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RESEARCH ARTICLE

Postmortem Histological Sequential Changes In Human Renal Vessels And Pelvis Of Ureter Up To Thirteen Hours Post Mortem Interval.

Yogita Kanwar [1], Meena Goyal[2] ,Bichitrananda Roul[3]

1. IIIrd Yr P.G.,Dept of Anatomy,Pt.J.N.M.Medical College,Raipur
2. Professor & Head ,Dept of Anatomy,Pt.J.N.M.Medical College,Raipur
3. Assistant Professor ,Dept of Anatomy,Pt.J.N.M.Medical College,Raipur

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Corresponding Author

Bichitrananda Roul

Abstract

This study was performed in Department of Anatomy in close association with the Department of Forensic Medicine & Toxicology Pt.J.N.M.Medical college and Dr. B.R.Ambedkar Memorial Hospital Raipur (C.G.).Present study was done on human cadaver. Material for the present study was renal vessels and pelvis of ureter, taken directly from the dead bodies during postmortem examination.Human renal vessels and pelvis of ureter was obtained as and when available from cadavers at the time of autopsy. It was removed from cadavers with a known time of death where death had resulted from accident. The stages for which it was available were temperature between14.8/25.1-27.6/42.2^{0}C,humidity between 17/53 to 75/95% and duration range was between 4hr30min to 13hr. In the present study 11 cases were studied. In each case renal vessels and pelvis of ureter were studied histologically. The renal artery (tunica intima, media, adventitia), renal vein(tunica intima, media, adventitia) and pelvis of ureter (transitional epithelium, muscle layer, fibrous layer) were studied. In this study increase in the rate of postmortem histological sequential changes were found to be increased with rise in the temperature and duration. In the preasent study earliest remarkable sequntial postmotem histological changes were seen after PMI 4hrs 30 mins (T 23.9/33.4 ^{0}C) in transitional epithelium of pelvis of ureter and tunica adventitia of renal vein. In the present study sequential postmortem histological changes of renal vessels and pelvis of ureter were studied. Retraction of epithelium from basement membrane and its disruption with darkening of nuclei of endothelial cell and loss of endothelial cells were observed in tunica intima of renal vessels. Appearance of clear spaces between smooth muscle fibres, broken smooth muscle fibres, nuclear pyknosis, karyorrhexis and loss of architecture were observed in tunica media of renal vessels. Various degree of loss of adventitial tissue (i.e. mild, moderate,moderate to severe,severe) and disruption of collagen fibres with loss of architecture were observed in tunica adventitia of renal vessels. Retraction and disruption of epithelium with individualization of cells, nuclear pyknosis, karyolysis and loss of epithelial architecture were observed in transitional epithelium of pelvis of ureter. Post-mortem histological changes are directly dependent not only on the length of post-mortem time but also to a bigger extent on the temperature of environment. The rate of autolysis varies with environmental temperature, body size, nutritional status, pelage.The changes were found to be irregular in some cases. In the present study it was observed that sequential postmortem histological changes were different in some cases of same duration. The main reason lies in the fact that there are an extreme number of factors, which influence the post-mortem

degradation of tissue in each case. The rate of cellular degradation is increased by large carcass size, excessive adipose tissue, thick fur or wool and antemortem hyperthermia caused by pyrexia violent exercise or heat exhaustion

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INTRODUCTION

After death due to deprivation of blood supply, every organ under goes series of gross as well as histological changes. Most of the organ in human body undergoes coagulative necrosis, cell swelling, cell membrane disruption, staining changes in cytoplasm, enzymatic digestion of cellular organelles, nuclear changes like pyknosis, karyorrhexis and karyolysis etc. Histomorphologically, the autolysis represents the intra vital or post mortal disintegration of living structures, and biochemically corresponds to a loss in the system of metabolic balance with demotion of the metabolic substance which results in energy and material loss. Autolysis matches with the activity of certain enzyme called autolytic enzyme, proved in lysosomes of living cells, which after death lead to the destruction of their own cell components. Those enzymes disintegrate intracellular material, including organelles very quickly, so the cytoplasm becomes of homogenic looks and intensively eosinophilic, which culminates with a loss of cell details and tissue architecture.[1,2,3,4]

Autolysis is digestion of tissues by their own cellular hydrolytic enzymes.[5] The rate of autolysis varies with environmental temperature, body size, nutritional status, pelage and existing disease conditions. Autolytic changes proceed rapidly at 37^0C, corresponding to the temperature optimum for mammalian enzymes.[6] Therefore the rate of cellular degradation is increased by warm weather large carcass size, excessive adipose tissue thick fur or wool and antemortem hyperthermia caused by pyrexia violent exercise, or heat exhaustion. Conversely cooling of a carcass slows the autolytic process. Body tissues are affected by autolysis at variable rates depending on sensitivity of their cells to anoxia and cellular concentration of proteolytic enzymes. Renal proximal convoluted tubules and adrenal medulla are tissue reported to be rapidly altered.[7,8]

The histological studies on various tissues after death have been mostly confined to single organ or tissue by individual workers at different atmospheric conditions. Moreover very few workers works based on histological studies of postmortem tissue changes appears to have been undertaken by Indian and more so in Utter Pradesh. Since only a single organ was studied by most workers, any comparative evaluation of the varying rate of decomposition of the different organs and tissues can not be made out. In this study control cannot be taken because the histological changes of tissue after death is influenced a great deal by atmospheric temperature and humidity besides other external and internal factors.So in this study random sampling is done.

In Urinary Bladder the transitional epithelium showed early sign of fragility at 24 hr. Detachment of the epithelium progressed during the following two days, leaving a single layer of triangular and spike-shaped cells by day three. Only small areas of epithelium were found at day seven all the epithelium had been lost by three weeks.[9]

The Heart and Great Vessels the heart becomes flabby, and may contain coagulated plasma separated from the red components of blood. The endocardial surfaces and the intima of great vessels may show reddish discolouration following haemoglobin imbibition.[10]

Aortic Changes after death, the aorta shrunk at all levels, and became oval in shape in descending thoracic and abdominal aorta. The contraction was greater in younger cases than older cases.[11] Till now postmortem histological changes have been studied on muscles, kidney, liver, RBCs, WBCs etc of various animals. A few of studies also performed for same purpose on various organs of human beings.[12] The histological changes in kideny & pelvis of ureter after death have been studied in various animals but yet studies with same view which may provide keen and fruitful results for human renal blood vessels & pelvis of ureter have not been done. That's why this present study is being carried out with this hope that it will be helpful for estimation of various postmortem histological sequential changes in human renal vessels and pelvis of ureter.

