

# Prevalence and anatomohistopathologic studies of uterine anomalies in she-camels in southeast Algeria

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**Abstract.** The aim of this study was to determine the epidemiologic and anatomohistopathologic features of genital tract disorders in she-camels slaughtered at abattoirs in southeast Algeria. We estimated the prevalence of the disorders among a total of 740 female camels selected from different breeds and ages. Abnormalities were detected in 213 animals (28.8%) at the level of the uterus, oviducts, or vagina. Infection was the most common uterine disorder, followed by endometritis (3.2%), metritis (2.8%), and pyometra (1.1%). Other lesions with low incidence included endometrial cysts, polyps, abscesses, and adhesions. Oviduct abnormalities included pyosalpinx (0.7%), hydrosalpinx (0.1%) and catarrhal salpingitis (0.5%). Cervicitis constituted the most frequent cervical lesion (2%), followed by total obstruction of the cervix (0.3%). Vaginitis accounted for 2/3 of the vaginal pathologies detected in the present study, and vaginal adhesions for 1/3. Microscopic examination revealed the histologic modifications generally associated with the various abnormalities.

**Key Words:** anatomohistopathology, oviduct, pathology, prevalence, she-camel, uterus.

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## Introduction

In Algeria, Sahara Desert covers 87 percent of the total land area (Mwakikagile 2009). Adapted for desert conditions, dromedary camel is considered as a multi-purpose animal providing man with milk and meat in the harsh conditions imposed by the environment. Camel population is estimated to stand at more than 350,000 heads (FAOSTAT 2014). However, several obstacles limit the camel populations increasing. These include, the low reproductive performance, where delayed first service, induced ovulatory (non-spontaneous), seasonal breeding, long gestation period, long calving interval, and with relatively short breeding period of about 3 to 4 months (Kaufmann 2005; Tibary and Anouassi 1997), higher culling rate (Benaissa et al 2016), and the high incidence of reproductive disorders (Ali et al 2015). Increasing the reproductive efficiency is essential for profitable production, furthermore in genetic improvement and selection of camel breeds.

Genital abnormalities play an important role in animal breeding by causing subfertility, thus have serious economic impact to the animal production sector. Post-partum uterine diseases alter fertility by delay in uterine involution, reduce milk production and generally affect the animal's health (Walsh et al 2011). As in many domestic animal species, uterine infections have been associated with repeat breeding pathology in she-camels (Ali et al 2015). Many prevalence surveys of reproductive abnormalities have been conducted since the 1980s in Saudi Arabia (Al-Afaleq et al 2012; Mahmoud et al 2011; Ali et al 2009), in Nigeria (Ribadu et al 1991), in United Arab Emirates (Tibary and Anouassi 2000), in Egypt (Elwishy 1989; Omar et al 1984), and in Jordan (Al-Ani et al 1992), with a wide range from 2,1%

(Elwishy 1989) to 43,9% (Al-Afaleq et al 2012). The discrepancy in these prevalence rates presumably relates to the application of different diagnostic methods, with variable test performance, and the use of different classification systems to define the abnormalities. Comparing to other species, there are many gaps in our understanding of the etiology and pathogenesis, and evolution of this common disorder in camelids. Failure to diagnose early and provide appropriate treatment may result in serious outcomes.

Investigation of camel reproductive abnormalities based on abattoir survey of specimens could be effective for providing useful information on prevalence of reproductive disorders and their incidence. In camel, the histopathological criteria of uterine abnormalities are largely understudied. For this reason, our study was carried out to obtain further information on prevalence of the uterine lesions and the histopathological features of uterine specimens of she-camels in Southern Algeria.

## Materials and methods

A total of 740 genital tracts of female camels slaughtered in two abattoirs (El-Oued and Touggourt) were examined in Southeast of Algeria, from February 2011 to June 2013. No information was available on the clinical history of the animals. The reproductive organs of each camel were carefully removed and examined for gross pathological changes. Specimens from uteri showing gross abnormalities were fixed in 10% neutral formalin, processed in paraffin. Sections of 4 µm thickness were cut from formalin-fixed, and stained with hematoxylin and eosin (H&E) to examine the histopathological features such as hemorrhage, infiltration of lymphocytes polymorphonuclear, neutrophil,

