



## Comparative pathological Studies on Kidneys affections in slaughtered farm animals

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### ABSTRACT

The aim of this study was to detect the comparative pathological affections in kidneys of cattle and sheep. A total number of 192 kidney samples showing different pathological lesions were collected from El-basatin abattoir in Cairo-Egypt; 69 samples were collected from cattle and 123 samples were collected from sheep, respectively. Microscopically, the highest incidence of occurrence of renal interstitial nephritis was found to be 17.39% in cattle and 28.45% in sheep, followed by glomerulonephritis 21.73% in cattle and 25.20% in sheep; circulatory disturbances were 15.94% in cattle and 16.3% in sheep; suppurative nephritis were 11.59% in cattle and 13.00% in sheep; amyloidosis was 7.24% in cattle while in sheep was 13.20%;. Meanwhile, neoplasms were detected in 3.25% cases collected from sheep. Moreover, parasite, stones, polycystic kidney, hydronephrosis and acute necrotic nephritis were observed in few cases of cattle as 2.89%, 7.24%, 2.89%, 8.69% and 4.34% respectively. Detailed gross and microscopical findings in each lesion were described. Inflammatory conditions in the kidneys were a common finding in both cattle and sheep. However, parasitic infestation is not a common finding in renal lesion.

**Keywords:** *Kidney, Pathology, Nephritis, Cattle, sheep, Abattoir.*

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### 1. INTRODUCTION

The animal kidneys are paired organs with their physiological functions like excretion of waste products, regulation of acid-base balance, body fluid balance, hormonal effects, and play an important role in the life of animals (Eaton and Pooler 2009).

Diseases of the kidneys are as complex as its structure but dividing them into those that damage the three basic morphologic components; glomeruli, tubules, and interstitium; facilitates their study. This traditional approach is useful because the early manifestations of disease that damage each of these components seems to be characterized. Further, some components

appear to be more vulnerable to specific forms of renal injury: for example, tubular and interstitial diseases are more likely to be caused by toxic or infectious agents. In spite of, other diseases damage more than one structure. Chronic renal disease can able to destruct all three components of the kidney, culminating in chronic renal failure, and what has been known, end-stage contracted kidney (McGavin *et al.*, 2001; Carlyle *et al.*, 1997; Jubb *et al.*, 1993; Cotran *et al.*, 1999).

Renal diseases have received much less attention in cattle than in some species and there is still a lack of knowing in this field

(Yeruham *et al.*, 2006). Hence the proposed investigation has been undertaken with the following objectives: To fine out occurrence of varying pathological conditions in kidneys of cattle and sheep. To study the comparative macroscopic and microscopic of varying pathological conditions in kidneys of cattle and sheep with reference to the type, pattern and morphology.

## 2. MATERIALS AND METHODS

### 2.1. Sample collection:

Our studies carried out on a total number of about 192 affected kidneys, 69 of cattle and 123 kidneys of sheep that showing gross pathological lesions were collected from EL-Basatin abattoir from the period of December 2016 to October 2017.

### 2.2. Histopathology:

Following collection, all the samples were properly preserved in 10% formaldehyde solution after cutting the affected parts with a few normal parts for identification of organ.

For histopathological examination, processing of tissues was done by paraffin embedding. These specimens were collected then fixed in 10% neutral buffered formalin. After proper fixation, the tissue specimens were trimmed, washed in running tap water, dehydrated in different ascending grades of ethyl alcohol, cleared in xylene and embedded in paraffin. The paraffin embedding block were sectioned at 5  $\mu$ m thickness and stained by hematoxylin and eosin (H&E) staining, according to Bancroft *et al.* (1996).

## 3. RESULTS

### 3.1. Incidence of kidney lesions:

The total numbers and percentages of each lesion in kidney of cattle and sheep were illustrated in table (1).

### 3.2. Pathological lesions of kidneys of cattle and sheep:

Hemorrhages grossly were varied in the shape and size, from petechiae to ecchymosis and were found just beneath the capsule and visible through it. Histopathologically, the kidneys showed severe hemorrhages both in the glomeruli and in between the renal tubules (Fig.1a).

Infarction characterized grossly by Pale yellowish dry lesions projecting slightly above the surface of affected kidneys. Cut surface showed pale yellowish wedge-shaped areas with base of them being on the surface and apex directed towards the hilus of the kidney. Microscopically, the tubular epithelium showed focal coagulative necrosis surrounded by a zone of leukocytic infiltration separate it from the adjacent normal kidney (Fig.1.b).

Amyloidosis was recorded in cattle and sheep, grossly; the kidneys were of normal size or slightly enlarged, pale in color and had smooth to finely granular capsular surface. Microscopically, the amyloid substances appeared as homogenous translucent extracellular eosinophilic substances that compresses the glomerular capillaries and obscure the glomerular tuft (Fig.1.c). Moreover, the amyloid was deposited under endothelium lining the blood vessels resulting in severe thickening of the wall of medullary blood vessels and basement membranes of renal tubules (Fig.1.d).

