
CROSS-SECTIONAL SURVEY OF CONGENITAL AND ACQUIRED GENITAL DISORDERS IN SAHRAOUI FEMALE CAMELS (*CAMELUS DROMEDARIUS*) AT EL OUED ABATTOIR, SOUTH-EAST ALGERIA

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ABSTRACT

The present study was carried out to highlight the prevalence and the incidence of the genital tract abnormalities in Sahraoui female camels at south-east Algeria. One hundred and sixty five (165) animals were examined at El Oued abattoir before and after slaughter from February 2013 to August 2014. The prevalence of female camels with genital tract pathologies was 20.0 %. The total number of identified genital tract pathologies was 41, representing an incidence of 124.2 %. These pathological conditions were ranked in descending order of incidence: ovarian disorders (48.8 %), uterine pathologies (21.1 %), ovarian bursal pathologies (18.2 %) oviducts affections (18.2 %), adhesions (15.2 %) and pathology of the cervix (3.0 %). The prevalence of dominant pathologies was 7.9 % for ovarian cysts, 3.6 % for oviduct lesions, 2.4 % for infundibular cyst, 1.8 % for chronic endometritis and 1.8 % for tubo-ovarian adhesion. This study is the first report of uterine agenesis in camel from Algeria. The number of female camels with multiple pathologies (two or three pathologies) was 6, representing prevalence of 3.6 %. Higher prevalence of female camels with genital disorders was recorded in >10 years old, high BCS and during the dry season. However, a non-significant chi-square dependence test ($p>0.05$) was observed for the risk factors. In conclusion, the ovarian, uterine, and bursal pathologies were most commonly recorded in the genital tracts of the female camels from south east, Algeria. Their contribution in the reduction of fertility and fecundity of local herds needs further investigation.

Keywords: Female camel, *Camelus dromedarius*, Genital disorders, Incidence, Prevalence, Risk factors

INTRODUCTION

The reproductive performance of livestock depends on the genetic potential of the species and breed, the management of the livestock and the production conditions (Kaufmann, 2005).

The reproductive efficiency of camel under natural pastoral conditions is said to be low. This may be due to short breeding season, late age of reaching puberty and long gestation period (El-Hassanein, 2003; Skidmore, 2005). Other factors contributing to low fertility in camels include age at first calving, low libido of

male thereby reducing breeding opportunities and late postpartum estrus (Al-Qarawi, 2005; Monaco *et al.*, 2015; Padalino *et al.*, 2015). Furthermore, poor management practices in regions where camels are raised, negatively affect its reproduction and productive performance (Abdussamad *et al.*, 2011).

The available data on the incidence, pathogenesis and treatment of camel's reproduction disorders are limited, thus the diagnosis and treatment in this species are usually addressed in the same way described for cows and mares. Most of these disorders are usually associated with repeated breeding, early embryonic mortalities, fetal mortalities and abortions. Infertility in this species is one of the major reproductive problems. It is mainly due to the absence of ovulation (Tibary and Anouassi, 1998). Ovarian lesions, particularly burso-ovarian adhesions and cystic degeneration of the ovaries, are responsible of long-term infertility problems in farm animals, including camels (Tibary and Anouassi, 2001; Kubar and Jalakas, 2002). Cystic degeneration of the ovaries of the camel includes follicular cysts, luteal cysts, hemorrhagic cysts and para-ovarian cysts (Chen *et al.*, 1983; El-Wishy, 1990; Waheed *et al.*, 2017). Oversized follicles lead to infertility problems in *C. dromedarius* such as repeat breeding, nymphomania and anestrous (Waheed *et al.*, 2017). Ovarian hypoplasia, characterized by the absence of ovarian follicular activity due to genital and chromosomal abnormalities, has also been reported in camel species (Tibary and Anouassi, 2001; Hussein and Saad, 2017).