Table 1. Percentage of genital tract disorders in she-camels

Pathology	Number of cases (N 213) (%)	Percentage of examined cases (N 740) (%)	Percentage of affected cases (N 282) (%)
<b>Oviduct lesions</b>			
Pyosalpinx	5	0.7	1.8
Hydrosalpinx	1	0.1	0.4
Catarrhal salpingitis	4	0.5	1.4
<b>Total</b>	<b>10</b>	<b>1.4</b>	<b>3.5</b>
<b>Uterine lesions</b>			
Endometrial cysts	7	0.9	2.5
Endometrial polyps	9	1.2	3.2
Metritis	21	2.8	7.4
Endometritis	24	3.2	8.5
Peri-uterine adhesion	15	2	5.3
Pyometra	8	1.1	2.8
Hydrometer	2	0.3	0.7
Uterine abscesses	4	0.5	1.4
Uterine atrophy	2	0.3	0.7
Hematoma	1	0.1	0.4
Serous cyst	2	0.3	0.7
<b>Total</b>	<b>99</b>	<b>13.4</b>	<b>35.1</b>
<b>Cervical lesions</b>			
Cervicitis	15	2	5.3
Total obstruction	2	0.3	0.7
<b>Total</b>	<b>17</b>	<b>2.3</b>	<b>6</b>
<b>Vaginal lesions</b>			
Vaginitis	6	0.8	2.1
Adhesion	3	0.4	1.1
<b>Total</b>	<b>9</b>	<b>1.2</b>	<b>3.2</b>
<b>Other pathologies</b>			
Embryo mortality	5	0.7	1.8
Maceration	2	0.3	0.7
<b>Total</b>	<b>7</b>	<b>0.9</b>	<b>2.5</b>

macrophage and plasma cells, peri-glandular or blood vascular fibrosis, cystic glandular degeneration, cystic degeneration and necrosis and epithelial disruption or loss.

Data were analyzed using descriptive and quantitative statistical tools (SPSS, IBM Corp Ver. 20.0).

## Results

### Epidemiological profile

#### Prevalence of the lesions according to their macroscopic aspect

Of the 740 genital tracts examined in this study, 28.8% (213 tracts) presented at least one macroscopic lesion. The observed pathologies were dominated by ovarian and ovaro-bursal pathologies (49.6%) followed by uterine disorders (35.1%), cervical lesions (6%), oviduct abnormalities (3.5%) and vaginal lesions (3.2%). Among the 740 camels slaughtered, 143 (19.32%) were pregnant.

### Uterine disorders

Among the macroscopic lesions revealed in the present study, clinical endometritis was the predominant uterine affection (24.2%), followed by metritis (21.2%), peri-uterine adhesion (15.1%), endometrial polyps (9.1%) and pyometra (8.1%). Other abnormalities noted with low prevalence were endometrial cysts (7.1%), hydrometer (2%), and uterine abscesses (4%) (Table 1).

### Oviduct lesions

Pyosalpinx was the most frequent oviduct disorder (71.4%) followed by hydrosalpinx and catarrhal salpingitis with the same prevalence (14.3%).

### Cervical and vaginal abnormalities

Cervical infections were represented by cervicitis (88.2%) and total obstruction of the cervix (11.8%). Vaginitis constituted 2/3 of the vaginal pathologies found in the present study, the

Table 2. Repartition of the affected animals according to the number of the lesion on the same organ

	Animals	Pathologies	One pathology	Two pathologies	Three pathologies	Four pathologies
<b>Total</b>	740	213	159	41	11	2
<b>Percentage</b>	/	100%	74.60%	19.20%	5.20%	1%
<b>Sahraoui</b>	647	191	144	29	8	1
<b>Tergui</b>	93	22	15	12	3	1

