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Occurrence and pathology of renal lesions in buffaloes

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Abstract

In the current study, a total of 1214 buffalo urine system specimens were macroscopically inspected. 368 kidney specimens with macroscopic lesions were processed for further histological analysis out of this total. These tissue samples from kidney showing gross lesions were collected in 10% NBF and processed for histopathological evaluation. Histopathological examination revealed overall occurrence of various pathological conditions of kidney as 30.31 percent (368 out of 1214). It was found that interstitial nephritis (26.63%) was most frequent lesion found followed by circulatory disturbances (25%), glomerulonephritis (20.65%), suppurative inflammatory conditions (8.69%), nephrosis (8.42%), miscellaneous condition (5.16%), malformation and cystic lesions (4.89%) and tuberculosis (0.54%). The predominant pathological conditions in kidney were interstitial nephritis, circulatory disturbance, and glomerulonephritis.

Keywords: Buffaloes, kidney, pathological conditions

Introduction

Livestock plays an important role in Indian economy. About 20.5 million people depend upon livestock for their livelihood. Livestock contributed 16% to the income of small farm households as against an average of 14% for all rural households. Livestock provides livelihood to two-third of rural community. It also provides employment to about 8.8% of the population in India. India has vast livestock resources. Livestock sector contributes 4.11% GDP and 25.6% of total Agriculture GDP. In India, buffaloes are favoured over cattle due to their unique attributes, which include higher milk fat percentage, greater disease resistance, and improved feed conversion efficiency compared to cows. (Bandyopadhyay *et al.*, 2003) [5]. Among various common disorders affecting buffalo, urinary disorders are more frequent and have been considered to be an important cause of ailment. Pathological investigation in the various organs of urinary system in buffaloes gives a guideline for diagnosis of urinary diseases. In this study the emphasis is on various pathological conditions found in kidney. Certain pathological conditions are common in urinary system of buffaloes such as renal congestion (Saiyari *et al.*, 1996) [25], infarction (Bamnele *et al.*, 2014) [4], cystic kidney (Boru *et al.*, 2013) [7], intertubular haemorrhages (Sankarappa and Rama Rao, 1982) [26], hyaline degeneration (Mandal *et al.*, 2013) [15], renal amyloidosis (Mensua *et al.*, 2003) [19], pyelonephritis (Elias *et al.*, 1993) [9], glomerulonephritis (Akram, 2001; Rezaie *et al.*, 2014) [1, 22], renal abscess (Kiem and Charan, 1992) [12], interstitial nephritis (Kiem *et al.*, 1993; Aktar *et al.*, 2015) [13, 2], tuberculosis (Mathur *et al.*, 2000) [18], etc.

Materials and Methods

Sampling

In the present investigation, total 1214 specimens of the urinary system of buffaloes irrespective of age, sex and breed were collected from slaughter houses of Alwar, Bikaner, Jaipur, Sikar and adjoining areas of these districts of Rajasthan. The tissue specimens were also collected from the carcasses of the buffalo submitted to the Department of Veterinary Pathology, College of Veterinary and Animal Science, Bikaner for post-mortem examination. Collected samples were examined and 368 specimens of kidneys showing macroscopic lesions were processed for further histopathological examination.

Histopathological investigation

Representative tissue samples (0.5 cm in size) were taken in 10% NBF and processing of tissues was done by paraffin embedding using acetone and benzene technique (Lillie, 1965). The tissue sections of 4-6 micron thickness were cut and stained with haematoxylin and eosin staining method and examined under microscope. Special staining was done with Van Gieson as and when required

Results

Gross and histopathological findings

Out of these 1214 specimens, 368 specimens of kidney

showing gross lesions were further processed for histopathological examination which revealed several overlapping conditions. An overall occurrence of various pathological conditions of kidney was observed as 30.31 percent (368 out of 1214). It was found that interstitial nephritis (26.63%) was most frequent lesion found followed by circulatory disturbances (25%), glomerulonephritis (20.65%), suppurative inflammatory conditions (8.69%), nephrosis (8.42%), miscellaneous condition (5.16%), malformation and cystic lesions (4.89%) and tuberculosis (0.54%). The details of the classification of pathological lesions of the kidney are given in table 1.

Table 1: Pathological conditions involving Kidney

S. No.	Name of Lesion	No. of Samples	Percentage
1.1	Inflammatory conditions of Interstitial Tissue	98	26.63
1.1(a)	Diffuse interstitial nephritis	53	14.40
1.1(b)	Focal interstitial nephritis	45	12.22
1.2	Inflammatory conditions of Glomeruli	76	20.65
1.2(a)	Acute glomerulonephritis	24	6.52
1.2(b)	Subacute glomerulonephritis	29	7.88
1.2(c)	Chronic glomerulonephritis	23	6.25
1.3	Suppurative Inflammatory Conditions	32	8.69
1.3(a)	Pyelonephritis	22	5.97
1.3(b)	Renal abscess	10	2.71
1.4	Specific condition	2	0.54
1.4(a)	Tuberculosis	2	0.54
1.5	Nephrosis	31	8.42
1.5(a)	Hyaline degeneration	7	1.90
1.5(b)	Tubular nephrosis	11	2.98
1.5(c)	Renal amyloidosis	13	3.53
1.6	Malformation and Cystic Lesions	18	4.89
1.6(a)	Retention cyst	11	2.98
1.6(b)	Congenital polycystic kidney	7	1.90
1.7	Circulatory disturbances	92	25
1.7(a)	Haemorrhage	53	14.40
1.7(b)	Congestion	28	7.60
1.7(c)	Hydronephrosis	11	2.98
1.8	Miscellaneous condition	19	5.16
1.8(a)	Renal fibrosis	4	1.08
1.8(b)	Renal cortical necrosis	9	2.44
1.8(c)	Rupture of kidney	6	1.63
	Total	368	100