MATERIAL AND METHOD

This study was performed in Department of Anatomy in close association with the Department of Forensic Medicine & Toxicology Pt.J.N.M.Medical college and Dr. B.R.Ambedkar Memorial Hospital Raipur (C.G.).Present study was done on human cadaver. Material for the present study was renal vessels and pelvis of ureter, taken directly from the dead bodies during postmortem examination.

Human renal vessels and pelvis of ureter was obtained as and when available from cadavers at the time of autopsy. It was removed from cadavers with a known time of death where death had resulted from accident. The stages for which it was available were temperature between14.8/25.1-27.6/42.2^{0}C,humidity between 17/53 to 75/95% and duration range was between 4hr30min to 13hr.

In the present study 11 cases were studied. In each case renal vessels and pelvis of ureter were studied histologically.

MATERIALS REQUIRED FOR THE STUDY

Materials required are :-

1. Renal vessels and pelvis of ureter of 30 dead bodies.
2. Plastic jars.
3. 10% formalin.
4. Scalpel,fine forceps,blunt forceps.
5. Alcohol of graded % - 70%,80%,95%,100%
6. Xylene
7. Paraffin
8. Materials required for H & E Stain.

INCLUSION CRITERIA

The selection of cases were based on following criteria-

1. Deceased registered in Department of Forensic Medicine & Toxicology.
2. Deceased without any history or evidence of any vascular & renal disorder.
3. The exact time of death of individual must be known.
4. Consent from Department of Forensic Medicine & Toxicology as well as from the attendant of dead individual taken before renal vessel & pelvis of ureter biopsy.
5. All road traffic accident cases were taken into account.

EXCLUTION CRITERIA

1. Deceased of unknown time of death and diseased renal vessels & kidney.
2. Deceased individual suffering from vascular diseases, hypertension, diabetes mellitus etc.
3. Burn and poisoning cases.

Total 11 cases of different age and sex were selected.The environmental temperature in ^{0}C [minimum/maximum] and humidity in % [minimum/maximum] was recorded from "India Meteorological Department, Meteorological Centre Raipur". After collection of kidney from mortuary it was transported in 10% formalin solution for 48 hrs for fixation. Small pieces or block of renal vessels & pelvis of ureter tissues were taken and processed by the routine methods for histological examination.

OBSERVATION

Post mortem histological changes in human renal vessels and pelvis of ureter.

STUDY NO:-1.

Post mortem interval (PMI)- 4hrs 30 mins Temperature-23.9/33.4 ^{0}C , humidity-75/95%

H& E staining

A)Renal artery:

Tunica intima:Slightly separated from basement membrane. ,Endothelial cells are seen at few places.

Tunica media-Clear spaces are seen between smooth muscle fibres at places.,Peripheral dark stained nuclei are seen ,Fibres are broken at places.

Tunica adventitia-Adhered to tunica media. ,Lamellar structure of collagen fibres are seen.

B)Renal vein

Tunica intima-Adhered to basement membrane.,Endothelial cells are seen at few spaces.

Tunica media-Clear spaces are seen at few places. ,Peripheral dark stained nuclei are seen and some dark stained nuclei are also seen.

Tunica adventitia- Mild loss of adventitial tissue. ,Clear spaces are seen between smooth muscle fibre at places with ,pyknotic nuclei.

C)Pelvis of ureter

Transitional epithelium

- Architecture is maintained.

-Retraction of epithelium and it is disrupted at few places. -Peripheral dark stained nuclei are seen, pyknotic changes are hardly seen.

Muscle layer-Architecture is disturbed.,Clear spaces are seen between smooth muscle fibres at most of places,Shrunken & broken muscle fibres are seen.,Pyknotic nuclei are seen.

Fibrous layer-Slightly retracted from muscle layer.,Pyknotic changes are seen.,Fibers are broken at most of places.

STUDY NO:-2.

Post mortem interval (PMI)- 5hrs Temperature-18.1/34.6 ^{0}C , humidity-20/42%

H& E staining

A)Renal artery:

Tunica intima-Slightly separated from basement membrane,Oedematous endothelial cells are seen at few places.

Tunica media-Clear spaces are seen between smooth muscle fibres at places.,Nuclei are not clearly seen ,Fibres are broken at places.

Tunica adventitia-Adhered to tunica media. ,Lamellar structure of oriented collagen fibres are seen.

B)Renal vein

Tunica intima -Adhered to basement membrane.,Endothelial cells are seen at few spaces.

Tunica media-Clear spaces are seen between smooth muscle fibres at places,Nuclei are not visible clearly,Fibres are broken at places.

Tunica adventitia -Mild loss of adventitial tissue. ,Clear spaces are seen between smooth muscle fibre at places with pyknotic nuclei.

C)Pelvis of ureter

Transitional epithelium --Architecture is somewhat maintained.,Retraction & disruption of epithelium at places.Pyknotic changes are seen.,Cell outline is not clear.

Muscle layer-Architecture is somewhat maintained,Clear spaces are seen between smooth muscle fibres at places.Broken muscle fibres are seen at places.,Dark stained nuclei are seen.

Fibrous layer -Fibrous layer is retracted & disrupted at most of places,Nuclei are not visible.

STUDY NO:-3.

Post mortem interval (PMI)- 6hrs15mins Temperature-28.1/39.3 ^{0}C , humidity-59/74%

H& E staining

A)Renal artery:

Tunica intima- Slightly separated from basement membrane.Oedematous endothelial cells are seen at few places.

Tunica media-Clear spaces are seen between smooth muscle fibres at places.,Peripheral dark stained nuclei are seen ,Fibres are broken at places.

Tunica adventitia -Adhered to tunica media.,Lamellar structure of oriented collagen fibres are seen.