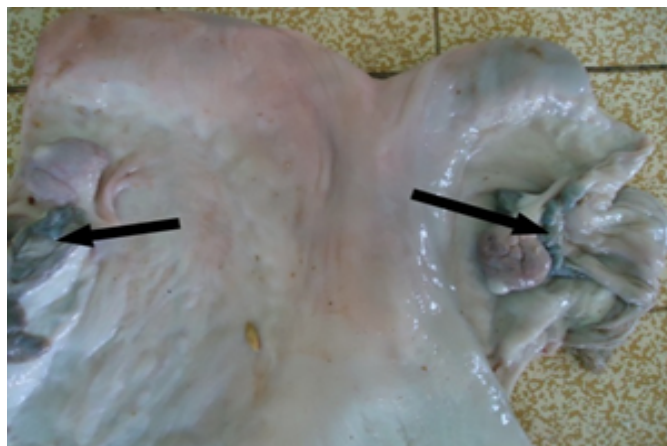


Figure 1. Catarrhal salpingitis

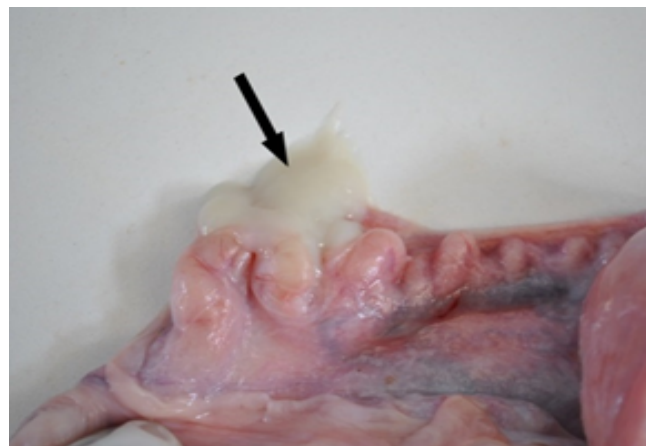


Figure 3. Pyosalpinx



Figure 2. Hydrosalpinx

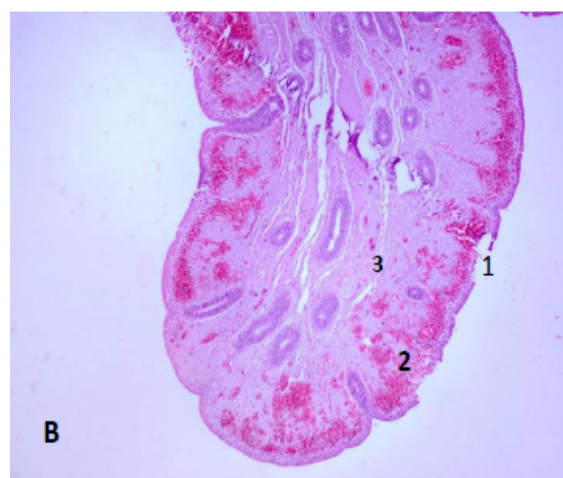
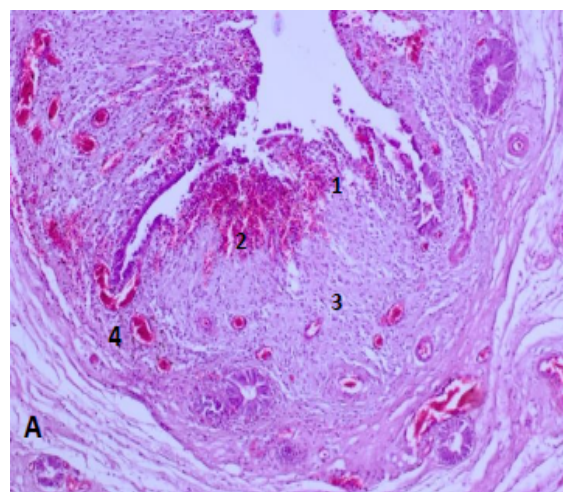


Figure 4: Pathological changes of the endometrium in camels A: acute endometritis with subepithelial hemorrhage; 1: Desquamation and hyperplasia of the epithelium: 4: Polymorph infiltrate, Endometrium atrophy; B 2: Sub-epithelial hemorrhage 3: Chorion edema: x 40; HE

remaining cases (1/3) were represented by vaginal adhesions. Table 2 showed the number of the females with one or more abnormalities. Of the 213 tracts with abnormalities, 159 genital tracts (74.6%) showed a single lesion, while 41 (19.2%) presented two lesions. In addition, females with three and four lesions were noted in 5.2% and 1% of the cases, respectively.

**Macroscopic examination and histopathological profile of the principal lesions**

**Oviduct lesions**

The prevalence of acute catarrhal salpingitis (Figure 1) was estimated at 4/740 (0.5%). Microscopically, the oviduct was enlarged in size and the mucosa was hyperemic and covered with a mucosal exudate. This examination showed also epithelial hyperplasia, congestion of blood vessels and mononuclear inflammatory cells infiltration of the lamina propria.

One case of hydrosalpinx was noted in this study (0.1%). It was unilateral, affecting the right ovary and was associated with ovarobursal adhesion (Figure 2). Pyosalpinx was characterized by the presence of a purulent liquid collection (Figure 3), bilateral in 60 % (3/5) of the cases and unilateral in 40 %

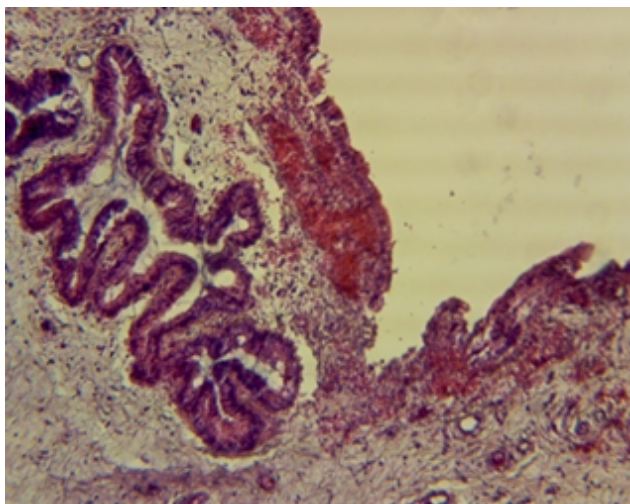


Figure 5. Degenerative Acute Endometritis x 40; HE (1: Periglandular fibrosis, 2: cystic dilatation of the endometrial glands).