Hydronephrosis, was recorded in cattle only; grossly, the kidneys were swollen and enlarged due to progressive dilatation of the renal pelvis and calyces. Histopathologically, the kidneys showed degenerative changes in the glomerular tuft manifested by vesiculation of the cytoplasm of endothelial cells lining of the glomerular tuft capillaries. Moreover, segmentation of the glomerular tuft with periglomerular mononuclear cell infiltration were also detected (Fig.1.e). Occasionally, the

lumen of large numbers of renal tubules contained proteinaceous eosinophilic material. Cystic dilatations of some of the renal tubules were also seen.

Membranous glomerulonephritis lesions were recorded in cattle and sheep, grossly; the kidneys were enlarged, pale, with smooth non-adherent surface. Microscopically, the glomeruli showed severe thickening and hyalinization of the Bowman's capsule and also the basement membrane of the glomerular tuft. Shrinkage and segmentation of the glomerular tuft were also seen (Fig.1.f).

Proliferative glomerulonephritis lesions were recorded in cattle only and characterized grossly by pale cortical areas with focal adhered capsule while microscopically by hyper-cellularity of the glomerular tuft with hyperplasia of mesangial and endothelial cells which associated with peri-glomerular leukocytic cells aggregation. The glomerular tuft showed also degenerative changes and vesiculation (Fig.2.a).

Membrano-proliferative glomerulonephritis lesions were recorded in sheep only and characterized grossly by enlarged, pale kidneys while microscopically by glomerular hyper-cellularity, thickening and hyalinization of Bowman's capsule and thickening of glomerular capillary basement membrane with hyper-segmentation of glomerular tuft (Fig.2.b).

Chronic glomerulonephritis was recorded in cattle and sheep, grossly; the kidneys were shrunken and contracted with adherent capsule. Microscopically, the kidneys showed severe thickening of the Bowman's capsule with intense peri-glomerular fibrous connective tissue proliferation with shrinkage and segmentation of glomerular tuft (Fig.2.c). Multifocally, severe areas of hemorrhage and hyaline casts in the adjacent renal tubules were also detected in kidney of sheep (Fig.2.d).

Embolic nephritis in cattle and sheep were characterized grossly by presence of small sized abscesses imbedded in the renal tissue especially in the cortex while, microscopically by presence of abscesses characterized by homogenous pinkish colored pus in the center of abscess and surrounded by dead and life neutrophils in addition to coagulative necrosis in most of the surrounding renal tubules (Fig.2.e). Pyelonephritis characterized grossly by swelling in the renal pelvic and medullary area while, microscopically by diffuse neutrophilic infiltrations within the renal tubules with desquamation of the lining epithelial cells was common. Moreover, there were interstitial neutrophilic aggregations replaced the renal tissue (Fig. 2.f).

Focal interstitial nephritis grossly showed little pathological lesions. Microscopically were represented by focal interstitial replacement of the renal tissue by connective tissue infiltrated by mononuclear leucocytic cells and these foci of fibrous connective tissue extending in renal cortex and medulla replacing renal tubules and also glomeruli (Fig.3.a). Meanwhile, diffuse interstitial nephritis grossly kidneys may be of normal size or slightly enlarged with distinct red and grey mottling on the capsular surface and characterized microscopically by most of the renal tubules were atrophied or replaced by connective tissue. The remnant of renal tubules showed severe degree of degenerative changes with desquamation of their epithelial cells lining and the presence of hyaline casts in their lumen (Fig.3.b). Acute necrotic nephritis grossly showed enlarged pale and swollen kidneys with tense and non-adherent capsule. Microscopically, the kidneys showed severe necrosis of the epithelial cell lining of the renal tubules, manifested by pyknosis, karyolysis or absent nucleus (Fig.3.c).

Urolithiasis lesions were recorded in cattle only, grossly; stones were usually, situated in the calyx and renal pelvis, and have different

size and shape (Fig.3.d). Histopathologically, the glomeruli showed mild thickening of the Bowman's capsule with segmentation of glomerular tuft with the presence of homogenous eosinophilic substances in the Bowman's space (Fig.3.e).