The incidence of early embryonic mortality in camels is about 23.0 % (Moustafa *et al.*, 2004). Many factors are reported with regards to uterine diseases. Uterine disorders are mainly inflammatory in nature. The catarrhal endometritis is the most frequently recorded uterine pathology in camels (Shalaby, 1986; EL-Deeb, 1995; Hegazy *et al.*, 1998; Hanafi *et al.*, 1999; Tibary, 2018). In addition, metritis, uterine fibrosis, cysts, abscesses and uterine neoplasms are considered as acquired uterine lesions often result in infertility in camels (Shawki *et al.*, 1985; Tibary and Anouassi,

1997; Hegazy *et al.*, 1998; Tibary and Anouassi, 2000a).

The above citations indicated that the health of the genitalia of camels plays an important reproductive role in she-camels. Thus, the present survey was undertaken at El Oued local slaughterhouse at southeastern Algeria in order to offer information about the frequency and incidence of pathological conditions contributing to low reproductive performances in Sahraoui she-camels.

MATERIALS AND METHODS

Study Region: The experiment was conducted at El Oued region situated in the extreme arid region of the southeastern of Algeria (Latitude 33°5' and Longitude 6°11', average altitude 80 m, average annual temperature of 25 °C, and mean annual precipitation of 80 mm). The relief of El Oued region is composed of the great eastern erg which is a real sea of sand dunes, the Hamada, that is a tray vast and stony lands, a fairly prospered valleys, and few depressions called the zone of the chotts (Ballais, 2010).

Animals: This study was conducted between February 2014 and November 2015. The studied animals were selected by random sampling technique from the local Sahraoui camel targetted population. The reproductive histories of the studied animals were unknown. They were culled from pastoral herds and intended for the production of meat for human consumption. General inspection of each animal was undergone with special attention to genital loco-regional signs (Hanzen, 2015a). Those who have normal clinical conditions were retained. The size of the collected samples was determined according to the formula provided by Thrusfield (2005) with 95.0 % confidence interval and 7.0 % absolute precision. The expected prevalence of genital diseases was 28.78 % (Benaissa *et al.*, 2015). Accordingly, a total of 165 genital tracts of pubertal and non-pregnant she-camels were collected at the slaughterhouse. The age of these animals varies between 6 to 20 years (Rabagliati, 1924) and their body condition ranges from 2 to 4 on a scale of 5 (Faye *et al.*, 2001).

Macroscopic Examination of Genital

Tracts: After slaughter, the genital tract was separated carefully from the pelvis and surrounding tissues. A standard genital examination (Hanzen, 2015a) was adapted for an *in-vitro* diagnosis. Macroscopic examination was performed thorough inspection and palpation in a progressive ascending sequence (vulva, vagina, cervix, uterus, oviducts and ovaries). Then, the genital tracts were incised longitudinally and opened for the examination of their lumen. Small, flat and smooth or rough ovaries (follicles >5 mm) were not included in the ovarian pathologies (Gherissi *et al.*, 2018). All genital tracts with macroscopic abnormalities were sampled. 2 – 3 cm³ tissue sampled from different genital parts were fixed in 10 % formalin for subsequent histopathological investigations. The identification and classification of the various pathologies encountered were carried out according to the guide of the genital pathologies of infertile and subfertile female camelid (Tibary and Anouassi, 1997; Rodriguez *et al.*, 2014). The suggested method for uterine infection classification was based on the clinical definitions for the common postpartum uterine diseases (Sheldon *et al.*, 2006).

Statistical Analysis: The morbidity statistics for each pathological condition were generated by measuring: (i) prevalence (percent from examined cases) = (number of affected cases / total number of examined cases) x 100, (ii) incidence (percent form affected cases) = (number of affected cases of a disorder / total number of affected cases) x 100. The statistical analysis of collected data was performed using SPSS software 20 (IBM, SPSS statistics). The descriptive results of each genital abnormality (or association of pathologies) were calculated. The contingency tables and the Chi-square test were applied to determine the association between the frequency of genital conditions and risk factors: age, season, and body condition (Yates *et al.*, 1999). The level of statistical significance was set at $p < 0.05$.