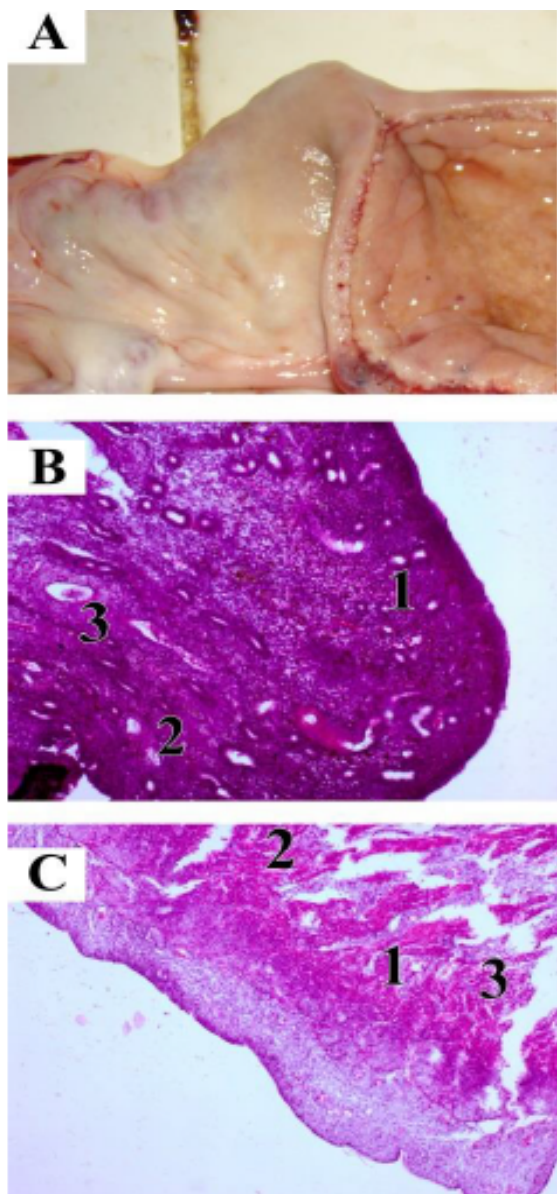


Figure 6. Chronic endometritis with sub-epithelial hemorrhage; 1: Diffuse hemorrhage with hemosiderosis; 2: Disappearance of the glands, 3: Chorion fibrosis. x 100; HE

(2/5) of the cases. It was generally associated with genital infection (Pyometra).

#### Uterine lesions

On the 24 cases of endometritis, 20 cases were diagnosed as acute catarrhal endometritis (2.7%). Macroscopically, the uterus was hypertrophied and the mucous membrane was excessively congested and edematous. In some cases, different areas of petechia which were associated with thick mucoid exudate were noted. Histological examination revealed the destruction of the epithelial surface layers associated with blood vessels congestion, intense edema and glands dilation. These glands were invaded by inflammatory cells infiltration. Some foci of epithelial desquamation and hyperplasia (Figure 4) and glands degeneration were observed. Moreover, multiple hemorrhagic areas mixed with pellets of brown pigments of hemosiderin in the mucous membrane were also detected. In some cases, microscopic examination showed cystic dilation of endometrial glands bordered by a flattened epithelium (Figure 5).

Chronic endometritis was found in 0.5 % of the cases. This lesion is generally asymptomatic and its diagnosis is rarely done clinically. It is based on histological data obtained by endometrial biopsy. Necrosis and surface epithelial elimination can be noted (Figure 6).

Metritis was found in 2.8% of the cases. Acute metritis showed a high stroma invasion by polymorphic inflammatory infiltrate with the prevalence of granulocytes. In suppurative form, the granulocytes were normal or degenerated, present in great number and in most cases with epithelial cells (Figure 7.D). Surface and glandular epithelium presented degenerative areas. The necrosis and the elimination of the epithelial surface can be also visible (Figure 8.B). A dense polymorphic inflammatory infiltrate of the stroma was associated with a superficial edema and with the presence of plasmocytes (numerous, high nuclei-cytoplasmic ratio). Edema is usually located close to the epithelium. The prevalence of pyometra was estimated at 1.1%. According to our macroscopic study, these cases were characterized by large accumulation of purulent fluid in the uterus without emptying the latter (Figure 9.A). Histologic examination showed a disappearance of the epithelium with the presence of intense edema (Figure 9.D), associated with a large glandular fibrosis in parallel with a glandular atrophy more or less consistent.

Adhesions were found on 2% of the genital tract examined (Figure 10). These adhesions were linked to different organs of the abdomen (peritoneum, kidney and intestine)

Endometrial polyps were not frequent in the present study. This lesion represented 3.1% (8 cases) of all the abnormalities (Figure 11). Two types of polyps were noted: broad-sided polyps (sessile) and polyps which were attached to the uterus by elongated pedicle (Pediculate). Pediculate polyps were more frequent than the others. Their size was ranging from 0.6 mm to 1.9 mm.

#### Cervical lesions

Of the 740 genital tracts examined, cervicitis was found as acute catarrhal cervicitis (0.4%). Macroscopically, the volume of the cervix was increased with irregular contours, the mucous membrane is edematous, congested, and covered with yellowish or whitish viscid exudate. Histologically, the cervix showed great variations: congestion of blood vessels, epithelial desquamation

