruli, distinct Bowman's capsule and space with close to normal cellular mesangium, though some cells were still swollen within the capsule and in the interstitial tissues. This implies that the elimination of ultravist from the system is rapid and thus supports the findings of Berg et al (1958) and Shellock and Kanal (1999) who found out that 83% of injected dose of contrast medium is eliminated by six hours.

## V. Conclusion

The main aim of this study was to assess the effects of radiographic contrast media on the histological patterns of the kidney of the wistar rat using ultravist (iopromide -a non-ionic contrast medium). From the findings of this study the following conclusion can be drawn.

The kidney of Wistar rat is affected by radiographic contrast medium (ultravist) by alteration of the normal histological pattern of the cells (glomerular, Bowman's capsule, tubules, mesangium and interstitium.

The effects of low dose ultravist compared to that of high dose may not be outstanding within the intervals of monitoring.

The effect of radiographic contrast media on kidney cells is rapid and is recoverable.

## References Références Referencias


1. Berg NO, Idbohrn H. and Wendeberg B. (1958) Investigation of tolerance of the rabbit's kidney to newer contrast media in renal angiography. Actaradiol. (stock), 50, 285.
2. Burns E. M., Dobben G. D. and Kruckeberg T. W. (1981): Blood – brain barrier: morphology, physical and effects of contrast media. Advances in neurology, 3(1): 159 – 165.
3. Cotran, RS S.; Kumar, Vinay; Fausto, Nelson; Robbins, Stanley L.; Abbas, Abul K. (2005).Robbins and Cotran pathologic basis of disease. St. Louis, MO: Elsevier Saunders.
4. Hoffmann M. L., Tielbeck A. V. and Krause W. (2000): Haemostatic effects of low osmolar non – ionic and ionic contrast media: a double blind comparative study. The British Journal of Radiology, 73: 248 – 255.
5. Katayama H., Yamaguchi K. and Kozuka (1990): Adverse reactions to ionic and non-ionic contrast media: a report from the Japanese Committee on the safety of contrast media. Radiology; 175r: 621 – 628.
6. Marshall Gill (2006a): iodinated contrast agents – the state of the art: Synergy imaging and Therapy practice, November: 18 – 23.
7. Marshall Gill (2006b): iodinated contrast agents – induced nephrotoxcity. Synergy Imaging and Therapy practice: 18 – 21.
8. Meth M. J. and Maibach H. I. (2006): Current understanding of contrast media reactions and implications for clinical management. Drug safety, 29i (2): 133 – 141.
9. Morcos S.K. (2003): Effects of radiographic contrast media on the lung. The British Journal of Radiology, 76: 290 – 295.
10. Raport S. I. and Levitan H. (1974): neurotoxicity of X-ray contrast media: relation to lipid solubility and blood-brain barrier permeability. American Journal of Roentgenology, 122: 186 – 193.
11. Shellock F. G. and Kanal E. (1999): Safty of magnetic resonance imaging contrast agents, J. Magn. Reson Imaging. 10(3): 477-484.
12. Speck U. (1993): Contrast media; overview, use and pharmaceutical aspects. Berlin/Heidelberg: Springer – Verlag, 1 – 119.
13. Thomsen HS, Morcos SK (2000) Radiographic contrast media: BJU International; 86 suppl. 1: 1-10.