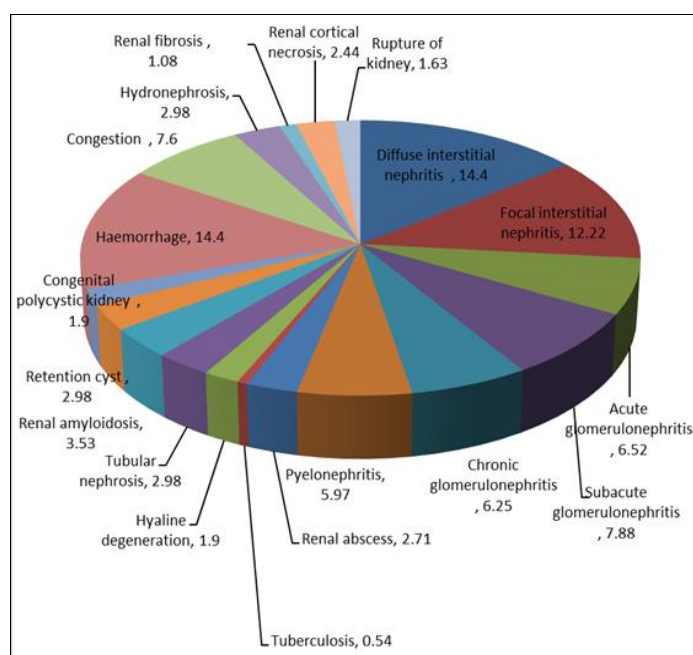


Fig 1: Pie diagram showing percent abnormalities with respect of specific conditions in Kidney

Inflammatory conditions of Interstitial Tissue**Diffuse interstitial nephritis**

Pathological lesions of the diffuse interstitial nephritis were observed in 53 (14.40%) cases. Grossly, the affected Kidneys were either normal or slightly enlarged in acute cases. Red and grey mottling of cortex was present. The capsule stripped off easily. In chronic cases, kidneys were smaller in size and pale grey in colour. The kidney was hard and difficult to cut. The capsule was peeled off with difficulty. The cortex was reduced. Microscopically, kidney sections showed degenerated and necrosed tubular epithelium. Infiltration of lymphocytes, monocytes and plasma cells was evident in cortex and outer medulla. Few neutrophils were also seen (Fig. 2).

Focal interstitial nephritis

Focal interstitial nephritis was diagnosed in 45 (12.22%) cases. Grossly, swollen kidneys were found. Grey white foci of pin point size were scattered over the entire surface. On cut surface, these nodules were confined to cortex. Microscopically, interstitial tissue appeared oedematous along with infiltration of polymorphonuclear cells (Fig. 3).

Inflammatory conditions of Glomeruli**Acute Glomerulonephritis**

This condition was found in 24 (6.52 percent) cases. Grossly, affected kidneys were found to be enlarged and pale. Tense capsule was found which peeled off easily. Congested glomeruli appeared as red dots. On the cortex, petechial haemorrhages were seen. Microscopically, hyperaemia of glomerular capillaries and proliferation of endothelial and epithelial cell was present. Glomerulus was ischemic. Cellularity of the glomeruli was increased. Severe infiltration by inflammatory cells was noticed. Leucocytes, erythrocytes, swollen tuft and precipitated protein occupied the capsular space.

Sub-acute Glomerulonephritis

Sub-acute Glomerulonephritis was recorded in 29 (7.88 percent) cases. Grossly, kidneys were "Large white" due to enlargement. Kidneys were found to be pale and soft with smooth surface and loose capsule. The tense capsule had cortical petechial haemorrhage. Microscopically, Glomerular capillaries were hyperaemic, and proliferation of endothelial and epithelial cell was more pronounced. Fatty degeneration occurred in tubular epithelium which eventually leads to hyaline droplet degeneration and necrosis. Oedematous interstitial tissue was filled up by infiltrated inflammatory cells and some collagenous tissue.

Chronic Glomerulonephritis

Pathological lesions of chronic glomerulonephritis were observed in 23 (6.25 percent) cases. Grossly, kidneys were shrunken and contracted with fine granular surface. Due to obstruction of tubules fine small cysts were noticed. Microscopically, glomeruli were fibrosed leading to decreased cellularity of glomerular tuft. The tubules were replaced by scar tissue. Both glomerulus and capsule were obliterated.