RESULTS

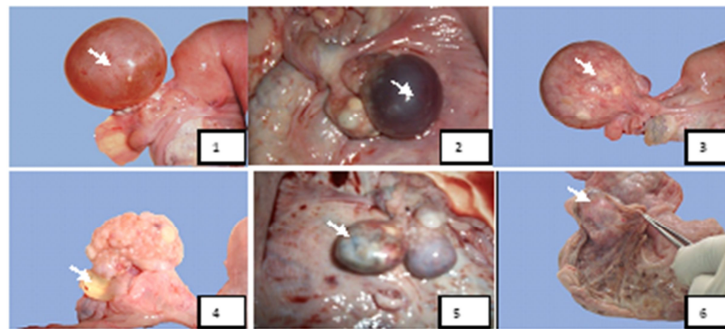
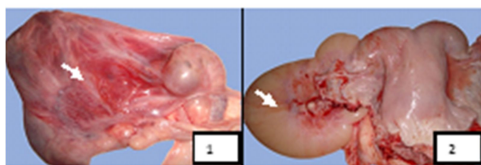
General Background: The results indicated that the total number of females with pathological genital conditions was 33 out of a total of 165 females, representing a prevalence of 20 %. The total number of identified genital disorders was 41 cases, i.e. a rate of 24.8 % among the examined female cases and 124.2 % among affected cases (Table 1). It was noted that 6 cases of associated genital disorders were recorded in this study, i.e. a rate of 3.6 % and an incidence of 18.0 %. The ovarian pathologies dominate with the highest incidence of 48.4 % followed by genital abnormalities of uterus (21.1 %), ovarian bursa (18.2 %), oviducts (18.2 %), adhesions (15.2 %) and cervicitis (3.0 %) (Table 1).

Prevalence and Incidence of the Genital

Disorders: Figures 1 to 5 showed the different genital conditions recorded on the studied she-camels at local slaughterhouse of El Oued. The prevalence of females with ovarian cysts (8 follicular cysts, 3 hemorrhagic cysts and 2 luteinized follicular cysts) was the highest (7.9 %) i.e. an incidence of 39.4 %. The hypertrophy and the torsion of oviducts occur with a prevalence of 3.6 % and an incidence of 18.2 %. Four cases of hydrobursitis (infundibular cyst) were identified among the studied population, representing a prevalence of 2.4 % and an incidence of 12.1 %. The two following pathological entities: chronic endometritis and tubo-ovarian adhesions were observed in 3 cases (prevalence of 1.8 % and incidence of 9.1 %) for each condition. In other hand, 2 cases (prevalence of 1.2 % and incidence of 6.1 %) of ovarian bursitis and peri-uterine adhesions were recorded in the studied animals. Finally, one case was found for each following abnormalities: para-ovarian cyst, ovarian teratoma, oophoritis, clinical metritis (puerperal metritis), pyometra, uterine agenesis, uterine serousal cyst and cervicitis i.e. a prevalence of 0.6 % and an incidence of 3.0 % for each case.

Table 1: Prevalence and incidence of different genital abnormalities found in female camels studied at El-Oued slaughterhouse

Genital abnormalities		Number of genital affections	Number of examined she-camels	Prevalence (%)	Incidence (%)
Ovaries	Ovarian cysts	13	165	7.9	39.4
	Para-ovarian cysts	1	165	0.6	3.0
	Ovarian teratoma	1	165	0.6	3.0
	Oophoritis	1	165	0.6	3.0
Ovarian Bursa	Bursitis	2	165	1.2	6.1
	Hydrobursitis (Infundibular cyst)	4	165	2.4	12.1
Uterus	Clinical metritis	1	165	0.6	3.0
	Chronic endometritis	3	165	1.8	9.1
	Pyometra	1	165	0.6	3.0
	Uterine agenesis	1	165	0.6	3.0
	Uterine serosal inclusion cyst	1	165	0.6	3.0
Oviducts	Oviduct hypertrophy/torsion	6	165	3.6	18.2
Adhesions	Tubo-ovarian adhesions	3	165	1.8	9.1
	Peri-uterine adhesions	2	165	1.2	6.1
Cervix	Cervicitis	1	165	0.6	3.0
Total genital affections		41		24.8	124.2
Total she camels with genital disorders		33		20.0	100.0