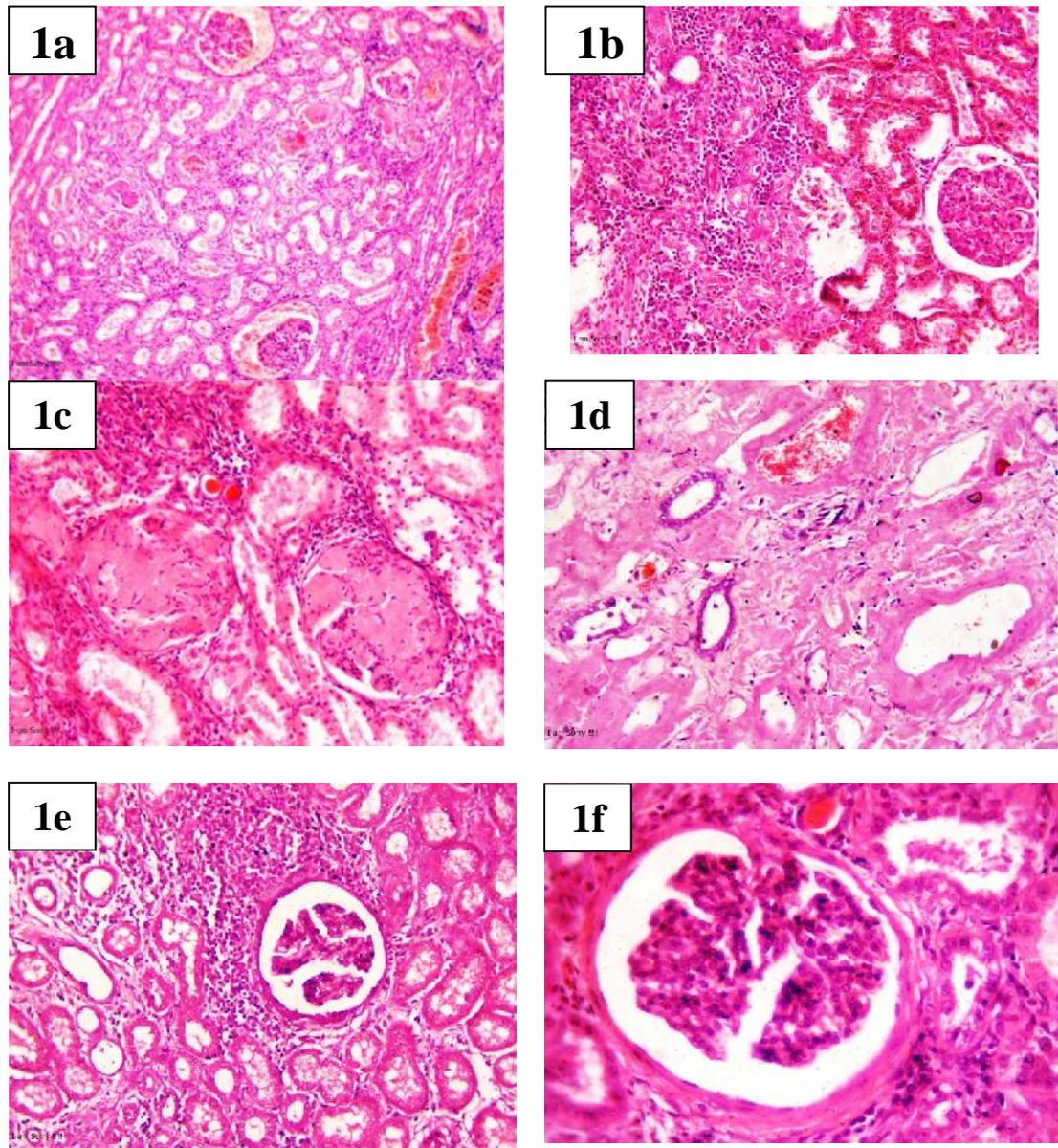
Polycystic kidney lesions were recorded in cattle only, grossly; multiple small cysts of varying sizes contained clear serous fluid. Microscopically, large areas in the cortex and medulla were expanded by numerous variable sizes cysts which were lined by single layer of flattening or cuboidal epithelium and having connective tissue in the wall (Fig.3.f). Additionally, gross examinations of cattle kidneys with parasite revealed presence of immature worm of trematode embedded in the renal tissue and appear on the kidney surface which takes white color (Fig.4.a). Microscopically, Kidney showed cross section of parasite in the renal pelvis (Fig.4.b). Additionally, there were variably sized granulomas, with center core necrotic tubules

surrounded by epithelial macrophages, lymphocytes and plasma cells and occasional foreign body giant cells (Fig.4.c).