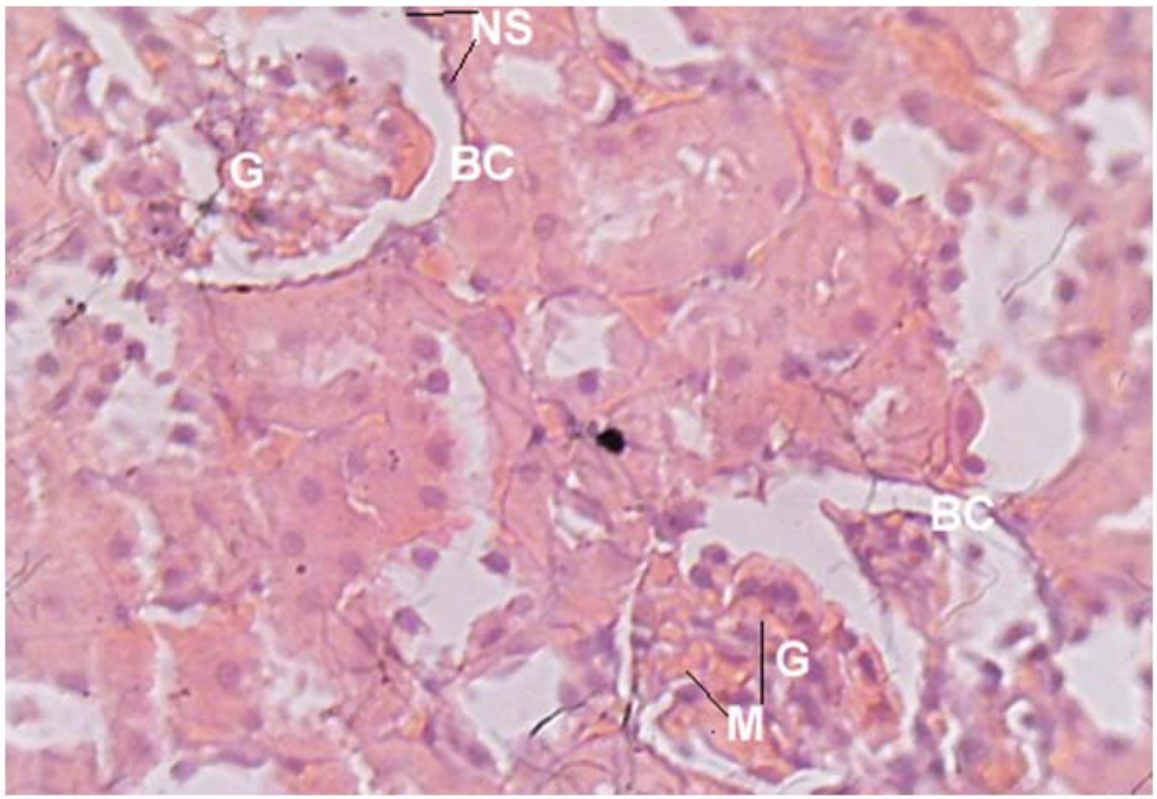


*Plate 1 :* Photomicrograph of a normal renal cortex of Wistar rat [X400; H&E]
**BC**- Bowman capsule **G**- Glomerulus M- Mensangial cells **NS**- Nuclei of squamous cells **BS**-Bowman space