B)Renal vein

Tunica intima -Adhered to basement membrane,Endothelial cells are seen at few spaces.

Tunica media-Clear spaces are seen between smooth muscle fibres at places ,Peripheral dark stained nuclei are seen,Fibres are broken at places.
Tunica adventitia -Mild to moderate loss of adventitial tissue.,Clear spaces are seen between smooth muscle fibre at places with pyknotic nuclei.
C)Pelvis of ureter
Transitional epithelium -Architecture is somewhat maintained,Disruption of epithelium at places,Perpheral dark stained nuclei are seen,Pyknotic changes are also seen.
Muscle layer-Architecture is somewhat maintained,Clear spaces are seen between smooth muscle fibres at places,Broken muscle fibres are seen at places.,Peripheral dark stained & some dark stained nuclei are seen.
Fibrous layer-Slightly retracted from muscle layer,Pyknotic nuclei are seen,Fibres are broken at places.
STUDY NO:-4.
Post mortem interval (PMI)- 6hrs50mins Temperature-14.8/25.1 ^{0}C , humidity-30/59%
H& E staining
A)Renal artery:
Tunica intima- Adhered to basement membrane,Oedematous endothelial cells are seen at places.
Tunica media-Clear spaces are seen between smooth muscle fibres at places.,Vesicular and some peripheral dark stained nuclei are seen ,Fibres are broken at places.
Tunica adventitia -Adhered to tunica media.,Lamellar structure of oriented collagen fibres are seen.
B)Renal vein
Tunica intima -Adhered to basement membrane.Oedematous endothelial cells are seen at few spaces.

Tunica media
-Clear spaces are seen between smooth muscle fibres at places -nuclei are not visible.Fibres are broken at places.
Tunica adventitia -Mild loss of adventitial tissue. ,Clear spaces are seen between smooth muscle fibre at places with pyknotic nuclei.
C)Pelvis of ureter
Transitional epithelium -Architecture is maintained.,Disruption of epithelium at places.Dark stained nuclei are seen.Some pyknotic nuclei are also seen.
Muscle layer-Architecture is maintained.Clear spaces are seen between smooth muscle fibres at places.Broken muscle fibres are seen at places.Peripheral dark stained & some dark stained nuclei are seen.
Fibrous layer-Retracted from muscle layer.Pyknotic nuclei are seen.Fibres are broken at places.
STUDY NO:-5.
Post mortem interval (PMI)- 8hrs10mins Temperature-21.2/28.6 ^{0}C , humidity-47/77%
H& E staining
A)Renal artery:
Tunica intima-Adhered to basement membrane.Endothelial cells are seen at places.
Tunica media-Clear spaces are seen between smooth muscle fibres at places.Dark stained nuclei are seen .Fibres are broken at places.
Tunica adventitia -Adhered to tunica media. Lamellar structure of oriented collagen fibres are seen.
B)Renal vein
Tunica intima -Retraction & disruption of tunica intima is seen.Endothelial cells are hardly visible.
Tunica media-Clear spaces are seen between smooth muscle fibres at most of places.Dark stained nuclei are seen.Some pyknotic nuclei are also seen.Fibres are broken at places.
Tunica adventitia -Mild to moderate loss of adventitial tissue. Clear spaces are seen between smooth muscle fibre at places with pyknotic nuclei.
C)Pelvis of ureter
Transitional epithelium -Architecture is somewhat maintained.Retraction of epithelium at places.Pyknotic & some karyoractic nuclei are also seen.
Muscle layer-Architecture is disturbed.Clear spaces are seen between smooth muscle fibres at most of places.Broken muscle fibres are seen at most of places.Pyknotic nuclei are seen.
Fibrous laye- Retracted & disrupted at places.Pyknotic nuclei are seen.Fibres are broken at places.
STUDY NO:-6.
Post mortem interval (PMI)- 10hrs15mins Temperature-32.0/38.5 ^{0}C , humidity-46/48%
H& E staining
A)Renal artery:

Tunica intim-Tunica intima is adhered to basement membrane.Endothelial cells with dark stained are seen at places.
Tunica media--Clear spaces are seen between smooth muscle fibres at places.Dark stained nuclei are seen .Fibres are broken at places.
Tunica adventitia -Tunica adventitia is adhered to tunica media. Lamellar structure of oriented collagen fibres are seen.
B)Renal vein
Tunica intima -Retraction of tunica intima is seen at places.Endothelial cells are seen at places.

Tunica media-Clear spaces are seen between smooth muscle fibres at places.Pyknotic nuclei are seen.Fibres are broken at places.
Tunica adventitia -Moderate loss of adventitial tissue. Clear spaces are seen between smooth muscle fibre at most of places with pyknotic nuclei.
C)Pelvis of ureter
Transitional epithelium -Architecture is disturbed.Retraction & disruption of epithelium at places.Dark stained nuclei are seen.Individualization of epithelial cells is seen.
Muscle layer-Architecture is disturbed.Clear spaces are seen between smooth muscle fibres at most of places.Broken muscle fibres are seen at most of places.Some pyknotic nuclei are seen.
Fibrous layer-Architecture is disturbed.Fibrous layer is retracted & disrupted at most of places.Pyknotic nuclei are seen.Fibres are broken at places.
STUDY NO:-7.
Post mortem interval (PMI)- 10hrs35mins Temperature-23.6/29.2 0C , humidity-86/91%
H& E staining
A)Renal artery:
Tunica intima-Tunica intima is adhered to basement membrane.Endothelial cells with dark stained are seen at places.
Tunica media-Clear spaces are seen between smooth muscle fibres at places.Peripheral dark stained nuclei are seen.Some dark stained nuclei are also seen .Fibres are broken at places.
Tunica adventitia -Tunica adventitia is adhered to tunica media. Lamellar structure of oriented collagen fibres are seen.
B) Renal vein
Tunica intima -Tunica intima is adhered to basement membrane. Endothelial cells are seen at places.