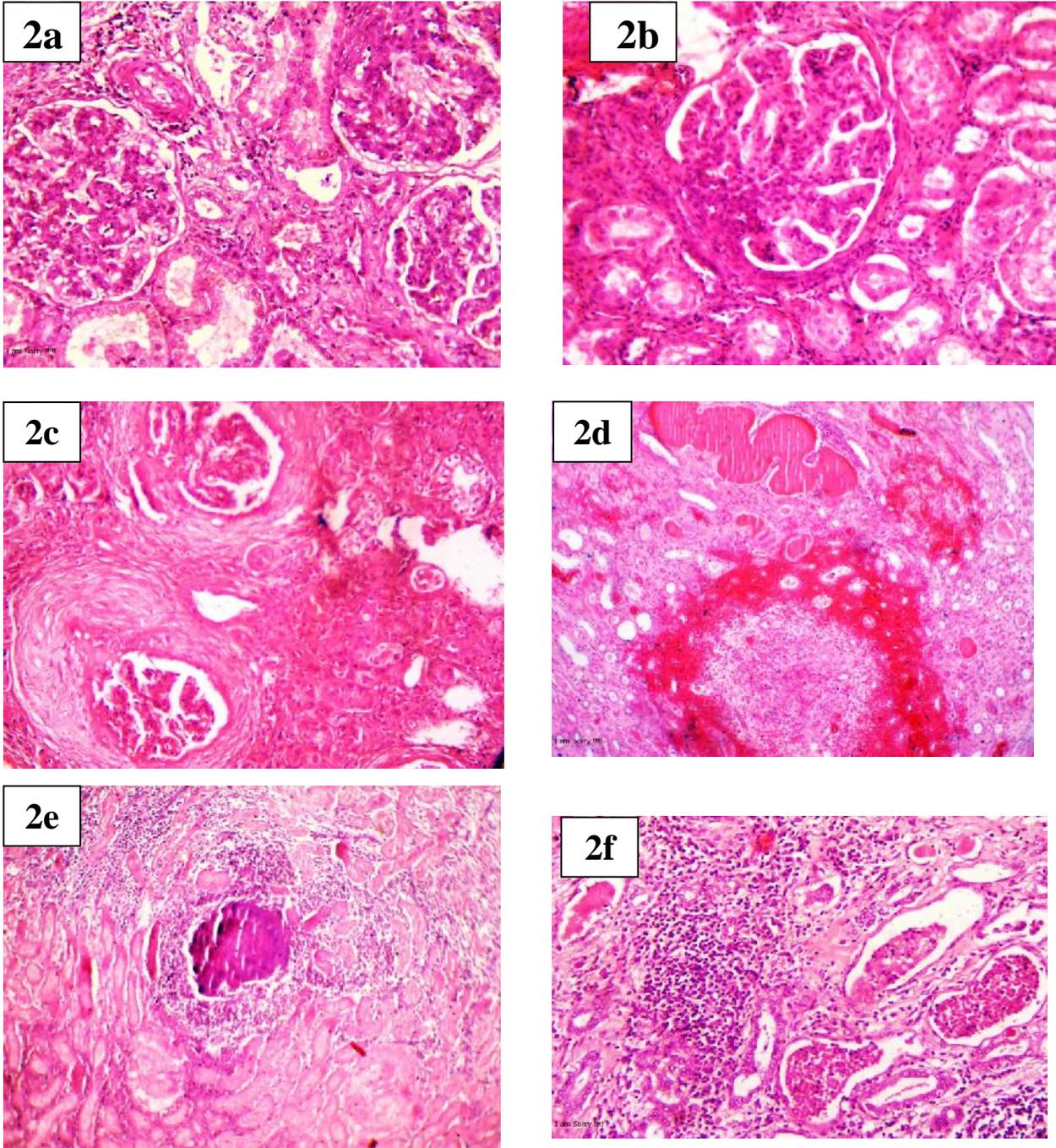
Metastatic lymphosarcoma were recorded in two cases in sheep only, grossly; the neoplastic foci appear as a single grayish white well circumscribed areas located in the renal cortex (Fig.4.d). Microscopically, the neoplasm composed of diffuse sheets of large lymphocytes effacing the renal cortex. Adinocacinoma was recorded in two cases in sheep only and characterized microscopically tumor composed of polygonal cells arranged in solid sheets, irregular tubules or papillary growth patterns and the neoplastic cells anaplastic vary in shape from cuboidal and columnar to polyhedral. Mitotic figures are numerous. These neoplasms have a moderate fibrovascular stroma. The glomeruli of such kidneys showing thickening of Bowman's capsule with segmentation of their tuft (Fig.4.e).

Table1: Incidence of different renal lesions in cattle and sheep.

Species	Cattle (69)		Sheep (123)	
	Total	percentage	Total	Percentage
<b>Circulatory disturbances</b>	<b>11</b>	<b>15.94</b>	<b>20</b>	<b>16.3</b>
. Hemorrhage.	6	8.69	12	9.75
. Infarction.	5	7.24	8	6.50
<b>Hydronephrosis</b>	<b>6</b>	<b>8.69</b>	-	-
<b>Amyloidosis</b>	<b>5</b>	<b>7.24</b>	<b>17</b>	<b>13.82</b>
<b>Inflammatory condition of glomerulus</b>	<b>15</b>	<b>21.73</b>	<b>31</b>	<b>25.20</b>
. membranous glomerulonephritis.	5	7.24	12	9.75
. proliferative glomerulonephritis.	4	5.79	-	-
. Membrano-proliferative glomerulonephritis.	-	-	9	7.31
. Chronic glomerulonephritis.	6	8.69	10	8.13
<b>Suppurative inflammation of kidney</b>	<b>8</b>	<b>11.59</b>	<b>16</b>	<b>13.00</b>
. Embolic nephritis.	4	5.79	8	6.50
. pyelonephritis.	4	5.79	8	6.50
<b>Inflammatory condition of interstitial</b>	<b>12</b>	<b>17.39</b>	<b>35</b>	<b>28.45</b>
. Focal interstitial nephritis.	7	10.14	18	14.63
. Diffuse interstitial nephritis.	5	7.24	17	13.82
<b>Acute necrotic nephritis</b>	<b>4</b>	<b>4.34</b>	-	-
<b>Miscellaneous</b>	<b>7</b>	<b>10.14</b>	-	-
. Stones.	5	7.24	-	-
. Polycystic kidney.	2	2.89	-	-
<b>Parasite</b>	<b>2</b>	<b>2.89</b>	-	-
<b>Neoplasm</b>	-	-	<b>4</b>	<b>3.25</b>
. Metastatic lymphosarcoma.	-	-	2	1.62
. Adenocarcinoma.	-	-	2	1.62