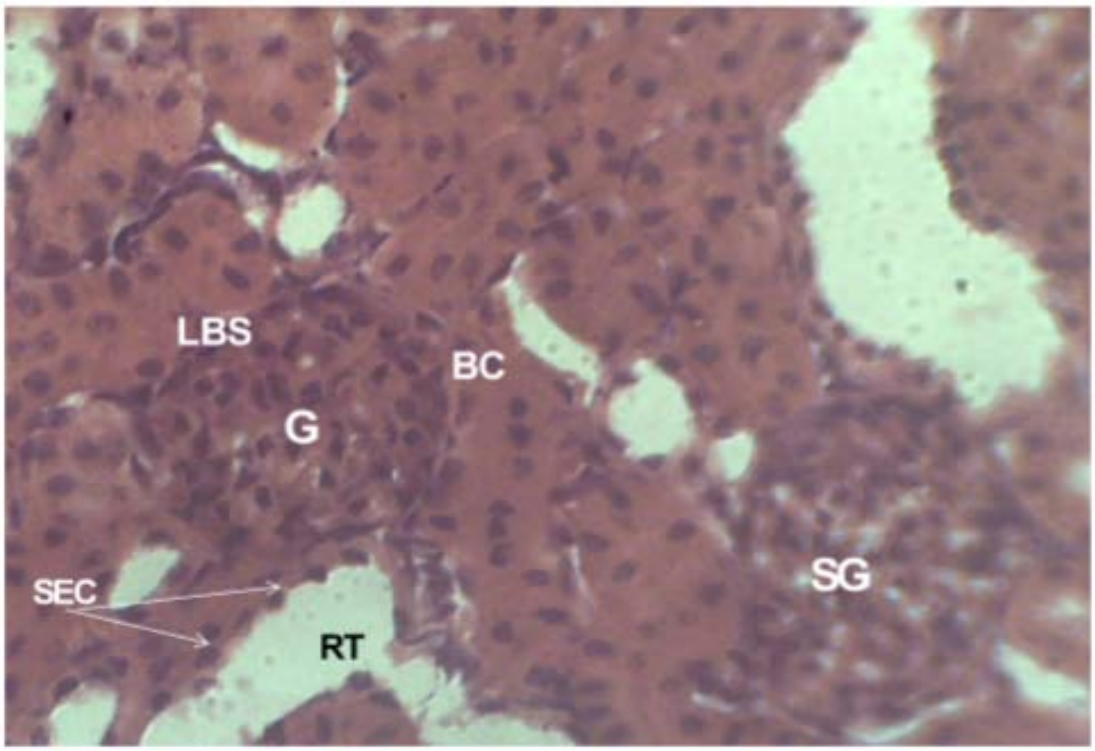


*Plate 2 :* Photomicrograph of the renal cortex of Wistar rat 30 mins after injection of 0.29ml of ultravist. H&E stain, X400
**LBS** – Lost Bowman space **SEC** – Swollen epithelial cells **RT** – Renal tubule **SG** – Swollen glomerulus.

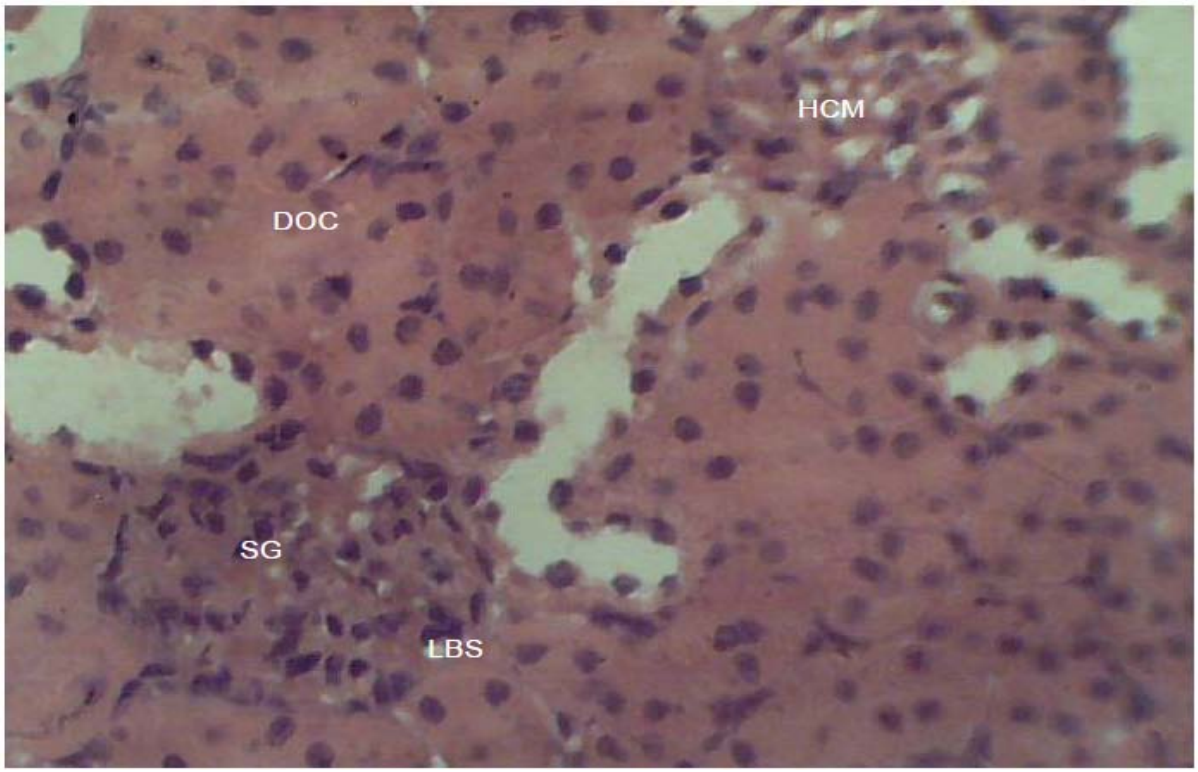


*Plate 3 :* Photomicrograph of the renal cortex of Wistar rat 30 minutes after injection of 0.19ml of ultravist. H&E, X400
**DCO** – Distorted cellular outline, **LBS** – Lost Bowman pace, **SG** – Swollen glomerulus, **HCM** – Hyper cellular mesabgium