Suppurative inflammatory conditions**Pyelonephritis**

Pyelonephritis was recorded in 22 (5.97 percent) cases. Grossly, this condition was characterised by irregular patches of hyperaemia and localised purulent areas in subcapsular

cortex. Microscopically, necrotic and desquamated transitional epithelium was observed. Infiltration of neutrophils, fibrin and perivascular fibrosis was seen. On denuded surface necrotic debris and neutrophils were adherent. Medullary tubules were dilated and contained neutrophils (Fig 4).

Renal abscesses

Renal abscesses were seen in 10 (2.71 percent) cases. Grossly, numerous abscess were projecting from surface of kidney. On section cutting creamy granular pus surrounded by thick wall of fibrous tissue was observed. Microscopically, abscess contained zone of cellular infiltration of lymphocytes and macrophages surrounding thick cellular debris. The zone of macrophages and lymphocytes was slightly fibrosed (Fig. 5).

Specific condition

Tuberculosis: Tuberculosis was noticed in 2 (0.54%) cases. Grossly, miliary granules were present on the affected kidney. The nodules were caseous, necrotic with firm greyish white fibrous tissue. Microscopically, tubercle was surrounded by fibrous capsule infiltrated by plasma cells and neutrophils (Fig. 6). This tubercle was characterised by central area of caseous necrosis surrounded by Langhan's cells, giant cells, plasma cells and lymphocytes (Fig 7).

Nephrosis**Hyaline degeneration**

Hyaline degeneration was seen in 7 (1.90 percent) cases. Grossly, kidney was swollen to a certain extent. The cortex had dull and opaque appearance. Microscopically, enlarged epithelial cells which were densely packed with protein granules were seen. Secondary changes *viz.* hydropic degeneration, cloudy swelling and fatty changes were observed in tubules. The tubules contained desquamated epithelial cells and hyaline cast (Fig. 8).

Tubular nephrosis

Tubular nephrosis was observed in 11 (2.98%) cases. Grossly, enlarged kidneys with tense and loose capsule which stripped off easily were found. Microscopically, the tubules were dilated and congested with patchy areas of haemorrhages. The tubular epithelium revealed degenerative changes *viz.* hydropic degeneration and cloudy swelling (Fig. 9).

Renal amyloidosis

Renal amyloidosis was noticed in 13 (3.53 percent) cases. Grossly slightly enlarged and pale kidneys were observed. The capsules were non adherent and peeled off easily revealing cortex with yellow spots of glomeruli and translucent grey points of dilated tubules. Microscopically, deposition of amyloid was found in mesangium and subendothelium. Due to presence of amyloid, nephrons became ischemic and atrophied. In this condition interstitial fibrosis, polymorphonuclear cells infiltration and tubular degeneration were predominantly observed (Fig. 10).

Malformation and Cystic Lesions

Retention cyst: Retention cyst was found in 11 (2.98%) cases. Grossly, in affected kidney single solitary cyst was found. The cortex appeared spongy. The cyst had firm smooth wall and contained serous and slightly gelatinous fluid. Microscopically, glomeruli revealed pressure atrophic changes. The cyst was found in form of dilation of subcapsular space of glomeruli. The cortical tissue was

replaced by hyaline membrane to form cyst wall. The cyst was filled with hyaline and granular substance (Fig. 11).

Congenital polycystic kidney

Congenital polycystic kidney was recorded in 7 (1.90 percent) cases. Grossly, there were various small cyst occupying whole part of affected kidney. They contained clear watery fluid. Microscopically, these cysts were lined by cuboidal or flat epithelium cells. In enlarged cyst the epithelium cell become flattened due to pressure atrophy. Tubular degeneration was also noticed (Fig. 12).

Circulatory disturbances

Haemorrhage: Haemorrhage was observed in 53 (14.40%) cases. Grossly, affected kidneys showed varying degree of haemorrhages on surface and cut surface also revealed petechial haemorrhages in both cortex and medulla. Microscopically, in Bowman's capsule red blood cells varied in number but in the convoluted tubules and in cortico - medullary region more red blood cells were found. In the intertubular spaces intact RBCs were found. (Fig. 13).

Congestion

Congestion was seen in 28 (7.60%) cases. Grossly, affected kidneys were enlarged in size and were uniformly dark. Dark red cortico- medullary junction zone was observed. On cut surface blood oozed out. Microscopically, vessels were greatly distended with blood. Blood vessels were engorged with RBCs.

Hydronephrosis

Hydronephrosis was recorded in 11 (2.98%) cases. Grossly, enlarged and swollen kidneys were found due to progressive pelvic dilatation. Kidneys with dilated pelvis and calyces with blunting of renal papillae were found. Microscopically, renal parenchyma was atrophied. Proximal convoluted tubule, distal and straight segments were dilated. Tubular epithelium was also atrophied.

Miscellaneous condition

Renal fibrosis

Renal fibrosis was observed in 4 (1.08 percent) cases. Grossly, affected kidneys were firm, shrunken and pale with adherent capsule. Fibrosis was seen in finely stippled (dotted) form. Cortex and medulla were found equally fibrotic. Microscopically, interstitial fibrosis, atrophic tubules and infiltration of erythrocytes and inflammatory cells were seen. Granular deposition was seen in fibrotic kidney (fig. 14). The fibrotic condition was confirmed by using special stain Van Gieson (Fig. 15).