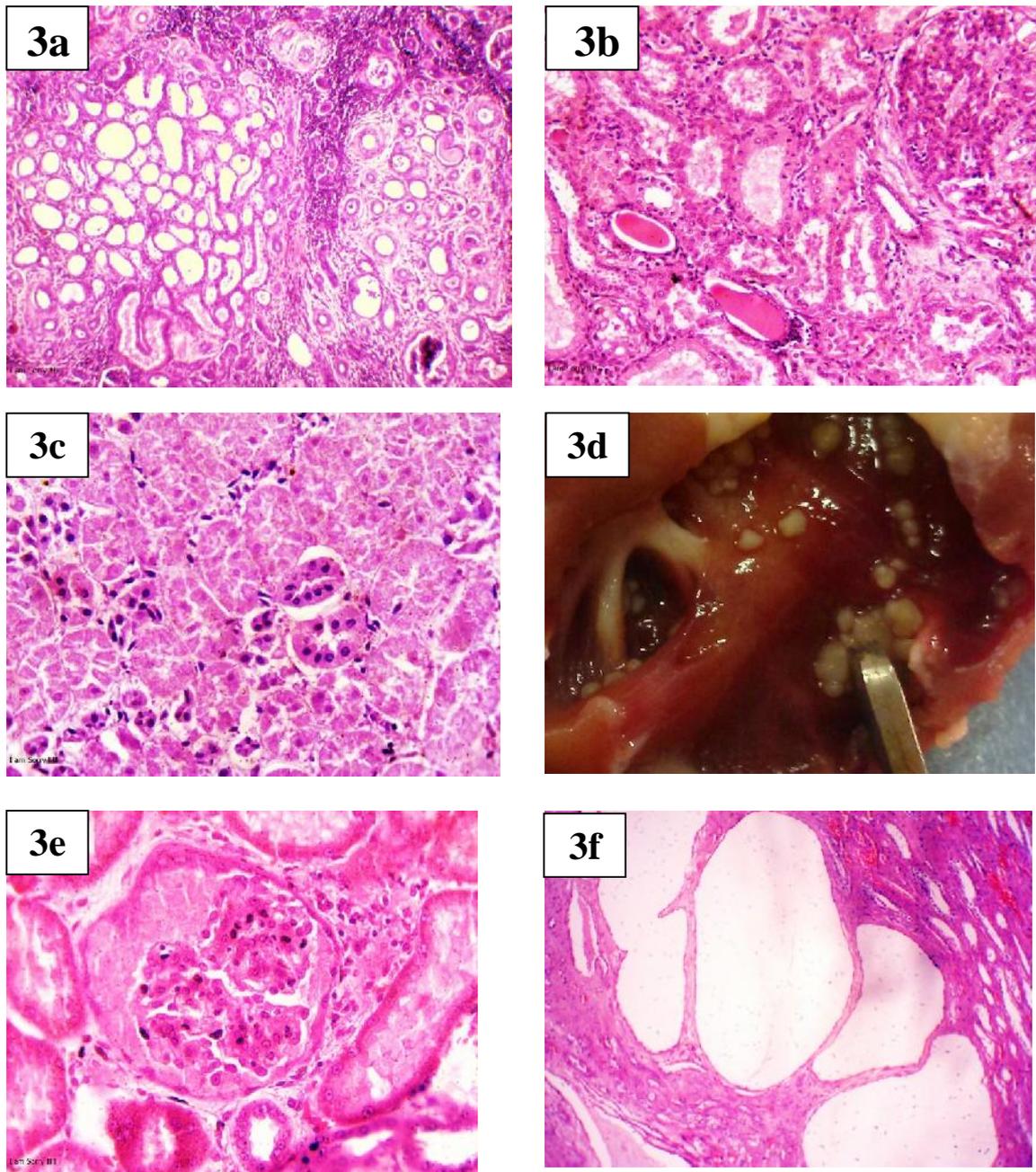


**Figure 1:** (a) kidney of cattle showing severe hemorrhages both in the glomeruli and in between the renal tubules (H&E x100). (b) Kidney of cattle showing, the tubular epithelium showed focal coagulative necrosis surrounded by a zone of leukocytic infiltration separate it from the adjacent normal kidney. (H&E x400). (c) Kidney of cattle showing amyloid substances appeared as homogenous translucent eosinophilic substances that compresses the glomerular capillaries and obscure the glomerular tuft (H&E x100). (d) Kidney of sheep showing the amyloid was deposited under endothelium lining the blood vessels resulting in severe thickening of the wall of medullary blood vessels and basement membranes of renal tubules. (H&E x200). (e) Kidney of cattle showing degenerative changes in the glomerular tuft manifested by vesiculation of the cytoplasm of endothelial cells lining of the glomerular tuft capillaries. Moreover, segmentation of the glomerular tuft with periglomerular mononuclear cell. (H&E x200). (f) Kidney of cattle showing severe thickening and hyalinization of the Bowman's capsule and also the basement membrane of the glomerular tuft associated with shrinkage and segmentation of the glomerular tuft. (H&E x400)