Tunica media-Clear spaces are seen between smooth muscle fibres at places.Pyknotic nuclei are seen.Fibres are broken at places.
Tunica adventitia -Moderate loss of adventitial tissue. Clear spaces are seen between smooth muscle fibre at most of places with pyknotic nuclei.
C)Pelvis of ureter
Transitional epithelium -Architecture is disturbed.Retraction of epithelium at places.Peripheral dark stained nuclei are seen.
Muscle layer-Architecture is disturbed.Clear spaces are seen between smooth muscle fibres at places.Broken muscle fibres are seen at places.Pyknotic nuclei are seen.
Fibrous layer-Architecture is disturbed.Fibrous layer is retracted at places.Pyknotic nuclei are seen.Fibres are broken at places.
STUDY NO:-8.
Post mortem interval (PMI)- 12hrs
Temperature-29.1/37.8 ^{0}C, humidity-50/63%
H& E staining
A)Renal artery:
Tunica intima-Retracted from basement membrane.Oedematous endothelial cells with dark stained are seen at places.
Tunica media-Clear spaces are seen between smooth muscle fibres at most of places.Pyknotic nuclei are seen .Fibres are broken at most of places.
Tunica adventitia -Slightly retracted from tunica media. Mild disruption of lamellar organization of collagen fibres are seen.
B)Renal vein

Tunica intima -Adhered to basement membrane.Endothelial cells are seen at places.
Tunica media-Clear spaces are seen between smooth muscle fibres at places.Dark stained nuclei are seen.Pyknotic changes are also seen.Fibres are broken at places.
Tunica adventitia -Moderate loss of adventitial tissue. Clear spaces are seen between smooth muscle fibre at places with dark stained nuclei.
C)Pelvis of ureter-Transitional epithelium .Architecture is disturbed.Retraction & disruption of epithelium at most of places.Peripheral dark stained nuclei are seen.Dark stained nuclei are also seen.
Muscle layer-Architecture is disturbed.Clear spaces are seen between smooth muscle fibres at most of places.Broken muscle fibres are seen at most of places.Some pyknotic nuclei are seen.
Fibrous layer-Architecture is disturbed.Fibrous layer is retracted & disrupted at most of places.Pyknotic nuclei are seen.Fibres are broken at places.
STUDY NO:-9.
Post mortem interval (PMI)- 12hrs10mins
Temperature-25.4/38.8 ^{0}C , humidity-25/57%
H& E staining
A)Renal artery:
Tunica intima-Tunica intima is retracted from basement membrane at places.Oedematous endothelial cells with dark stained are seen at places.
Tunica media-Clear spaces are seen between smooth muscle fibres at most places.Pyknotic nuclei are seen .Fibres are broken at places.
Tunica adventitia -Adhered to tunica media. Moderate disruption of lamellar organization of collagen fibres are seen.
B)Renal vein
Tunica intima -Tunica intima is adhered to basement membrane.Endothelial cells are not clearly visible.
Tunica media-Clear spaces are seen between smooth muscle fibres at most of places.Pyknotic changes are seen.Fibres are broken at most of places.
Tunica adventitia -Moderate loss of adventitial tissue. Clear spaces are seen between smooth muscle fibre at most of places with pyknotic nuclei.
C)Pelvis of ureter
Transitional epithelium-Shedding of epithelium is seen.Only 1 to 2 layer of epithelial cells are seen. Pyknotic nuclei are seen.
Muscle layer-Architecture is disturbed.Clear spaces are seen between smooth muscle fibres at most of places.Broken muscle fibres are seen at most of places.Some pyknotic nuclei are seen.
Fibrous layer-Architecture is disturbed.Fibrous layer is retracted.Pyknotic nuclei are seen.Fibres are broken at most of places.
STUDY NO:-10.
Post mortem interval (PMI)- 12hrs20mins
Temperature-24.9/39.4 ^{0}C , humidity-17/53%
H& E staining
A)Renal artery:
Tunica intima-- Adhered to basement membrane.Oedematous endothelial cells with dark stained are seen at places.
Tunica media-Clear spaces are seen between smooth muscle fibres at most of places.Pyknotic nuclei are seen .Fibres are broken at places.
Tunica adventitia -Retracted from tunica media. Moderate to severe disruption of lamellar organization of collagen fibres are seen.Fibres are broken at most of places.
B)Renal vein
Tunica intima -Disruption of tunica intima is seen at places.Endothelial cells are not clearly visible.
Tunica media-Clear spaces are seen between smooth muscle fibres at most of places.Nuclei are not clearly visible.Fibres are broken at most of places.

Tunica adventitia -Architecture is disturbed.Moderate to sever loss of adventitial tissue. Clear spaces are seen between smooth muscle fibre at most of places with Pyknotic nuclei.
C)Pelvis of ureter

Transitional epithelium-Architecture is severely disturbed.Retraction & disruption of epithelium at most of places.Dark stained nuclei are seen.Pyknotic changes are also seen.Some epithelial cells are anucleated.Cell outline is not clear.
Muscle layer-Architecture is disturbed.Clear spaces are seen between smooth muscle fibres at most of places.Broken muscle fibres are seen at most of places.Nuclei are not visible.
Fibrous layer- Retracted widely from muscle layer.Pyknotic nuclei are seen.Fibres are broken at most of places.
STUDY NO:-11.
Post mortem interval (PMI)- 13hrs
Temperature-23.9/38.7 ^{0}C, humidity-17/53%
H& E staining
A)Renal artery:
Tunica intima-Adhered to basement membrane.Endothelial cells with dark stained are seen at places.
Tunica media-Clear spaces are seen between smooth muscle fibres at places.Dark stained nuclei are seen .Fibres are broken at places.
Tunica adventitia - Retracted from tunica media. Moderate to severe disruption of lamellar organization of collagen fibres are seen.Fibres are broken at most of places. B)Renal vein
Tunica intima -Disruption of tunica intima is seen at places.Oedematous endothelial cells are seen at places.