Renal cortical necrosis

Pathological lesions of this condition were observed in 9 (2.44%) cases. Grossly, affected kidneys were moderately enlarged. On the entire surface, focal necrotic areas were observed. The affected area was pale and slightly swollen. Thickness of the cortex was reduced. Microscopically, tubular epithelium was irregularly necrosed throughout the cortex. Basement membrane of tubular epithelium was lost. Infiltration of inflammatory cells was observed (Fig. 16).

Rupture of Kidney

This condition was noticed in 6 (1.63 percent) cases. Grossly, affected kidneys had ruptured areas with irregular, lacerated and rough edges. Connective tissue tearing showed slight haemorrhagic infiltration. Microscopically, gap produced due

to rupture was filled up by blood cells. Clots were formed along with infiltration of macrophages and neutrophils. The site of rupture revealed haemorrhage and congestion. The detached kidney portions were showing signs of coagulative necrosis (Fig. 17).

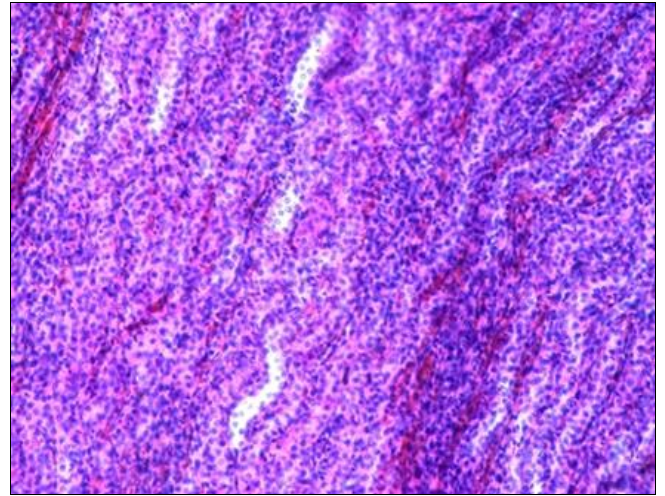


Fig 2: Microphotograph of kidney having interstitial nephritis along with tubular degeneration. H & E 10X

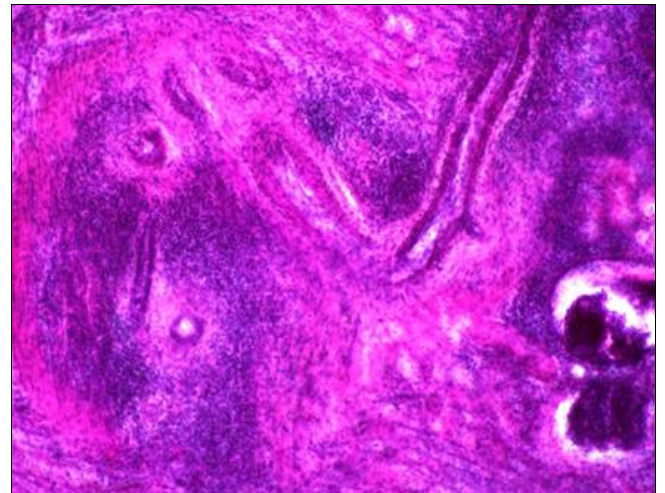


Fig 3: Microphotograph of kidney showing focal interstitial nephritis with heavy perivascular infiltration of polymorphonuclear cells. H & E 10X

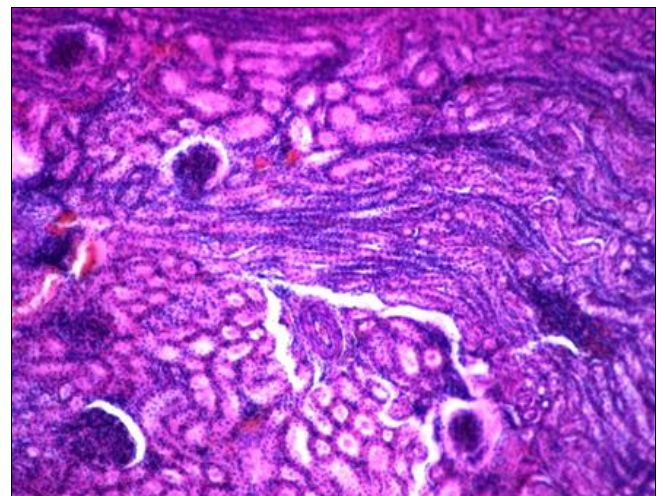


Fig 4: Microphotograph of kidney having pyelonephritis showing heavy infiltration of neutrophils and perivascular fibrosis. H & E 10X.