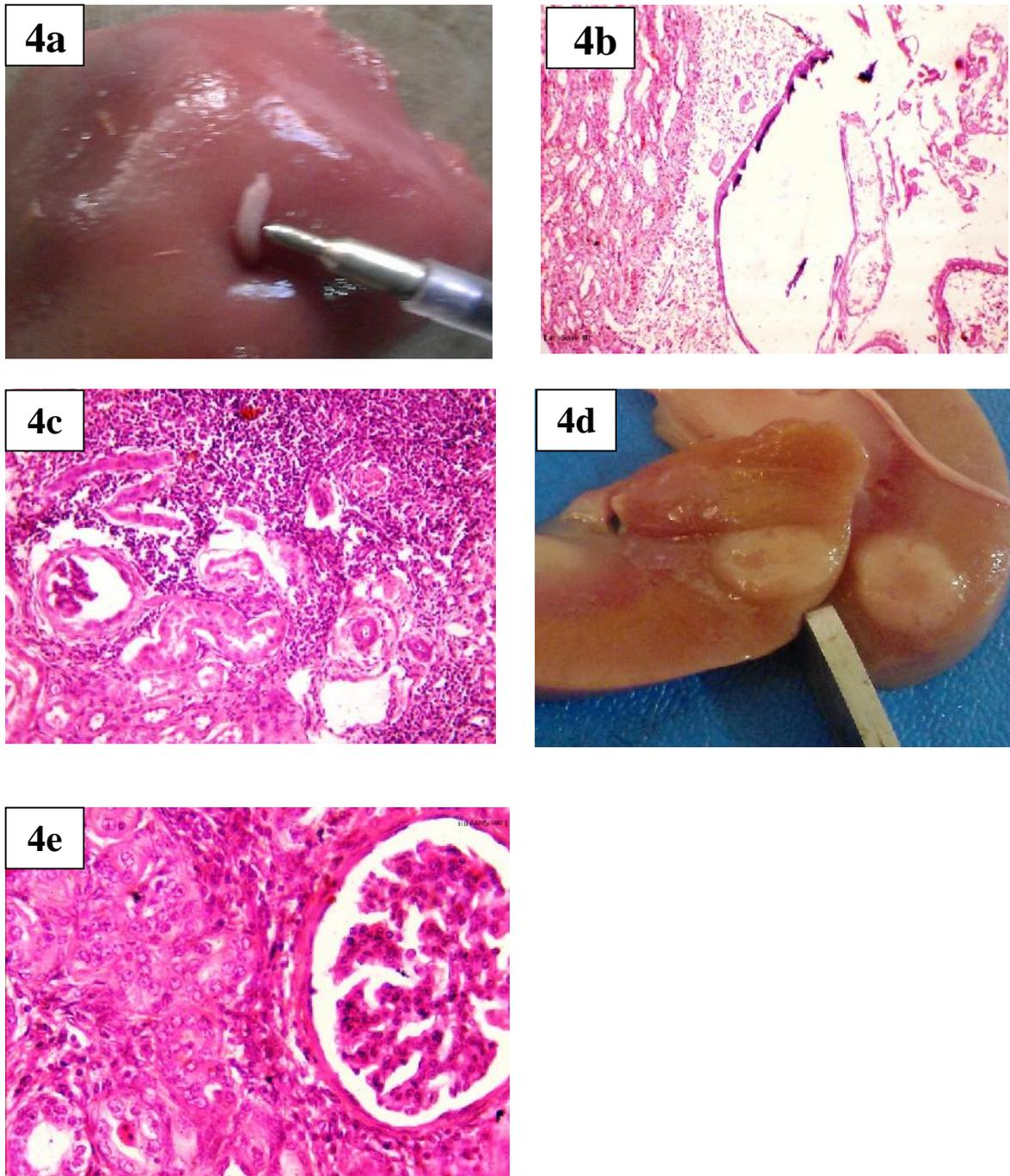


**Figure 2:** (a) Kidney of cattle showing hyper-cellularity of the glomerular tuft with hyperplasia of mesangial and endothelial cells associated with peri-glomerular leukocytic cells aggregation. The glomerular tuft showed also degenerative changes and vesiculation. (H&E x200). (b) Kidney of sheep showing glomerular hypercellularity, thickening and hyalinization of Bowman's capsule and thickening of glomerular capillary basement membrane with hyper-segmentation of glomerular tuft. (H&E x200). (c) Kidney of cattle showing severe thickening of the Bowman's capsule with intense peri-glomerular fibrous connective tissue proliferation with shrinkage and segmentation of glomerular tuft. (H&E x100). (d) Kidney of sheep showing multifocally, severe areas of hemorrhage and hyaline casts in the adjacent renal tubules. (H&E x200). (e) Kidney of sheep showing presence of abscesses characterized by homogenous pinkish colored pus in the center of abscess and surrounded by dead and life neutrophils in addition to coagulative necrosis in most of the surrounding renal tubules. (H&E x100). (f) Kidney of sheep showing pyelonephritis characterized by diffuse neutrophilic

infiltrations within the renal tubules with desquamation of the lining epithelial cells was common. Moreover, there were interstitial neutrophilic aggregations replaced the renal tissue. (H&E x200).



**Figure 3:** (a) Kidney of cattle showing focal interstitial nephritis were represented by focal interstitial replacement of the renal tissue by connective tissue infiltrated by mononuclear leucocytic cells and these foci of fibrous connective tissue extending in renal cortex and medulla replacing renal tubules and also glomeruli. (H&E x200). (b) Kidney of cattle showing, most of the renal tubules were atrophied or replaced by connective tissue. The remnant of renal tubules showed severe degree of degenerative changes with desquamation of their epithelial cells lining and the presence of hyaline casts in their lumen. (H&E x200). (c) Kidney of cattle showing severe necrosis of the epithelial cell lining of the renal tubules, manifested by pyknosis, karyolysis or absent nucleus. (H&E x400). (d) Gross section of kidney of cattle showing stones were usually, situated in the calyx and pelvis renalis, and have different size and shape. (e) Kidney of cattle showing mild thickening of the Bowman's capsule with segmentation of glomerular tuft with the presence of homogenous eosinophilic substances in the Bowman's space (H&E x200). (f) Kidney of cattle, showing large areas in the cortex and medulla were expanded by numerous variable sizes cysts which were lined by single layer of flattening or cuboidal epithelium and having connective tissue in the wall. (H&E x200).