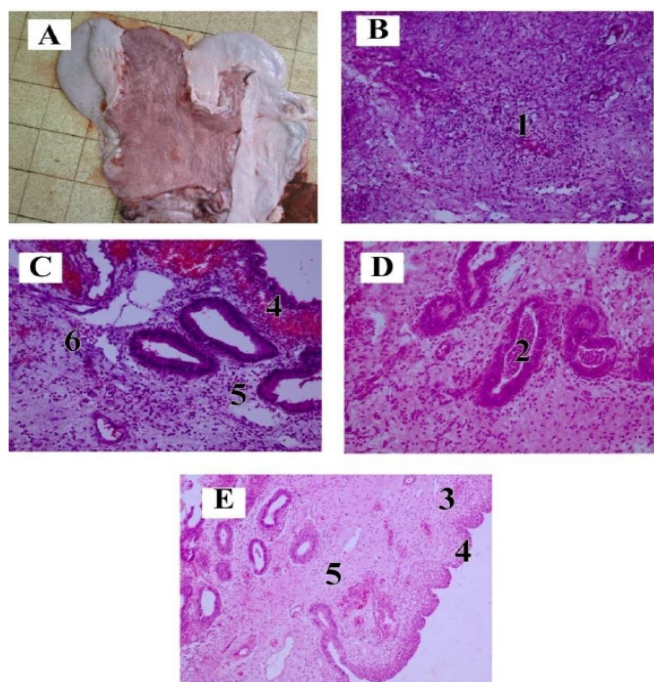


Figure 7. Pathological changes in endometrium A: acute metritis with subepithelial haemorrhage; B: 1: Polymorphic infiltrate; C: 4: Hemorrhagic and epithelial infiltrate 5: Chorion edema 6: Granulocyte infiltrate; D: 2: Intraglandular suppurative collection x 200; E: Acute endometritis with perivascular fibrosis 3: Congestion.4: Hemorrhagic infiltrate 5: Chorion edema

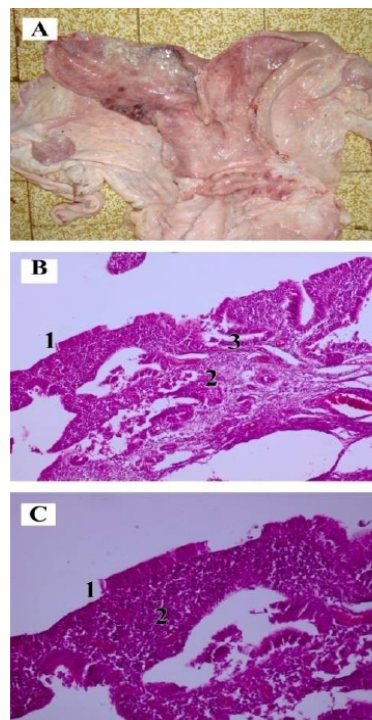


Figure 8. Suppurative chronic metritis 1. Desquamated epithelium. 2. Massive granulocytes infiltration of the chorion. 3. Intravagination

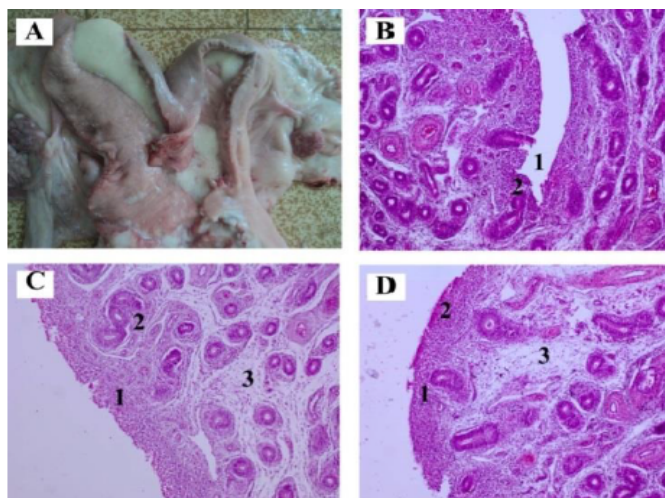


Figure 9: Pyometra in camels. A: Acute pyrometer with subepithelial hemorrhage; B: 1: Disappearance of the epithelium; 2: Superficial infiltrate; 3: Edema C: Chronic Endometritis 1: Disappearance of the epithelium; 2: Superficial infiltrate; 3: Edema C; D: 2: HE x 100

and hyperplasia of the cervical glands. Cellular infiltrations by neutrophils and sub-epithelial hemorrhages were also noted (Figure 12.B).

The total obstruction of the cervix is a congenital malformation (Figure 13). This lesion was associated with hydrometer. Two cases were recorded in our study.

**Vaginal lesions**

In the present study, six cases of vaginitis were detected in the examined female genitalia (0.6%). Macroscopically, the vaginal



Figure 10: Peri-uterine adhesions

mucosa was significantly swollen and congested (Figure 14). Under the microscope, congestion of blood vessels, epithelial desquamation of the mucosa and the submucosa, edema with inflammatory cellular infiltration mainly with lymphocytes were showed. In addition, focal aggregation of the mononuclear inflammatory cells was noted in one case.

Other less dominant lesions

Other less frequent lesions were represented by endometrial cysts (Figure 15), (0.9%), embryonic mortality (Figure 16), (0.7%), hydrometer (2%), para-ovarian abscess (Figure 17). A suspicion of metastasis on the uterine serosa (Figure 18) was noticed.