Tunica media-Architecture is disturbed.Clear spaces are seen between smooth muscle fibres at most of places.Pyknotic nuclei are seen.Fibres are broken at most of places.
Tunica adventitia -Architecture is disturbed.Moderate loss of adventitial tissue is seen.Tunica adventitia is retracted from tunica media.Cell outline is not clear.Nuclei are not visible.
C)Pelvis of ureter
Transitional epithelium-Architecture is disturbed.Retraction & disruption of epithelium at most of places.Pyknotic changes are seen.Some epithelial cells are anucleated.Cell outline is not clear.
Muscle layer-Architecture is severly disturbed.Clear spaces are seen between smooth muscle fibres at most of places.Broken muscle fibres are seen at most of places.Nuclei are not visible.
Fibrous layer- Retracted from muscle layer.Pyknotic nuclei are seen.Fibres are broken at most of places.

DISCUSSION

After death, when blood circulation stops, cells can no longer obtain the elements required for normal functioning and waste which is no longer eliminated, accumulates in the cell. Synthetic phenomena are interrupted while lysis of both the reserves accumulated in the cell and the cell itself takes over. The result is the start of irreversible disintegration and progressive tissue dissociation characteristic of autolysis.

The pH of the cells falls from 7.2 to 6.8 after a few minutes, to 6.7 after 4 hours, and to 6.4 after 24 hours. These changes in pH are brought about by chemical changes together with phosphoric acid and lactic acid formation. They are accompanied by major modifications of the cells, which can be observed by macroscopic and then by microscopic examination of the tissues. These aspects of autolysis vary with the conditions under which autolysis has taken place, with the time since death and also with the organ examined. (**F.M.Oliveria**)[30]

Autolysis is normally associated with autopsies and recognition of the phenomenon is very important,[31,32] to elucidate forensic cases. Thus autolytic changes have been investigated by forensic pathologists, because they may assist in determining the time of death, especially in the first few hours.[33] Although postmortem autolysis depends on various factors, the most important factor is the postmortem period.[19,34]

Moriyama et al.[28](2001) examined functional, metabolic, and histological changes in the aortic tissue of rats after the period of warm ischemia ranging from 0 to 24 hours to determine the window of time in which grafts can be optimally viable for harvest.Typical histological aortic structure was retained in the control tissues. Histological examination of all vessels after warm ischemia showed a greater loss of smooth muscle and endothelial cells than vessels examined immediately after death. After 6 hours of warm ischemia, slight separation of the elastic fibers and focal vacuolation were seen sporadically in some specimens, but these changes were not widespread. After 9 hours of warm ischemia pyknotic nuclei and shrunken smooth muscle cells were seen, but these also were not widespread.

Takahashi N, Higuchi T, Hirose Y, Yamanouchi H, Takatsuka H, Funayama K [11]found in aorta after death, the aorta shrunk at all levels and became oval in shape in descending thoracic and abdominal aorta. The contraction was greater in younger cases than older cases.

Hyodoh H, Sato T, Onodera M, Washio H, Hasegawa T, Hatakenaka M[39] found in postmortem images, the aortic diameter decreased and changes in the size and shape of the superior vena cava (SVC) were noted. The inferior vena cava (IVC) did not exhibit significant postmortem change.

In aorta their are formation of clear and pale staining areas between elastic laminae (<20min), darkening and condensation of smooth muscle nuclei (16hrs). In heart their are condensation and darkening of endothelial nuclei (20min), formation of interfibre clear spaces in muscle (40min). In the kidney their is separation and sloughing of pelvic urothelium (4hrs), and majority of glomerular cell nuclei are pyknotic (8hrs). In urinary bladder their is formation of vacuoles in transitional epithelium (<20min), formation of interfibre clear spaces and pyknosis of myofibre nuclei (1hr), disruption and sloughing of surface transitional epithelium (4hrs).**(Hand book of Toxicology, 2nd Edition)**[35]

The transitional epithelium showed early signs of fragility at 24 h. Detachment of the epithelium progressed during the following two days leaving a single layer of triangular and spike-shaped cells by day three. Only small areas of epithelium were found at day seven and all the epithelium had been lost by three weeks.**[M. Erlandsson et.al. [29](2007)]**

Deborah Barber[20] found in Porcine kidney after 3 Hours at 4^0C in glomeruli-Bowman's space of some glomeruli was reduced or obliterated in all specimens, proximal convulated tubule(PCT)the number of obliterated lumens was minimal.distal convulated tubule(DCT)epithelial cells of the distal convoluted tubules started retracting off the basement membrane. Most tubules were affected in all specimens. Individualization of retracted cells occur in nearly all DCT within 3 hours,CT-epithelium of collecting tubules were slightly retracted off basement membrane. After 3 Hours 24^0C in glomeruli had narrowed or obliterated Bowman's spaces, PCT-a moderate number of lumens of were obliterated due to cellular swelling, DCT-the epithelial cells were extensively retracted off the basement membranes, CT-moderate numbers of CT epithelial cells started retracting off basement membranes, pyknosis was noted occasionally, individualization of sloughed cells was seen within a few tubules.

Ismait kati[36] found after 3 hrs mild tubular atrophy, necrosis and fibrin deposition in the glomeruli. **Tomita et al**[19] found slight clumping of nuclear chromatin and distal tubules 3 hrs after death in wistar rats. In the present study after 4 hrs 30 mins postmortem interval (PMI) at temperature (T23.9/33.4^{0}C)tunica intima of renal artery showed slight separation from basement membrane and endothelial cells were seen at few places. In tunica media clear spaces were seen between smooth muscle fibres at places. At places peripheral dark stained nuclei were seen in tunica media, smooth muscle fibres were broken at places. Tunica adventitia was adhered to tunica media and lamellar structure of collagen fibres were seen. In renal vein tunica intima was adhered to basement membrane and few endothelial cells were seen . In tunica media clear spaces were seen at few places, peripheral dark stained nuclei were seen mostly and some dark stained nuclei were seen also.In tunica adventitia there was mild loss of adventitial tissue and clear spaces were seen between smooth muscle fibres at places with pyknotic nuclei. In pelvis of ureter transitional epithelium was retracted and disrupted at places with peripheral dark stained nuclei, pyknotic changes are hardly seen. In muscle layer clear spaces were seen between smooth muscle fibres at most of places along with broken muscle fibres, pyknotic nuclei and disturbed architecture. The fibrous layer was slightly retracted from muscle layer, fibers were broken at most of places with pyknotic nuclei.