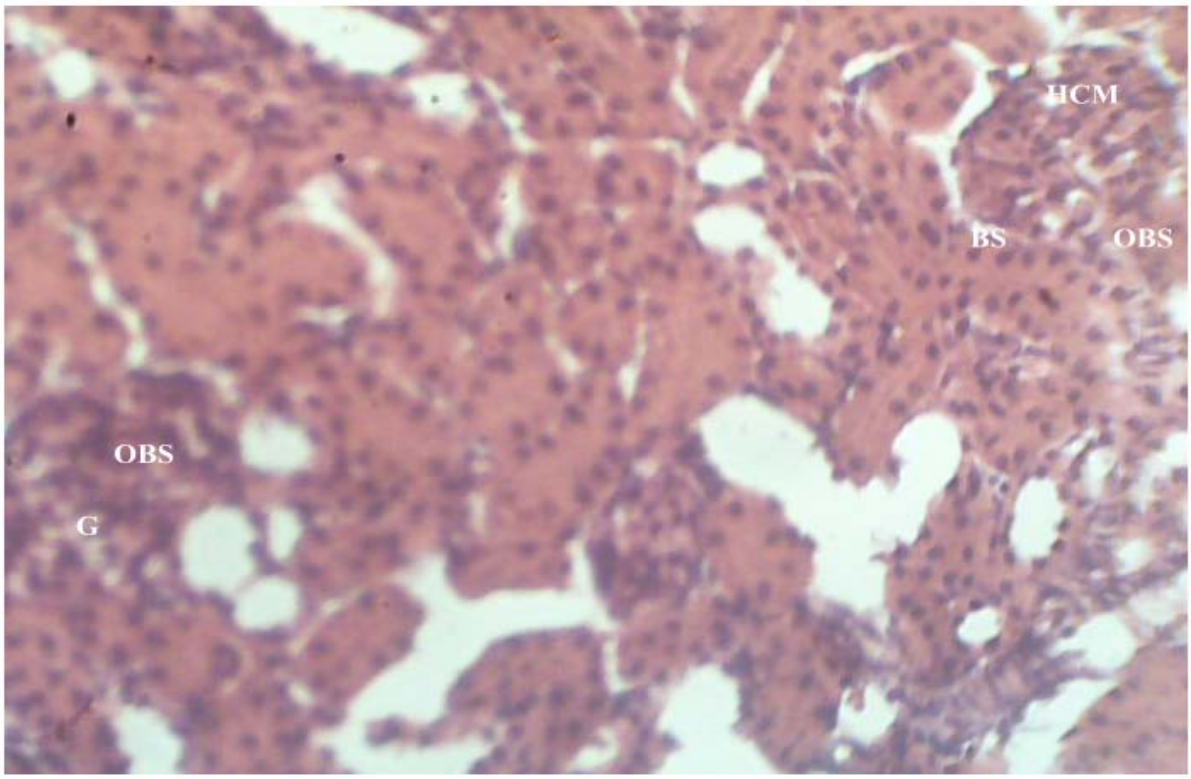


*Plate 4 :* Photomicrograph of the renal cortex of Wistar rat 60 minutes after injection of 0.26ml of ultravist. H&E stain, X400
**HCM** – Hypercellularmesangium, **OBS** – obliterated Bowman space, **G**-glomerulus, **BS**- Bowman space