**Discussion**

In the current study, the prevalence of oviduct disorders was 3.5% of the total lesions, which is in agreement with the results

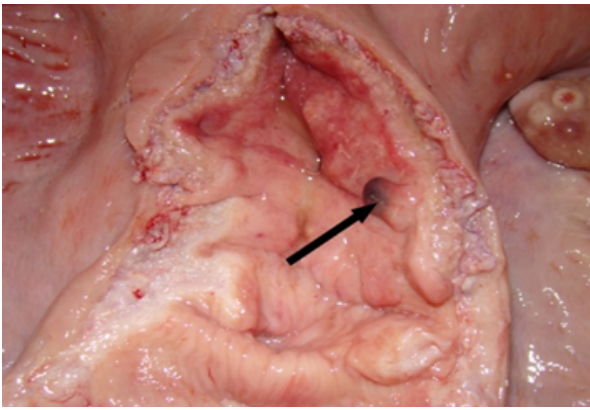


Figure 11. Endometrial polyps

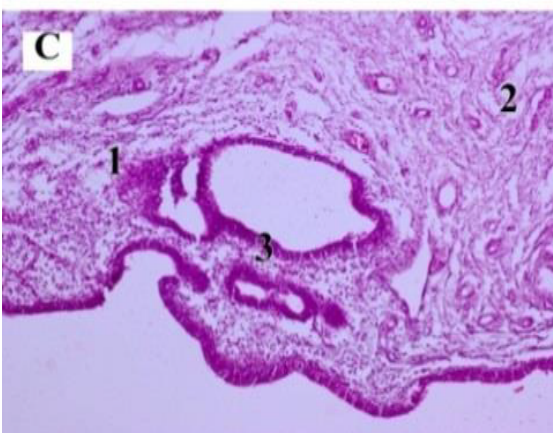
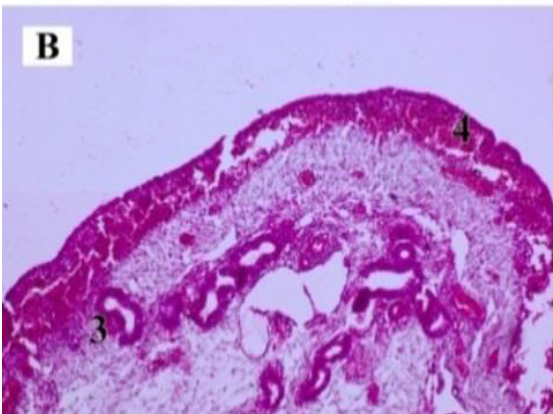
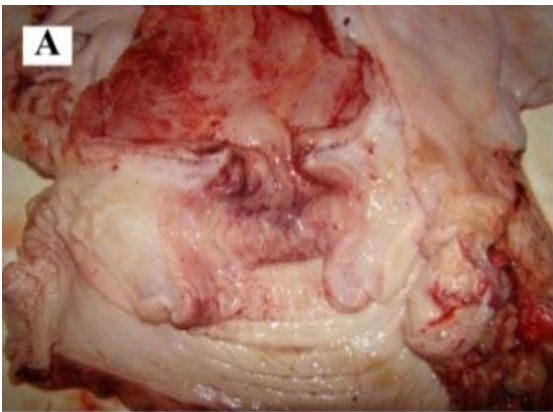


Figure 12: Pathological changes in the cervix A: Acute cervicitis with B: 3: Granulocytes infiltration; Desquamated epithelium. 4: sub-epithelial hemorrhage; C: Acute cervicitis with 2: chorion edema; Hyperplasia of the cervical glands

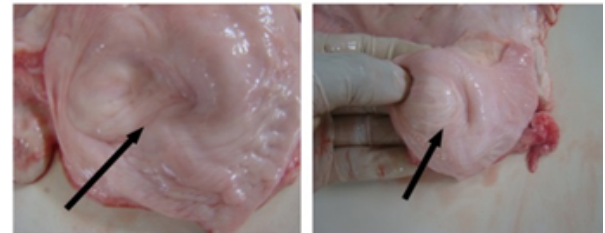
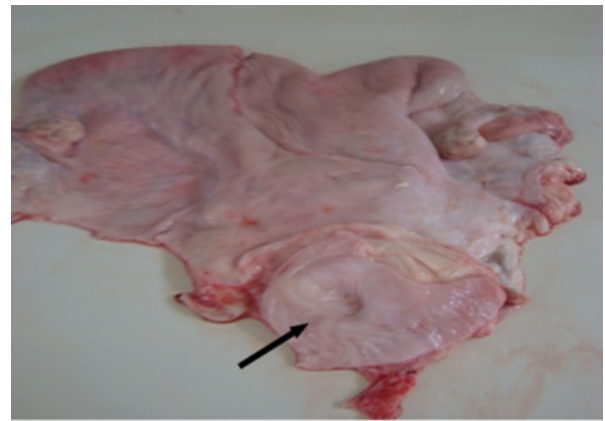