Deborah Barber[20] found in Porcine kidney after 6 hours at 4^0C in glomeruli having obliterated Bowman's space due to swellings of the glomerular tufts,visceral and pariental layer of the capsules, PCT-the number of obliterated lumen became marked. After 6 hours at 24^0C in glomeruli-the glomerular tufts were swollen and almost obliterated Bowman's spaces. Vessels within the tufts were visible and the nuclei were round to ovoid. PCT-nearly all tubular lumens were obliterated by cellular swelling. Brush borders were indistinct but still visible. Nuclei were vesicular and enlarged. DCT-most of the cells had sloughed off the basement membrane and formed cellular debris within the lumen. Few cells remained in contact with the basement membranes.

Rajni Thakur [37]observed in kidney at 6 hrs PMI (18.5 /33.3^{0}C)- retraction of epithelium in PCT and DCT. In present study at (PMI)-6hrs15mins (T-28.1/39.3 ^{0}C),the tunica intima of renal artery showed slightly separation from basement membrane and oedematous endothelial cells were seen at places. In tunica media clear spaces were seen between smooth muscle fibres at places. At places peripheral dark stained nuclei were seen in tunica media, fibres were broken at places. The tunica adventitia was adhered to tunica media and lamellar structure of collagen fibres were seen. In renal vein tunica intima was adhered to basement membrane and endothelial cells were seen at places. In tunica media clear spaces were seen between smooth muscle fibres at places. Peripheral dark stained nuclei were seen in tunica media, fibres were broken at places. In tunica adventitia mild to moderate loss of adventitial tissue and clear spaces between smooth muscle fibre at places with pyknotic nuclei were seen. In pelvis of ureter the transitional epithelium disrupted at places with peripheral dark stained nuclei. Pyknotic changes in nuclei were also seen .In muscle layer clear spaces were seen between smooth muscle fibres at places. Muscle fibres were broken at places with peripheral dark stained & some dark stained nuclei .The fibrous layer was slightly retracted from muscle layer, fibres were broken at places with pyknotic nuclei . At (PMI) 6hrs50mins (T14.8/25.1 ^{0}C),in renal artery tunica intima was adhered to basement membrane while it was separated at (PMI) 6hr15mins(T28.1/39.3 ^{0}C).In tunica media clear spaces were seen between smooth muscle fibres at places, along with peripheral dark stained nuclei and vesicular nuclei were seen. The tunica adventitia was adhered to tunica media and lamellar structure of collagen fibres were seen. In renal vein, tunica intima showed oedematous endothelial cells and it was adhered to basement membrane. In tunica media clear spaces were seen between smooth muscle fibres at places but nuclei were not visible. In tunica adventitia mild loss of adventitial tissue and pyknotic changes were seen. In Pelvis of ureter the transitional epithelium disrupted at places with dark stained nuclei and pyknotic nuclei were also seen. In muscle layer architecture was maintained and clear spaces were seen between smooth muscle fibres at places, muscle fibres were broken at places with peripheral dark stained nuclei. Some dark stained nuclei were seen. The fibrous layer was retracted from muscle layer. Fibres weres broken at places with pyknotic nuclei.

Rajni Thakur[37] found at 8.30hrs PMI (9.8/26.3^{0}C) in PCT dark stained nuclei and vesicular nuclei were almost equal while in DCT number of vesicular nuclei were more than dark stained nuclei. In present study at (PMI) 8hrs10mins (T-21.2/28.6 ^{0}C),in renal artery tunica intima was adhered to basement membrane and endothelial cells were seen at places. In tunica media clear spaces were seen between smooth muscle fibres at places. Dark stained nuclei were seen in tunica media. Fibres were broken at places. Tunica adventitia was adhered to tunica media and lamellar structure of collagen fibres were seen. In renal vein tunica intima was retracted & disrupted, endothelial cells were hardly visible. In tunica media clear spaces were seen between smooth muscle fibres at most of places. Dark stained and some pyknotic nuclei were also seen. Fibres were broken at places. In tunica adventitia their were mild to moderate loss of adventitial tissue. Clear spaces were seen between smooth muscle fibre at places and pyknotic nuclei were seen also. In pelvis of ureter the transitional epithelium was retracted at places with pyknotic nuclei & some karyorrhectic nuclei were also seen. In muscle layer architecture was disturbed. Clear spaces were seen between smooth muscle fibres at most of places. Pyknotic nuclei in muscle layer. Muscle fibres were broken at most of places. Fibrous layer was retracted & disrupted at places with pyknotic nuclei. Fibres were broken at places.

Tomita Y et al.[4] observed in wistar rat at 10hrs PMI(23^{0}C) edema in the proximal tubules, condensation of nuclear chromatin and edema in distal tubules and atrophy of acinar cells in the pancreas.

Leticia Rodrigues et al[33] observed in sublingual gland at 12hrs, almost all the acini presented intermediary stage of autolysis, despite the external limits remaining well defined. Some nuclei presented karyorrhexis and others were pyknotic and hyperchromatic due to high chromatin condensation. Bryant BH et al observed in testis at 12hrs postmortem, clumping and margination of chromtin in leyding cells.Kushwaha et al observed kidney in first 12hrs at temperature range 26-30^{0}C, there was mild cloudy swelling in cytoplasm, some cases show severe changes. **Rajni thakur**[37] found at 12.30hrs PMI(24.5/38.1^{0}C)in PCT retraction of epithelium with vesicular as well as darkly stained nuclei and edematous epithelial cells were also found.