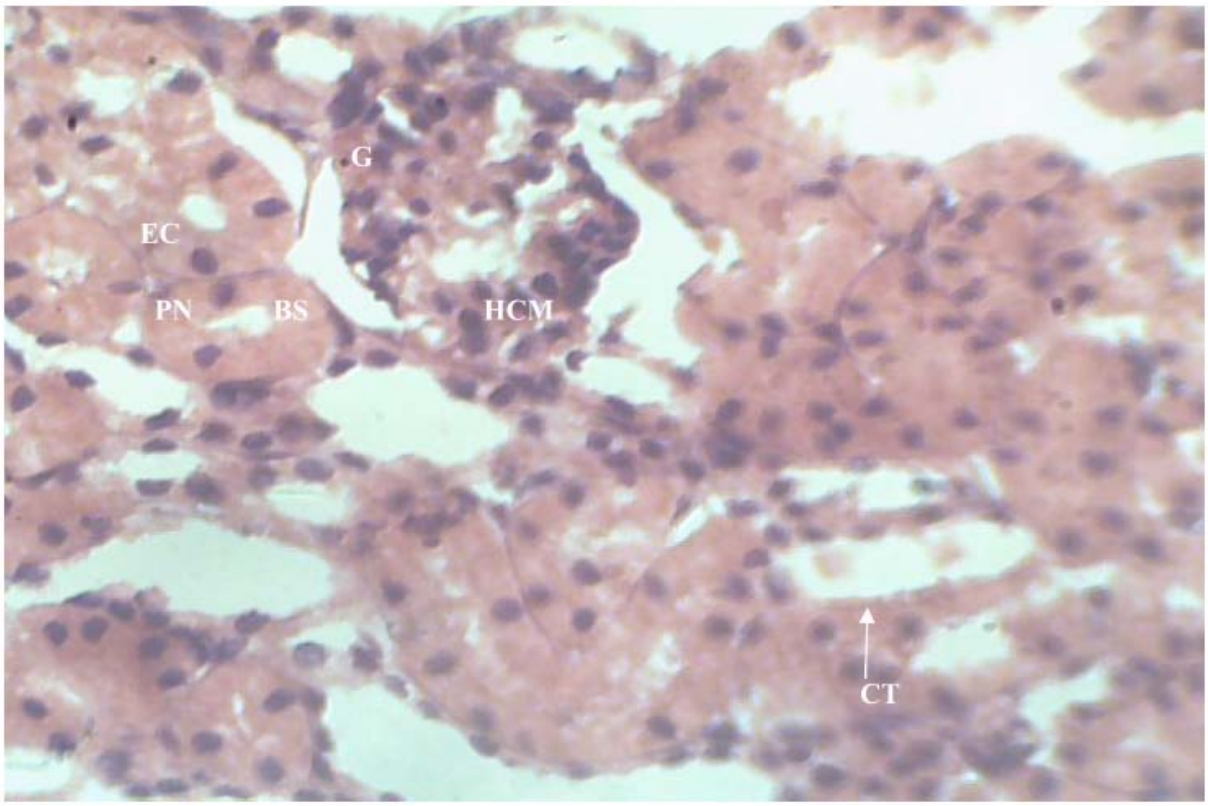


*Plate 5 :* Photomicrograph of the renal cortex of Wistar rat 60 minutes after injection 0.16ml of ultravist. H&E stain, X400

**EC** – Epithelial cell, **PN** – Prominent nucleus, **BS** – Bowman space, **HCM** –Hypercellularmesangium, **CT** – Cortical tubule