**Figure 1: Macroscopic aspects of ovarian affections found in female camels studied at El-Oued slaughterhouse.** Key: 1-Follicular cyst, 2-Hemorrhagic cyst, 3-Luteinized follicular cyst, 4-Para-ovarian cyst, 5-Ovarian teratoma, 6- Oophoritis**Figure 2: Macroscopic aspects of ovarian bursal affections found in female camels studied at El-Oued Slaughterhouse.** Key: 1- Bursitis, 2- Hydrobursitis

Influence of Age, Seasons and Body Condition Score (BCS): The Table 2 showed the distribution of she-camels with genital affections according to the age, seasons and the BCS. The rate of these animals was higher in

the age category of >10 years (70.0 %). Similarly, among the healthy animals, those belonging to this same age category represented a rate of 78.8 %. This was expressed by a non-significant chi-square dependence test ($p>0.05$). Likewise, the healthy and pathological she-camels with high BCS constituted the highest rates (60.6 and 59.8 %, respectively, $p>0.05$). The high frequencies of she-camels that carry a genital disorder and those without any affection were recorded during the dry season (77.2 %, 65.9 %, $p>0.05$).

Associate Genital Abnormalities: The associate genital disorders in the studied she-



Figure 3: Macroscopic aspects of uterine affections found in female camels studied at El-Oued Slaughterhouse. Key: 1 - Pyometra, 2 - Uterine serosal inclusion cyst, 3 - Uterine agenesis

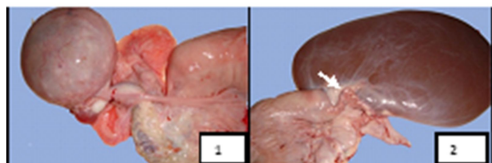


Figure 4: Macroscopic aspects of oviduct affections found in female camels studied at El-Oued slaughterhouse. Key: 1 - Oviduct hypertrophy, 2 - Oviduct torsion

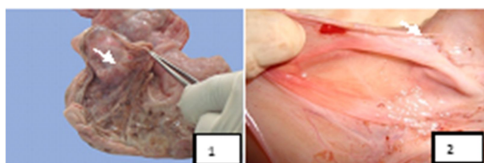


Figure 5: Macroscopic aspects of adhesion among genital tracts of female camels. Key: 1 - Burso-ovarian adhesion, 2 - Peri-uterine adhesions

camels are mentioned on the Table 3. A total of 6 cases were recorded including 4 cases associations of two pathologies namely: Follicular cyst/oviduct hypertrophy, hydrobursitis / hemorrhagic cyst, hydrobursitis/oviduct torsion and cervicitis/clinical endometritis and 2 cases of associations between three different affections namely: hydrobursitis/bursitis/tubo-ovarian adhesion and ophoritis/hydrobursitis/periuterine adhesion. The overall prevalence and incidence of each associate pathological condition were 3.6 and 1.3 %, respectively.

DISCUSSION

The quality of the female genital tract is one of the most important factors for successful camel reproduction. Congenital disorders are often less common and have a limited incidence compared to acquired genital disorders. The last ones occur mainly during pregnancy, parturition and peripartum (Tibary and Anouassi, 2000b). Transient disorders such as longer waiting