Figure 13. Total obstruction of the cervix

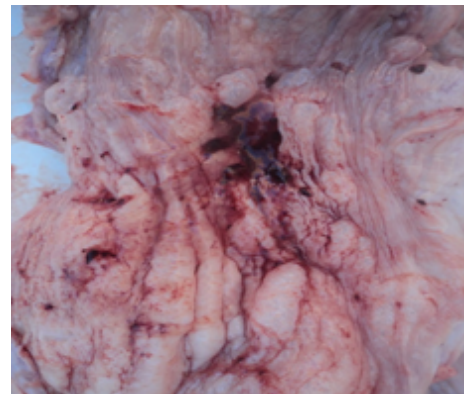


Figure 14. Vaginitis

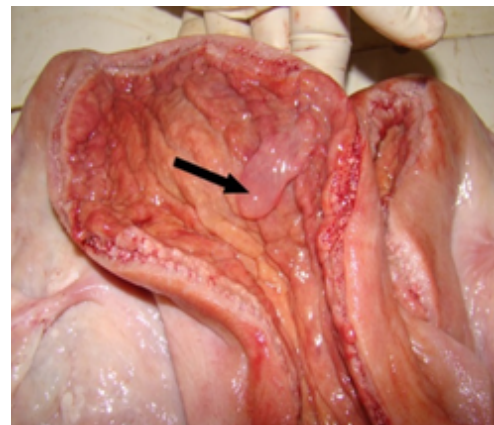


Figure 15. Endometrial cyst

of Shawky *et al* 2004 (3.08%). In the dromedary, inflammatory changes and accumulation of the fluids (pyosalpinx and hydrosalpinx) are the most frequent lesions of the oviduct (Tibary and Anouassi 1997). In this study, hydrosalpinx was recorded at low level (0.1%) than those of Nur, 1984 (6.1%). Endometritis showed a frequency of 3.2%, which is quite low compared to other values in slaughterhouse surveys in different

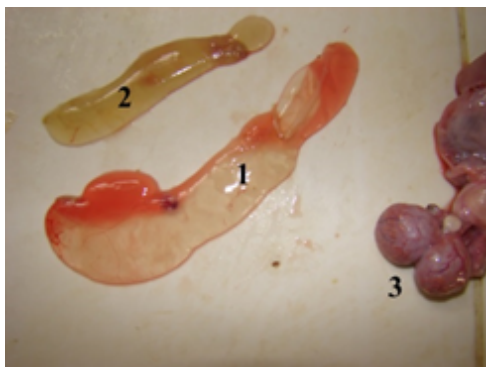


Figure 16. Embryonic mortality

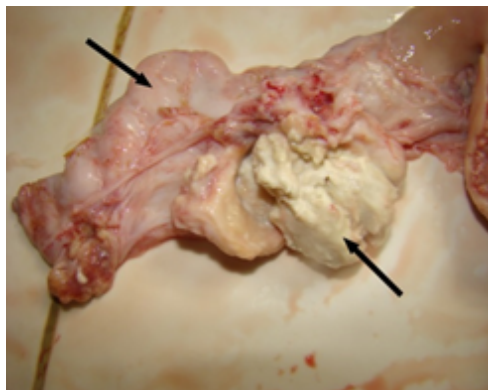


Figure 17. Para-ovarian abscess

countries: Nigeria (9.6%) (Mshelia et al 2013), Saudi Arabia (12.7%) (Al-Afaleq et al 2012), Sudan (16.7%) (Yagoub 2005), Egypt (16.5%) (Omar et al 1984); (13.2%) (Schawky et al 2004). Much higher frequencies were found in clinical studies about infertility factors ranged from 24% (Waheed et al 2009); 31% (Ali et al 2015b); 34.2% (Tibary et al 2005) and 57.1% (Ali et al 2009). Uterine infection is a major abnormality of the genital tract, resulting in infertility (Tibary et al 2006). The low prevalence of endometritis observed in our study may be partially explained by the fact that only clinical endometritis was considered.

Histologically, the endometrium showed massive mononuclear infiltration with high number of lymphocytes and macrophages. Some cases may contain cystic glandular areas and peri-glandular fibrosis with inflammatory cellular infiltration. The same histological findings were also found in other studies (Shawky et al 2004; Waheed et al 2009). In some cases, extensive degenerative lesions of the endometrial glands were observed. Cellular infiltration, edema, vascular congestion and alteration of the luminal epithelium are essential features of acute endometritis. The pathological thresholds for uterine infiltration at 21-35 days post-partum have already been reported in cows (Deguillaume et al 2012). Actually, there is no information about the threshold of uterine infiltration or endocervical inflammation in the literature in camels. A recent study by Ali et al (2015) revealed that endometrial inflammations were more common in repeat breeder camels which confirmed the study of Waheed et al (2009).

The prevalence of metritis reached 2.8% (21/740) in the current study. This result is close to those cited in the bibliography (Tibary and Anouassi 1997; Al-Ani et al 1992; Omar et al

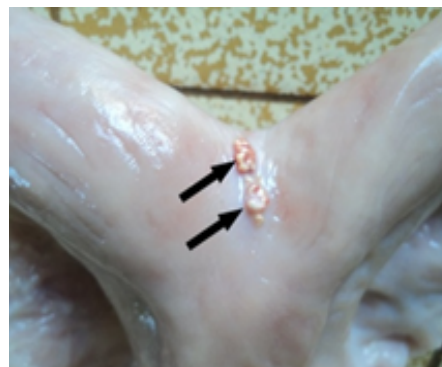


Figure 18. Metastatic mass

1984). The most suggestive histological lesion for metritis diagnosis was cellular infiltration of the epithelium and leukocyte infiltration of the endometrium with the presence of lymphoid nodules and hemorrhagic and sub-epithelial infiltrates. The most frequently isolated germs in camels are *P. vulgaris*, *C. pyogenes*, *Escherichia coli* and *Campylobacter* spp. (Al-Afaleq et al 2012; Tibary et al 2006; Yagoub 2005).