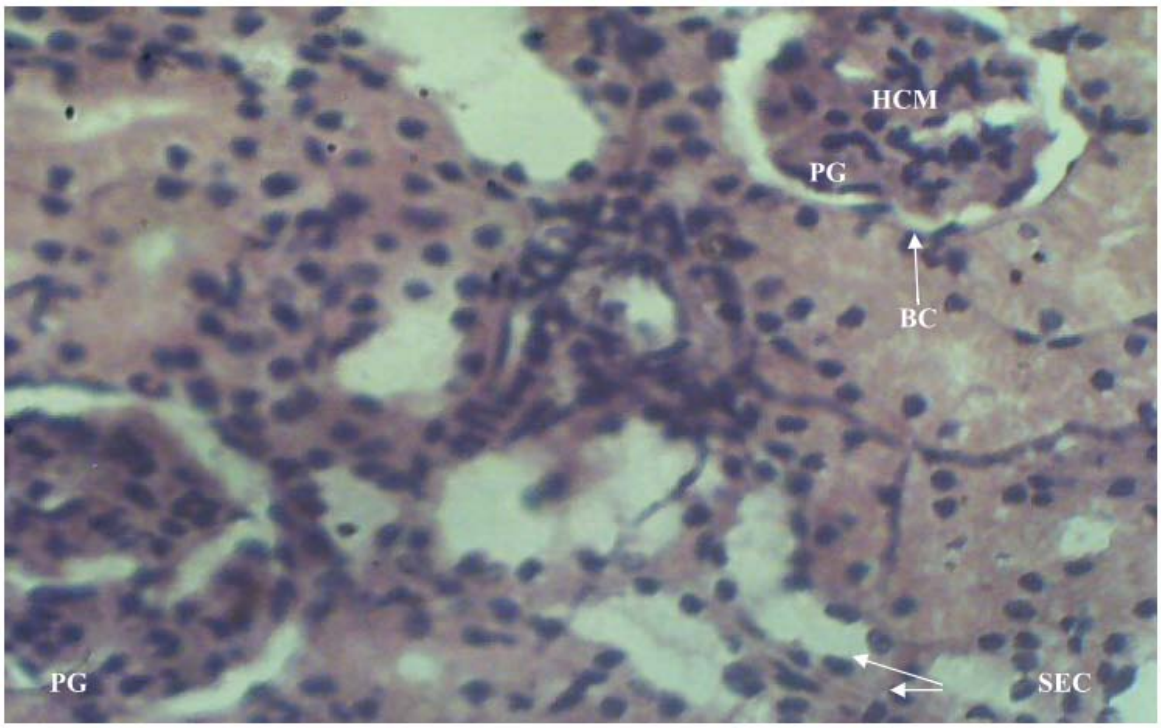


*Plate 6 :* Photomicrograph of the renal cortex of Wistar rat 2 hours after injection of 0.27 of ultravist. H&E stain, X400.