**Figure 4:** (a) Gross section of kidney of cattle showing the presence of immature worm of trematode embedded in the renal tissue and appear on the kidney surface which takes white color. (b) Kidney of cattle showing cross section of parasite in the renal pelvis (H&E x100). (c) Kidney of cattle showing variably sized granulomas, with center core necrotic tubules surrounded by epithelial macrophages, lymphocytes and plasma cells and occasional foreign body giant cells. (H&E x100). (d) Cross section of kidney of cattle showing the neoplastic foci appear as a single grayish white area, well circumscribed areas located in the renal cortex. (e) Kidney of sheep showing the tumor composed of polygonal cells arranged in solid sheets, irregular tubules or papillary growth patterns and the neoplastic cells anaplastic vary in shape from cuboidal and columnar to polyhedral. Mitotic figures are numerous. These neoplasms have a moderate fibrovascular stroma. The glomeruli of such kidneys showing thickening of Bowman's capsule with segmentation of their tuft. (H&E x400).

#### 4. DISCUSSION

In the present study, the circulatory lesions were characterized primary by hemorrhage and

infarction. The incidence of hemorrhage was 8.69% in cattle which nearly similar to that reported by Jat *et al.* (2016) as 7.25% and

lower than those reported by Saiyari *et al.* (1993) as 14.77%, while in sheep was 9.75% which was higher than that reported by Sarita *et al.* (2016) as 6.16% and very lower than Dutta *et al.* (2016) as 20.40%. In this study, the characteristic gross and microscopic lesions of hemorrhage were detected in both the glomeruli and in between the renal tubules. These findings were similar to Saiyari *et al.* (1993), and Jat *et al.* (2016).

Renal infarction was 7.24% of cattle lesions and 6.50% in sheep which was very lower than that reported by Dutta *et al.* (2016) as 28.57% in sheep. The gross and microscopic findings of infarction in this study were in consistency with Jones *et al.* (2006) who suggested that infarcts of the kidneys were common due to occlusion of branches of renal artery.

Hydronephrosis were represented by 8.69% in cattle renal lesions, this result was higher than that reported by Marcato and Bettini (1990) as 1.66% and Jat *et al.* (2016) as 2.15%. Grossly in the present study, kidneys have hydronephrosis, were swollen and enlarged due to progressive dilatation of the renal pelvis and calyces. These results were completely agreed with Ahmed *et al.* (2013). Histologically, kidneys showed degenerative changes in the glomerular tuft with cystic dilatation of some of the renal tubules. These results agreed with Jat *et al.* (2016).