Deborah Barber[20] found in Porcine kidney at 12 Hours 4^{0}C in glomeruli-Bowman's space of glomeruli was reduced,DCT- Most of the cells had sloughed off the basement membrane and formed cellular debris within the lumen but few cells remained in contact with the basement membranes, lumens were nearly obliterated by cellular debris, indistinct cellular outlines cytoplasmic strands and pyknotic nuclei characterize the tubular

debris.At12 Hours 24^{0}C in PCT-Patent lumens were again visible and all contained some noncellular debris. Brush borders were present. The cytoplasm was finely granular and was starting to retract off the basement membranes. Nuclei were hyperchromatic to pyknotic. In present study at (PMI) 10hrs15mins (T-32.0/38.5 ^{0}C),in renal artery tunica intima was adhered to basement membrane. Endothelial cells with dark stained were seen at places. In tunica media clear spaces were seen between smooth muscle fibres at places. Dark stained nuclei were seen in tunica media. Fibres were broken at places. Tunica adventitia was adhered to tunica media and lamellar structure of collagen fibres were seen. In renal vein retraction of tunica intima was seen at places and endothelial cells were seen at places. In tunica media clear spaces were seen between smooth muscle fibres at places. Pyknotic nuclei were seen in tunica media. Fibres were broken at places. In tunica adventitia their was moderate loss of adventitial tissue and clear spaces were seen between smooth muscle fibre at most of places with pyknotic nuclei. In pelvis of ureter architecture of transitional epithelium was disturbed with retracted & disrupted epithelium at places. Individualization of epithelial cells with dark stained nuclei were seen. In muscle layer architecture was disturbed and clear spaces were seen between smooth muscle fibres at most of places. Muscle fibres were broken at most of places with some pyknotic nuclei. Fibrous layer was retracted & disrupted at most of places with pyknotic nuclei. Fibres were broken at places. Architecture of this layer was disturbed. At (PMI) 10hrs35mins (T-23 .6/29.3 ^{0}C)the histological changes were seen in tunica media of renal artery as peripheral dark stained nuclei were seen mostly along with some dark stained nuclei. In renal vein, tunica intima was adhered to basement membrane while it was separated at (PMI)10hrs15mins (T-32.0/38.5 ^{0}C). In pelvis of ureter the transitional epithelium showed peripheral dark stained nuclei. In muscle layer clear spaces were seen between smooth muscle fibres at places with some pyknotic nuclei .Fibres were broken at places. At(PMI)12hrs (T-29.1/37.8 ^{0}C) in renal artery tunica intima was retracted from basement membrane and oedematous endothelial cells with dark stained nuclei were seen at places. In tunica media clear spaces were seen between smooth muscle fibres at most of places. Pyknotic nuclei were seen in tunica media. Fibres were broken at most of places. Tunica adventitia was slightly retracted from tunica media and mild disruption of collagen fibres were seen.In renal vein tunica intima was adhered to basement membrane and endothelial cells were seen at places. In tunica media clear spaces were seen between smooth muscle fibres at places with dark stained nuclei. Pyknotic changes were also seen. Fibres were broken at places. In tunica adventitia moderate loss of adventitial tissue were seen and clear spaces were seen between smooth muscle fibre at places and fibers having dark stained nuclei. In pelvis of ureter architecture of transitional epithelium was disturbed. Retraction & disruption of epithelium at most of places. Peipheral dark stained nuclei were seen and dark stained nuclei were also seen. In muscle layer architecture was disturbed. Clear spaces were seen between smooth muscle fibres at most of places. Muscle fibres were broken at most of places with some pyknotic nuclei. In fibrous layer architecture was disturbed. Fibrous layer was retracted & disrupted at most of places with pyknotic nuclei. Fibres were broken at places. At(PMI)12hrs20mins (T-24.9/39.4 ^{0}C) postmortem histological changes in tunica intima of renal artery was adhered to basement membrane while it was retracted at (PMI)12hrs (T-29.1/37.8 ^{0}C) and (PMI)12hrs10min (T-25.4/38.8 ^{0}C). At (PMI)12hrs10min (T-25.4/38.8^{0}C) in tunica adventitia of renal artery moderate disruption of collagen fibres were seen while there were moderate to severe disruption of collagen fibres at(PMI)12hrs20mins (T-24.9/39.4^{0}C).In renal vein at (PMI)12hrs10mins (T-25.4/38.8 ^{0}C) and at(PMI)12hrs20mins(T-24.9/39.4^{0}C) endothelial cells were not clearly visible .In tunica media of renal vein clear spaces were seen between smooth muscle fibres at most of places and muscle fibers having pyknotic nuclei but nuclei were not clearly visible at(PMI)12hrs20mins (T-24.9/39.4 ^{0}C). In tunica adventitia of renal vein at (PMI) 12hrs20mins (T-24.9/39.4^{0}C) moderate loss of adventitial tissue were seen with pyknotic changes in nuclei and disturbed architecture. At (PMI)12hrs10min (T-25.4/38.8 ^{0}C) in pelvis of ureter shedding of transitional epithelium were seen. At (PMI) 12hrs20mins (T-24.9/39.4 ^{0}C) in pelvis of ureter architecture of transitional epithelium was severely disturbed. At most of the places retraction & disruption of epithelium with dark stained nuclei was observed. Cell outline was not clear and most of the epithelial cells were anucleated. In muscle layer architecture was disturbed. Clear spaces were seen between smooth muscle fibres at most of places and nuclei were not clearly visible. At (PMI) 12hrs20mins (T-24.9/39.4^{0}C) the fibrous layer was retracted widely from muscle layer and pyknotic changes in nuclei were seen.

Fig 1 PMI 4hrs 30 mins Temp-23.9/33.4 ^{o}C H&E stain 10X photomicrograph of renal vein showing tunica intima (TI) is adhered to basement membrane, few clear spaces between smooth muscle fibres are seen in tunica media(TM), mild loss of adventitial tissue are seen in tunica adventitia(TA).