**PG** – Prominent glomerulus **BC** – Bowman capsule **SEC** – Swollen epithelial cells

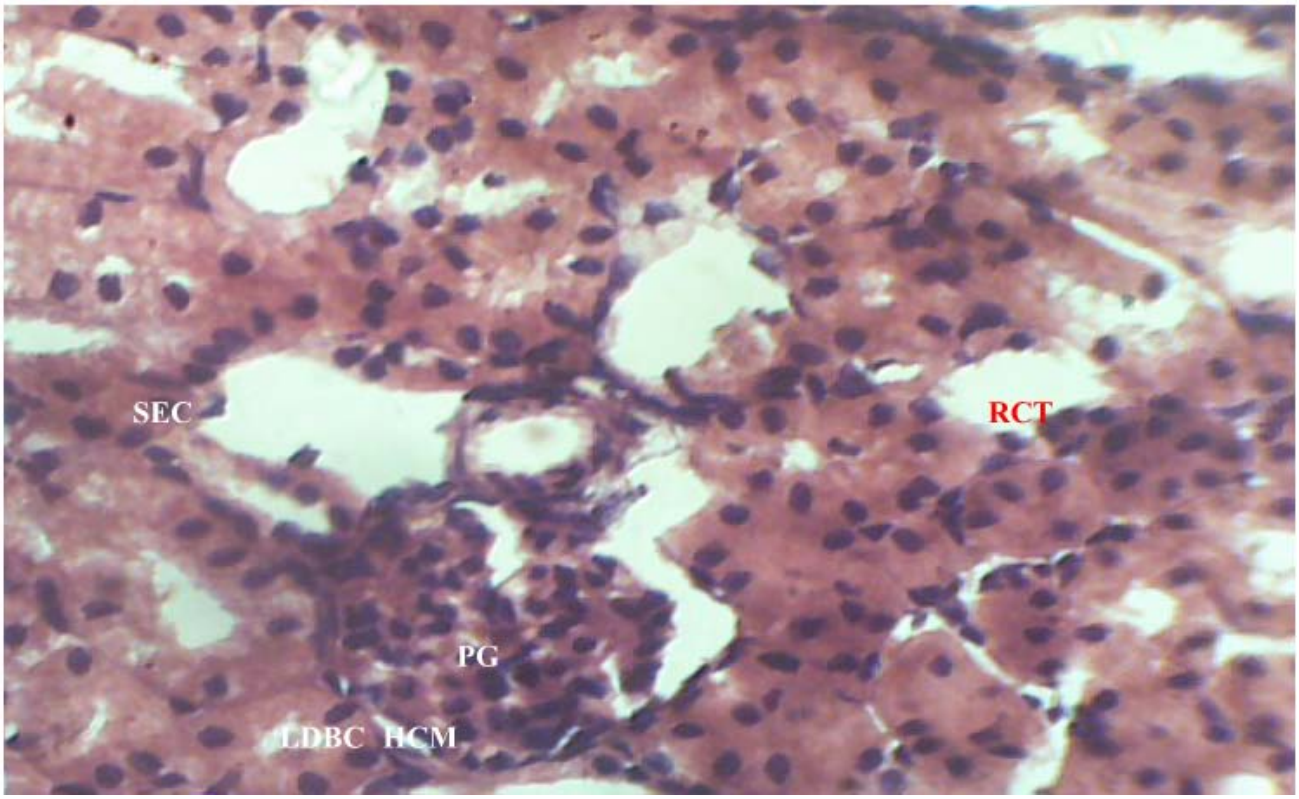


*Plate 7 :* Photomicrograph of the renal cortex of Wistar rat 2 hours after injection of 0.16ml of ultravist. H&E stain, X400

**SEC** – Swollen epithelial cells **LDBC** – Less distinct Bowman space **HCM** – Hypercellularmesangium
**RCT** – Renal cortical tubule

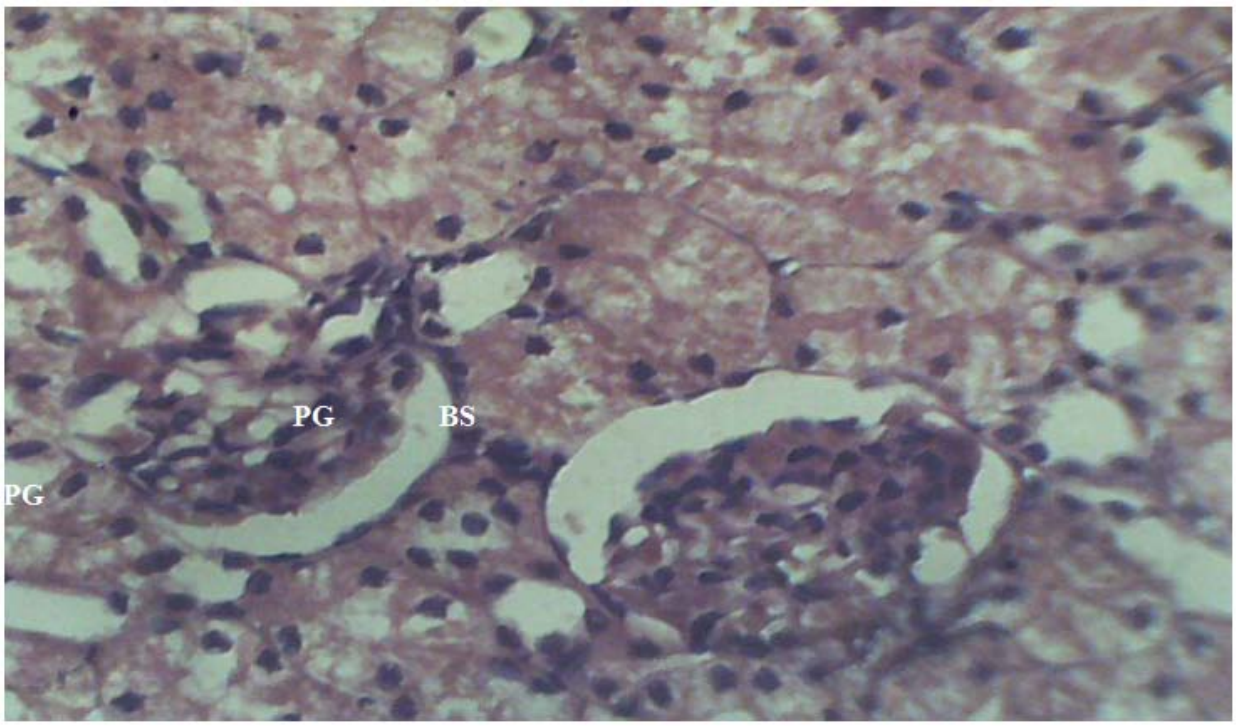


*Plate 8 :* Photomicrograph of the renal cortex of Wistar rat 24 hours after injection of 0.30ml of ultravist. H&E stain, X400.

**PG –** Prominent glomerulus **BS** – Bowman space.

This page is intentionally left blank