Amyloidosis were 7.24% in cattle which was higher than that reported by Elgumaa *et al.* (2017) as 6.52%, Jat *et al.* (2016) as 3.49%, and Yener and Erer (2000) as 2.1%, while in sheep was 13.82%, which was nearly similar to Dutta *et al.* (2016) as 14.61%, and higher than Elgumaa *et al.* (2017) as 4.61%. The gross and microscopic findings of amyloidosis in this study were in consistency with Dutta *et al.* (2016), Jat *et al.* (2016) and Elgumaa *et al.* (2017).

The incidences of glomerular lesions in the present study were 21.73% and 25.20% in cattle and sheep respectively which was nearly

similar to that recorded by Jat *et al.* (2016) as 21.23% in cattle; and higher than Sarita *et al.* (2016) as 20.85% in sheep. Grossly kidneys were enlarged, pale, with smooth non-adherent surface. Microscopically, lesions of glomerulo-nephritis in this study revealed characteristic changes in the glomeruli with shrinkage and segmentation of glomerular tuft. This result totally agreed with Elgumaa *et al.* (2017). Meanwhile, Chronic glomerulonephritis in this study characterized grossly by shrunken and contracted kidneys with adherent capsule. On microscopic examination, kidneys showed intense periglomerular fibrous connective tissue proliferation with shrinkage and segmentation of glomerular tuft. These results were in a complete agreement with Jat *et al.* (2016) and Sarita *et al.* (2016).

In the current work, the incidence of suppurative inflammatory condition in cattle was 11.59% which was higher than that recorded by Jat *et al.* (2016) as 6.98%, while in sheep was 13% which was higher than that recorded by Sarita *et al.* (2016) as 8.05%. In the present study, suppurative inflammatory condition of kidneys characterized microscopically by presence of homogenous eosinophilic pus infiltrating most of the renal tubules. These results were totally agreed with Ali and Khalid (2017) and Elgumaa *et al.* (2017).

Our result revealed the incidence of inflammatory condition of interstitial was 17.39% in cattle which was lower than the incidence reported by Jat *et al.* (2016) as 27.68%; while in sheep was 28.45% which was higher than the incidence reported by Sarita *et al.* (2016) as 25.59%. Interstitial nephritis microscopically, characterized by diffuse interstitial connective tissue proliferation which replaces the renal tissue especially in the medulla. These results were totally agreed with Jat *et al.* (2016).

The incidence of acute necrotic nephritis in our work was 4.34% and characterized microscopically by severe necrosis of the epithelial cell lining of the renal tubules, manifested by pyknosis, karyolysis or absent nucleus. These lesions were in complete agreement with Mahouz *et al.* (2015).

Stones in this study were 7.24% in cattle, which was higher than that reported by Jat *et al.* (2016) in which the incidence was 3.94%. Regarding microscopic lesions, the glomeruli showed segmentation of glomerular tuft with the presence of homogenous eosinophilic substances inside the Bowman's space. These results come in agreement with Ozmen (2004); and in partial agreement with Mathur *et al.* (2004) who reported mucinous metaplasia of the renal pelvic epithelium.

Meanwhile, polycystic kidney was 2.89% in cattle which was similar to the incidence recorded by Jat *et al.* (2016) as 2.95%. In the current research, the most prominent gross lesions of polycystic kidneys were represented by presence of multiple small cysts of varying sizes containing clear serous fluid. The microscopic examination revealed numerous variable sizes cysts lined by single layer of flattening or cuboidal epithelium and having connective tissue in the wall. These results were agreed completely with Jat *et al.* (2016). Incidence of parasite was (2.89%) in cattle, grossly in our work, the kidney showed the presence of immature worm of trematode embedded on the kidney surface, which takes white color. Microscopically there were variably sized granulomas, with center core necrotic tubules surrounded by epithelial macrophages, lymphocytes and plasma cells and occasional foreign body giant cells. These results were completely disagreed with Jamal and Kebede (2016) who reported hydatid cyst in condemned kidneys of domestic cattle.

The incidence of neoplasm in sheep was 3.25%, including, metastatic lymphosarcoma, composed of diffuse sheets of large

lymphocytes effacing the renal cortex. While adenocarcinoma in the present study composed of anaplastic cells with numerous mitotic figures, arranged in irregular tubules or papillary growth pattern in a fibrovascular stroma. These results were similar to that reported by Maeuten (2002) who described renal adenomas in domestic animals.

## 5. Conclusion

The present investigation had been concluded that:

- 1- Inflammatory conditions in the kidneys were common findings in both cattle and sheep especially non-suppurative condition; however, the suppurative lesions were nearly similar.
- 2- Incidence of inflammatory lesions were higher in sheep than cattle and the microscopic appearance were marked in sheep than cattle.
- 3- Incidence of circulatory disturbances was nearly similar in cattle and sheep.
- 4- Parasitic infestation is not a common finding in renal lesion and usually occurs due to incidental migration of parasitic larvae, was observed in cattle.
- 5- Other lesions as necrosis, parasite, stones and polycystic kidney were observed in cattle and absent or very rare in sheep. Meanwhile, neoplastic lesions including primary and secondary neoplasm were only detected in kidney of sheep.

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