Our study showed low prevalence of pyometra in camels (1.1%). This result is close to those of Elwishy (1989) and Omar et al (1984). However, no pyometra cases were revealed by Mshelia et al (2013) and Al-Afaleq et al (2012). As a result, the prevalence of pyometra in dromedaries seems to be low.

Mucometra represents accumulation of strongly viscous aseptic liquid in uterine lumen. It is associated with anatomical disorder of the genital tract or with an ovarian pathology (Mimoune et al 2016). In our work, mucometra was found in 0.3% of cases and was associated with a complete obstruction of the cervix in two cases. This result is close to those reported by Elwishy (1989) and Omar et al (1984), while in a recent study the prevalence was estimated at 7.8% (Mshelia et al 2013). In clinical studies, prevalence rates were significantly higher, ranging from 7.6% (Yagoub 2005) to 14% (Waheed et al 2009). Microscopic examination showed endometrium and myometrium atrophy and cystic aspect of the uterine glands.

Endometrial polyps showed a prevalence of 1.2% with a diameter ranging from 3 to 30 mm approximately. These polyps were pediculate and were multiple in 20% of cases. They may contain glandular and cystic areas. This lesion can lead to infertility in camels (Tibary and Anouassi 1997). Microscopically, we can distinguish hyperplastic polyps (covered with an epithelium close to that of endometrial hyperplasia) and atrophic polyps. The latter, were covered with atrophic glandular epithelium, and contained cystic and dilated glands. These polyps are also described in bitch and cat (Gelberg and Mcentee 1986).

Endometrial cysts constitute a common form of uterine lesions and they are rarely reported in the literature. In the present study, their frequency was estimated at 0.9%, in conformity with the result reported by Omar et al 1984 (0.32%). They are filled with lymph and can be single or multiple with a very variable size ranging from 2 mm to 5 cm (Tibary and Anouassi 1997). Cervicitis is generally associated with uterine infection. The result supported some authors' opinions that infectious agents in the vagina passing to cervix and uterine lumen may result in cervicitis and endometritis (Mimoune et al 2016). In this study, 15 cases of acute cervicitis were observed (2%). Moreover, our data is in agreement with the work of Omar et al (1984) (0.86%) and

Shawky et al (2004) (1.54%). Histological examination showed desquamation of epithelial surface with a complete disappearance in some cases and superficial infiltration of the epithelium by the lymphocytes. These observations are consistent with the study of Al-Afaleq et al (2012) and Shawky et al (2004).

Total or partial obstructions of the cervix were found, resulting in the accumulation of fluid (hydrometra) or pus (pyometra) in the uterus. This malformation can be congenital or acquired (with inflammatory or hormonal origin) (Ali 2010). These cases have been frequently observed clinically, and could be one of the major causes of repeat-breeding in camels (Ali et al 2015; Ali et al 2009; Tibary et al 2005).

In the present study, vaginitis was the most common vagina disorder (0.8%). The prevalence is consistent with the results reported by Shawky et al (2004) (0.6%) and Omar et al (1984) (0.7%). Generally, inflammatory vagina is associated with poor husbandry and inadequate manipulation of vaginal activity (Nur 1984). It may have resulted from inadequate hygienic condition during parturition, post-partum and vaginal examinations. Some cases showed necrosis foci. Symptoms are mostly local. Vaginal exploration is painful and the mucosa is congested (Tibary and Anouassi 1997).

The other abnormalities studied were minor lesions (which have no effect on female fertility or revealed with very low incidence). Other uterine disorders are described in the literature but remain very rare: cysts, abscess, adhesion and neoplasms. Different studies reported cases of adenocarcinoma, leiomyosarcoma, leiomyoma, lipoma as well as two cases of uterine adenocarcinoma (Al-Afaleq et al 2012; Shawky et al 2004; Ribadu et al 1991).

In the present work, no bacteriological analysis was performed. However, previous studies carried out by Ali et al (2015) Al-Afaleq et al (2012) and Mshelia et al (2013) enabled to identify the principal bacteria associated with uterine infections. Other causes of genital lesions such as viruses and fungi are not well described in she-camels.

## Conclusion

In the current work, endometritis is the most dominant pathology. Through this study, our results demonstrated the importance of the genital affections of the camels both in extensive (traditional) breeding and also to develop an intensive breeding of dairy type. These diseases may cause significant losses due to the decline of fertility of the herd, the costs of treatment, and the early reform of infertile camels. A significant number of abnormalities have an infectious origin. Therefore, we suggest that it is important to study the different risk factors and the pathogens involved in these diseases.

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