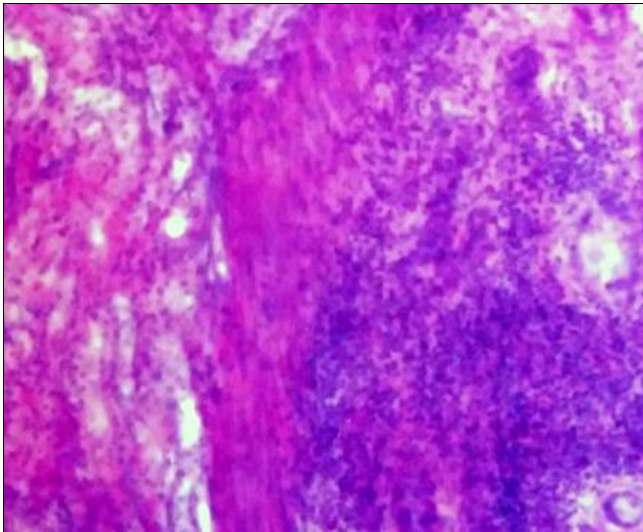


Fig 5: Microphotograph of kidney having abscess showing infiltration of neutrophils and fibroblast. H & E 20X

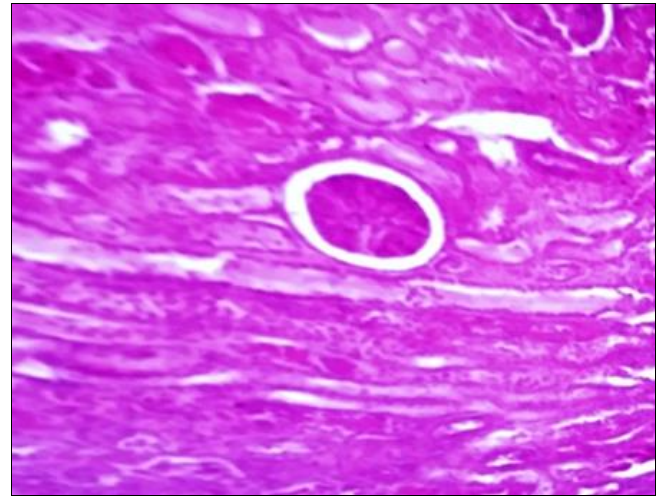


Fig 8: Microphotograph of hyaline degeneration showing hyaline cast and glomeruli converted into hyaline balls and desquamated epithelial cells. H & E 20X

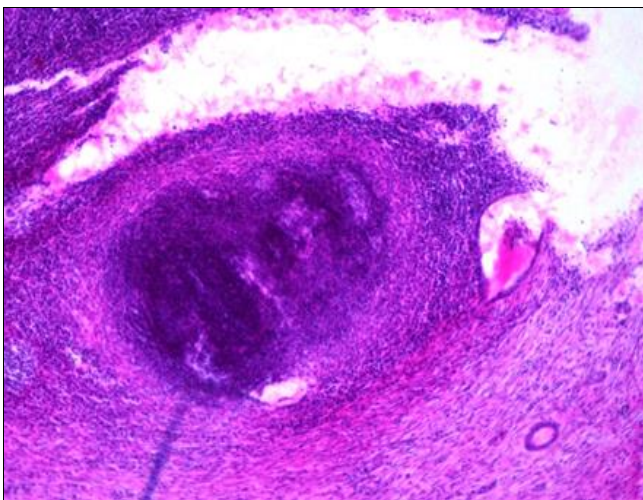


Fig 6: Microphotograph of kidney having tuberculosis with fibrosis around it & infiltration of mononuclear and polymorphonuclear cells. H & E 10X

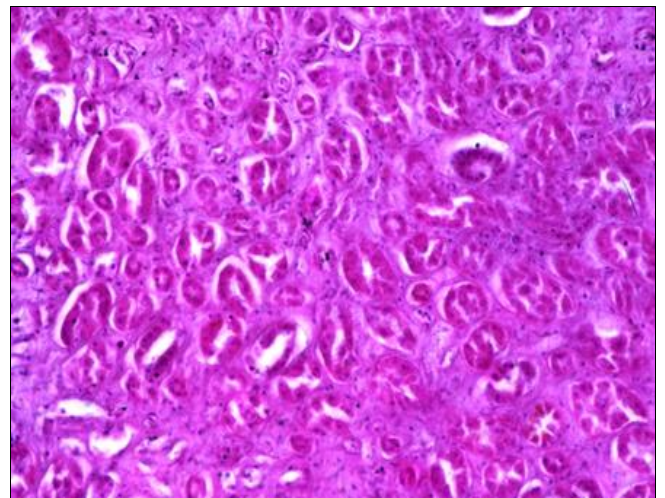


Fig 9: Microphotograph of kidney having tubular nephrosis showing cloudy swelling in tubules. H & E. 20X

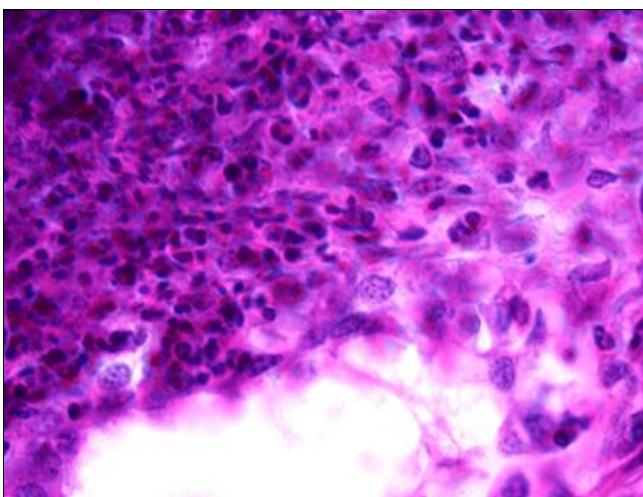


Fig 7: Higher magnification of figure 6 showing epithelioid cells and langhan's cells. H & E 100X