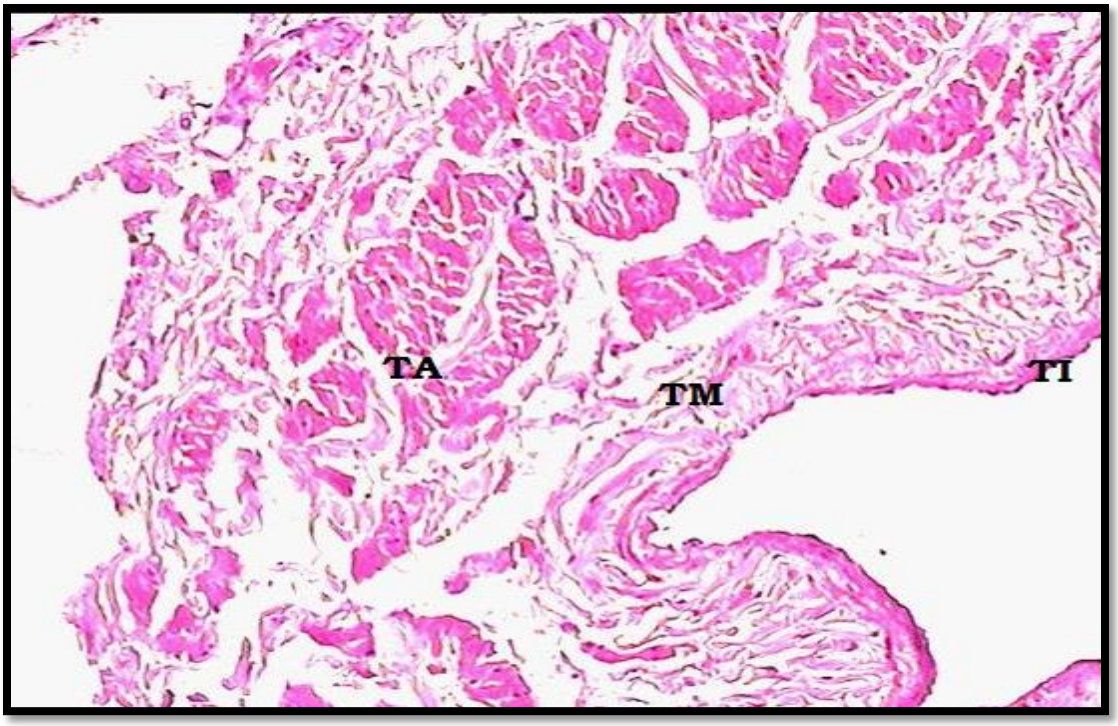
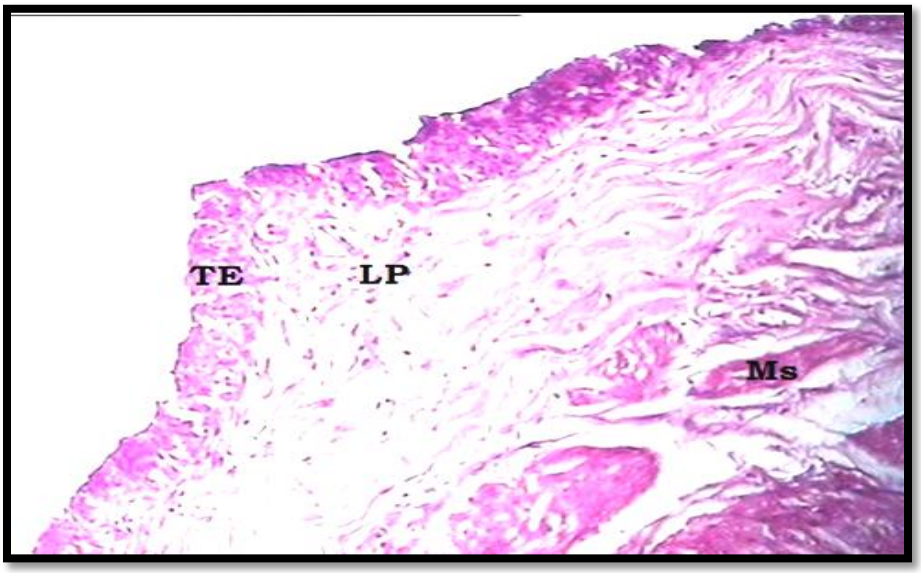


Fig 2 PMI 6hrs 15 mins Temp-28.1/39.3 ^{o}C H&E stain 10X photomicrograph of pelvis of ureter showing disruption of epithelium at places in transitional epithelium(TE).



SUMMARY AND CONCLUSION

A study of sequential postmortem histological changes of renal vessels and pelvis of ureter was done in 11 random samples of human renal vessels and pelvis of ureter at different time intervals and in different temperature conditions after death. Renal vessels and pelvis of ureter were studied under the light microscope after staining with Harris haematoxyline and eosin .

The renal artery (tunica intima, media, adventitia), renal vein(tunica intima, media, adventitia) and pelvis of ureter (transitional epithelium, muscle layer, fibrous layer) were studied. In this study increase in the rate of postmortem histological sequential changes were found to be increased with rise in the temperature and duration. In the preasent study earliest remarkable sequntial postmotem histological changes were seen after PMI 4hrs 30 mins (T 23.9/33.4 ^{0}C) in transitional epithelium of pelvis of ureter and tunica adventitia of renal vein.

In the present study sequential postmortem histological changes of renal vessels and pelvis of ureter were studied. Retraction of epithelium from basement membrane and its disruption with darkening of nuclei of endothelial cell and loss of endothelial cells were observed in tunica intima of renal vessels. Appearance of clear spaces between smooth muscle fibres, broken smooth muscle fibres, nuclear pyknosis, karyorrhexis and loss of architecture were observed in tunica media of renal vessels. Various degree of loss of adventitial tissue (i.e. mild, moderate,moderate to severe,severe) and disruption of collagen fibres with loss of architecture were observed in tunica adventitia of renal vessels. Retraction and disruption of epithelium with individualization of cells, nuclear pyknosis, karyolysis and loss of epithelial architecture were observed in transitional epithelium of pelvis of ureter.

Post-mortem histological changes are directly dependent not only on the length of post-mortem time but also to a bigger extent on the temperature of environment. The rate of autolysis varies with environmental temperature, body size, nutritional status, pelage.(Deborah Barber)

The changes were found to be irregular in some cases. In the present study it was observed that sequential postmortem histological changes were different in some cases of same duration. The main reason lies in the fact that there are an extreme number of factors, which influence the post-mortem degradation of tissue in each case.(Micozz MS)[40]. The rate of cellular degradation is increased by large carcass size, excessive adipose tissue, thick fur or wool and antemortem hyperthermia caused by pyrexia violent exercise or heat exhaustion.(Deborah Barber).[20]Further studies using large number of cases & environmental conditions such as age,sex, humidity, body built,clothings & surrounding of the body etc.in different seasons should be done.

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