period, "repeat breeding", mating refusal and early embryonic mortality may be secondary to a genital abnormality, lead to reduced reproductive and production performances and rise early reform rates (Ali *et al.*, 2010). This study consists on an inventory of pathological genital conditions observed during one-year survey of Sahraoui she-camels. The prevalence of she-camels with genital abnormalities was 20 %. This result was similar to previous reports in Egypt (Shawky *et al.*, 2004), Saudi Arabia (Ali *et al.*, 2010), Algeria (Benaissa *et al.*, 2015) and Ethiopia (Melaku *et al.*, 2015). It was clearly higher than the prevalence of 1.99 % recorded by Hussein and Saad (2017) in Sudan, by but slightly lower than the prevalence of 32.5 % reported in Iraq by Wajid (2015). The evoked ranges of the genital affections reflect the variable fertility rate in camels from 25 % to 80 % (Tibary and Anouassi, 1997; Ali *et al.*, 2010).

The present study indicated that the greatest incidences were observed for ovarian and uterine pathologies with respective rates of 48.8 and 21.1 %. According to Wajid (2015), the incidence of pathological lesions of the uterus, particularly endometritis, as well as that of the ovaries, accounted for 20.0 and 12.5 % respectively, thus they constituted the major problems of reproduction. The prevalence of ovarian abnormalities in this study (9.7 %) was lower than that reported by Hamouda *et al.* (2011) in Saudi Arabia (16.10 %) but close to that reported by Wajid (2015) in Iraq and Dawod and Elbaz (2018) in Egypt. However, the incidence of ovarian disease was higher compared to the 9.0 and 20 % scores reported by Ali *et al.* (2010) and Al-Afaeq *et al.* (2012), respectively, both in Saudi Arabia.

The recorded prevalence of ovarian cysts was 7.9 % including 4.8 % cystic follicles, 1.8 % hemorrhagic cysts and 1.2 % luteinized

Table 2: Frequency of normal and pathological conditions among the studied female camels in relation to the age, seasons and BCS

Associated parameters		She camels with genital affections	She camels without genital affections	Odds ratio (CI 95)	X ²
Age	5 – 10 years	10(30.0)	28(21.2)	0.88 (0.40-1.91)	NS
	>10 years	23(70.0)	104(78.8)		
Seasons	Dry	23(70.0)	87(65.9)	1.19 (0.52-2.71)	NS
	Wet	10(30.0)	45(34.1)		
BCS	BCS ≤ 2.5	13(39.4)	53(40.2)	0.75 (0.31-1.79)	NS
	BCS ≥ 3	20(60.6)	79(59.8)		
Total		33(100)	132(100)		

X² = Chi-square test, NS = not significant ($p > 0.05$), number in parenthesis = %

Table 3: Prevalence and incidence of different associated genital abnormalities found in female camels studied at El-Oued slaughterhouse

Genital abnormalities	Number genital affections	Percent from examined cases	Percent from affected cases
Follicular cyst/oviduct hypertrophy	1	0.6	3
Hydrobursitis/hemorrhagic cyst	1	0.6	3
Hydrobursitis/oviduct torsion	1	0.6	3
Hydrobursitis/bursitis/tubo-ovarian adhesion	1	0.6	3
Oophoritis/hydrobursitis/peri-uterine adhesion	1	0.6	3
Cervicitis/metritis	1	0.6	3
Total/prevalence/incidence	6	3.6	18

follicular cysts. The frequency of ovarian cysts was comparable to that reported by Ali *et al.* (2010) and Al-Afaeq *et al.* (2012). However, the prevalence of ovarian cysts was higher than that obtained by El-Wishy (1990), Wajid (2015) in Iraq and Mostafa *et al.* (2016) and a little lower than those reported by Benaissa *et al.* (2015) in Algeria and Ali *et al.* (2017) in Saudi Arabia. The incidence of these ovarian conditions of 39.4 % was similar to that reported by Hussein and Saad (2017) in Sudan. Follicular cysts, haemorrhagic cysts and luteal cysts are considered to be the development result of non-ovulatory follicles (functional cysts) if there is a failure of luteinizing hormone (LH) release in response to mating (Skidmore *et al.*, 1995, Hamouda *et al.*, 2011). Follicular cysts, especially hemorrhagic ones, can persist for several weeks and develop a luteal tissue to produce progesterone (Tibary and Anouassi, 1997; Nourani and Khodakaram-Tafti, 2004). For the luteal cyst, the levels of LH, progesterone and estrogen significantly increase, in parallel with a concomitant decrease in follicle stimulating hormone (FSH) compared