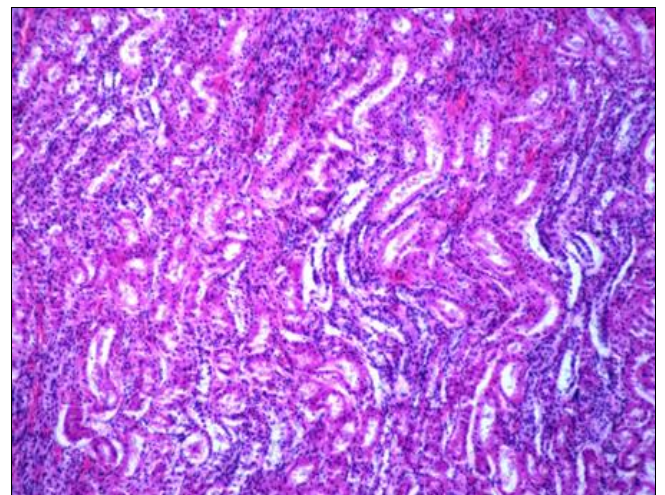


Fig 10: Microphotograph of kidney showing amyloidosis with infiltration of polymorphonuclear cells in renal parenchyma. H & E 10X

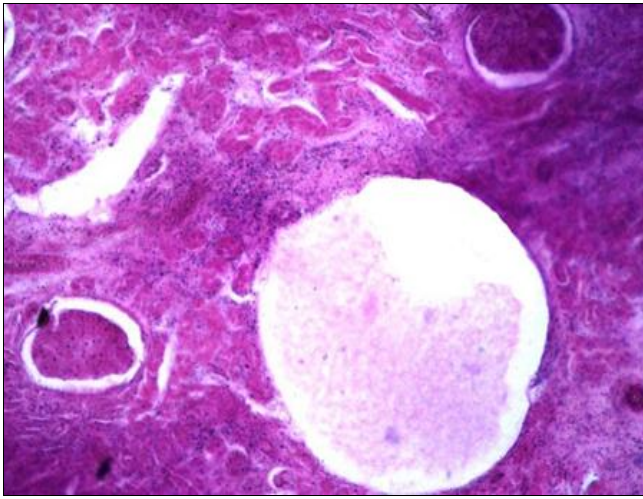


Fig 11: Microphotograph of kidney showing retention cyst along with mild infiltration in renal parenchyma. H & E 10X

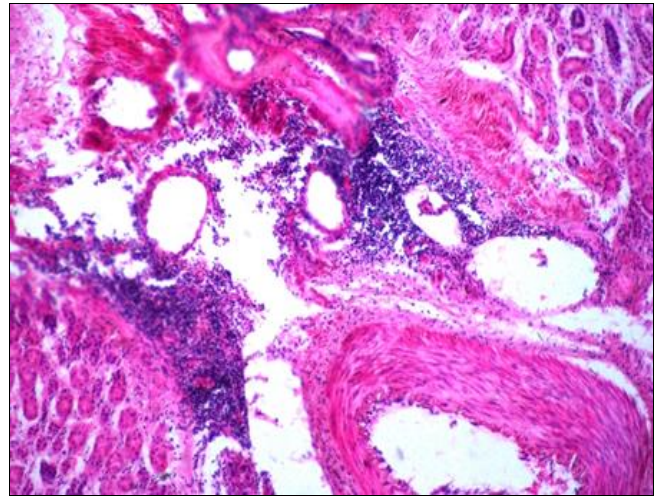


Fig 14: Microphotograph of kidney having fibrosis showing perivascular infiltration around blood vessel. H & E. 10X

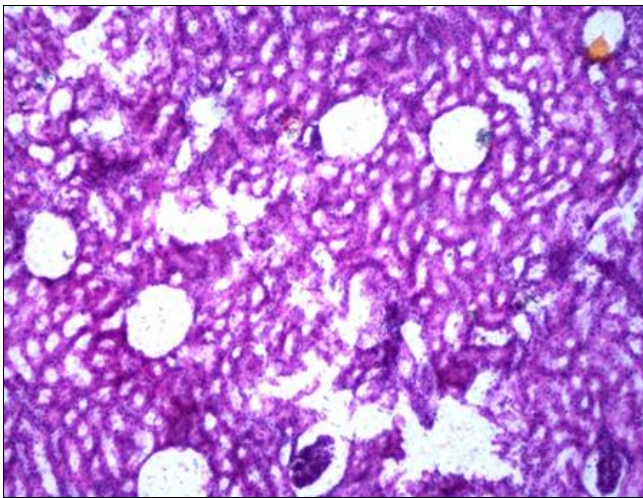


Fig 12: Microphotograph of kidney showing large no of cysts in cortical area along with tubular degeneration. H & E 10X

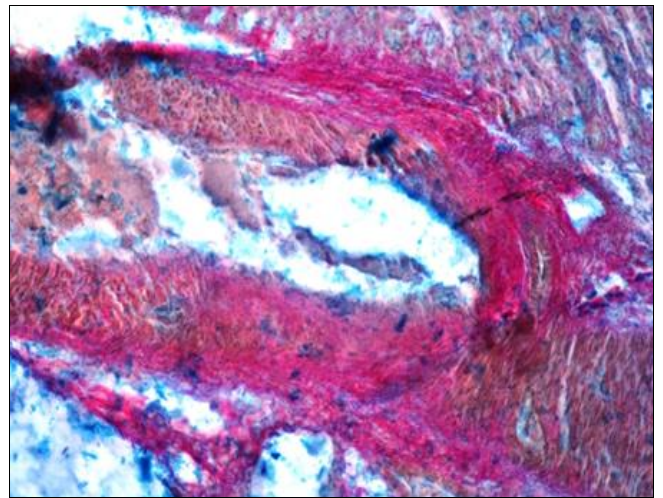


Fig 15: Microphotograph of kidney having renal fibrosis showing fibers taking red color. Van Gieson. 10X

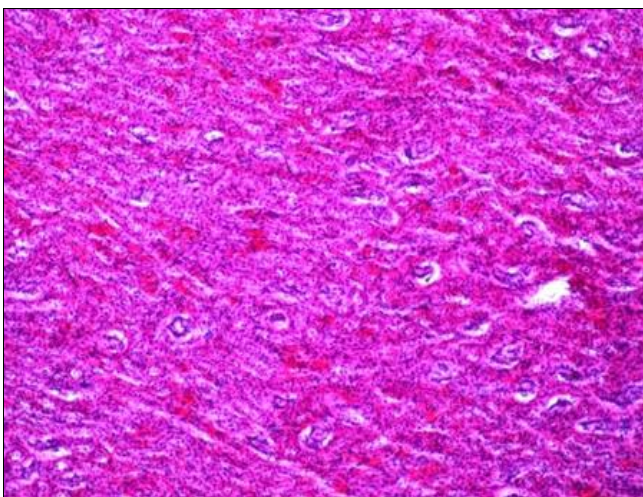


Fig 13: Microphotograph of kidney showing haemorrhage in medulla with infiltration of mononuclear cells. H & E 10X

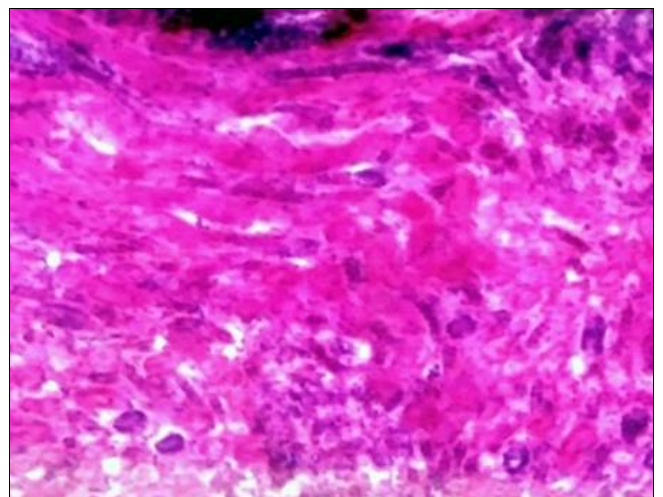


Fig 16: Microphotograph of kidney showing renal cortical necrosis of tubules. H & E 40X.

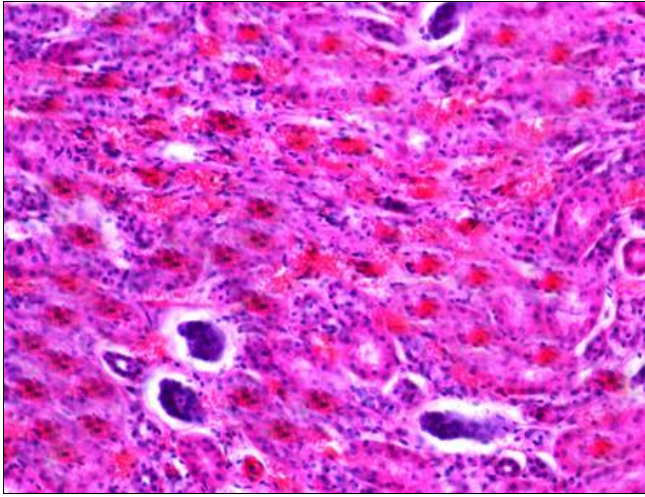


Fig 17: Microphotograph of ruptured kidney showing severe haemorrhage and infiltration of mononuclear cells in cortical area. H & E 10X

Discussion

Histological lesions were observed in 368 specimens of kidney. An overall occurrence of various pathological conditions of kidney was observed as 30.31 percent. Diffuse interstitial nephritis was noticed in 53 (14.40 percent) cases. Higher incidence rate was noticed by Mohammadian *et al.* (2016) as 27.2 percent in buffalo and but lower incidences were recorded by Mathur and Dadhich (2005) ^[17] as 8.96 percent in sheep. Focal interstitial nephritis was observed in 45 (12.22 percent) cases which was similar with findings of Bansiwali (2002) as 12.69 percent in cattle. Acute Glomerulonephritis was recorded in 24 (6.52%) cases. Higher incidence rate was noticed by Saiyari *et al.* (1993) ^[24] as 8.4 percent in cattle and but lower incidences were recorded by Hajikolae *et al.* (2016) as 0.08 percent in buffalo. Sub-acute Glomerulonephritis was recorded in 29 (7.88%) cases. Similar incidence was recorded by Saini (2015) as 7.43 percent in camel but Mathur (1996) ^[16] recorded lower incidence at 4.93 percent in sheep. Chronic Glomerulonephritis was observed in 23 (6.25%) cases. Similar incidence was recorded by Jat (2016) as 6.98 percent in cattle. Pyelonephritis was recorded in 22 (5.97 percent) cases. Lower incidence was recorded by Nikvand *et al.* (2014) as 1.4 percent in buffaloes. Renal abscesses condition was recorded in 10 (2.71%) cases. Similar incidence rate was recorded by Jat (2016) as 2.41 percent in cattle. Lower incidence was recorded by Awadin and Awad (2017) as 0.62 percent in cattle. Tuberculosis lesions were noticed in 2 (0.54 percent) cases. Grossly, miliary granules were present on the affected kidney. The nodules were caseous, necrotic with firm greyish white fibrous tissue. Similar findings were observed by Cohrs (1967). Hyaline degeneration was recorded in 7 (1.90 percent) cases. Higher incidence was recorded by Saini (2015) as 2.47 percent in camel. Tubular nephrosis was observed in 11 (2.98 percent) cases which was similar to Mohammadian *et al.* (2016) as 3.1 percent in buffaloes. Renal amyloidosis was noticed in 13 (3.53 percent) cases which was similar to incidence rate observed by Jat (2016) as 3.49 percent in cattle. Retention cyst was noticed in 11 (2.98 percent) cases. Similar incidences of retention cyst were observed by Bansiwali (2002) as 2.85 percent in cattle. Congenital polycystic kidney was recorded in 7 (1.90 percent) cases. A higher incidence was recorded by Jat (2016) as 2.95 percent in cattle. Haemorrhage was observed in 53 (14.40 percent) cases. Similar incidence of haemorrhages was recorded by Saiyari *et*

al. (1993) ^[24] as 14.77 percent in cattle but Jat (2016) recorded lower incidence at 7.25 percent in cattle. Congestion was noticed in 28 (7.60 percent) cases. A higher incidence was recorded by Tigre *et al.* (2012) as 10.2 percent in cattle. Hydronephrosis was recorded in 11 (2.98 percent) cases. Similar incidence was noticed by Mohammadian *et al.* (2016) as 2.5 percent in buffalo. Renal cortical necrosis was recorded in 9 (2.44 percent) cases which was similar to findings of Jat (2016) as 2.68 percent in cattle. Rupture of kidney was noticed in 6 (1.63 percent) cases which was similar to incidence rate recorded by Jat (2016) as 1.07 percent in cattle.

Conclusion

The present investigation was conducted to study the prevalence, etiology, gross changes, microscopic changes and histological alterations in affected kidney in Rajasthan.

In this study, irrespective of age, sex and breeds a total number of 1214 specimens of urinary system of buffalo suspected for anomalies were screened in Alwar, Bikaner, Jaipur and Sikar districts of Rajasthan. 368 specimens of kidney of buffaloes suspected for anomalies out of these 1214 specimens were further processed for histopathological examination.

The overall incidences of different affections of buffaloes urinary system were detected and categorised. An overall occurrence of various pathological conditions of kidney was observed as 30.31 percent (368 out of 1214).

The various forms of kidney affections were classified as Diffuse interstitial nephritis 14.40 percent, Focal interstitial nephritis 12.22 percent, Acute glomerulonephritis 6.52 percent, Sub-acute glomerulonephritis 7.88 percent, Chronic glomerulonephritis 6.25 percent, Pyelonephritis 5.97 percent, Renal abscesses 2.71 percent, Tuberculosis 0.54 percent, Hyaline degeneration 1.90 percent, Tubular nephrosis 2.98 percent, Renal amyloidosis 3.53 percent, Retention cyst 2.98 percent, Congenital polycystic kidney 1.90 percent, Haemorrhage 14.40 percent, Congestion 7.60 percent, Hydronephrosis 2.98 percent, Renal fibrosis 1.08 percent, Renal cortical necrosis 2.44 percent, and Rupture of kidney 1.63 percent. Eventually from the overall results of this investigation, it could be concluded that in the present study, the predominant pathological conditions in kidney were interstitial nephritis, circulatory disturbance, and glomerulonephritis. Approximately all gross and microscopic changes on different pathological conditions of urinary system studied in the present study were in close proximity with the observations of earlier workers described elsewhere.

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