to females with active ovaries (Hegazy *et al.*, 2004). The oversized follicles lead to infertility problems in *C. dromedarius*, accompanied by changes in serum and follicular fluid reproductive hormones and no concentrations (Waheed *et al.*, 2017).

The following three ovarian affections: para-ovarian cyst, ovarian teratoma and oophoritis were found in a single she-camel each one displaying a prevalence of 0.6 % and an incidence of 3.0 %. The prevalence of these three ovarian anomalies was consistent with that reported by Hamouda *et al.* (2011) in Al-Ahsa, Saudi Arabia and Hussein and Saad (2017) in Tamboul abattoir, Sudan. The incidence of para-ovarian cysts was lower than that reported by Benaissa *et al.* (2015) in the same study area (Algeria). However, the incidence of ovarian teratoma obtained by these same authors was close to that observed in this study. A suggestion about the origin of para-ovarian cysts indicated that they develop from the persistent remnants of Wolffian ducts during embryonic life (Hamouda *et al.*, 2011; Hanzen, 2015b). Oophoritis may be due to abrupt

manipulation of the ovaries, ascending infections from the uterus or specific diseases such as tuberculosis, brucellosis and campylobacteriosis (Tibary and Anouassi, 1997; Rodriguez *et al.*, 2014). For the teratoma, they were sporadically reported in the male and female gonads of domestic animals, particularly in equine and buffalo species (Kumar and Singh, 1984; Nielsen *et al.*, 1990; Pande *et al.*, 2016). A pre-meiotic or somatic origin of teratoma had been advanced (Oliveira *et al.*, 2004). Previous studies detected a homozygous genotype responsible for these tumors, suggesting that they are composed of germ cells undergoing meiosis I (Eppig *et al.*, 1977; Patil *et al.*, 1978). However, this is may not always be correct, since heterozygous genotypes are also reported for this pathology (Surti *et al.*, 1990).

Often the definitions of uterine diseases lack precision and vary among research groups, as it is the case of the term endometritis that is incorrectly includes metritis, endometritis and pyometra (Sheldon *et al.*, 2006). From the encountered uterine affections, the clinical endometritis was the most prevalent and incident with 1.8 and 9.1 %, respectively. Other uterine diseases, namely: pyometra, clinical endometritis, serous cyst of the uterus, uterine agenesis showed a prevalence of 0.6 % and an incidence of 3 % for each one. According to Al-Afaleq *et al.* (2012) and Melaku *et al.* (2015), acute clinical metritis generally had a lower incidence compared to other uterine pathological conditions. However, very high prevalence of 57.1 and 60.2 % of uterine infections has been reported in Saudi Arabia by Ali *et al.* (2010) and Khalafalla *et al.* (2017). Similarly, Benaissa *et al.* (2015) reported concordant incidence of metritis in she-camels at the southwestern of Algeria. Ali *et al.* (2017), reported higher prevalence of pyometra reaching 7.1 %, however, no cases of pyometra were found in Nigerian she-camels (Mshelia *et al.*, 2013).

The bibliographic data lacks information on the incidence of this congenital anomaly on the course of reproduction in the camel. The uterine agenesis may be associated with anoestrus state if ovulation and corpus luteum

occur on the ipsi lateral side of the absent horn (Hanzen, 2015b).

The frequency of uterine serosal inclusion cyst was similar to the result reported by Melaku *et al.* (2015) in Akaki abattoir, Ethiopia. Though, high prevalence of this pathology have been reported in other domestic animals; Vural *et al.* (2004) in dogs Ortega-Pacheco *et al.* (2007) in stray bitches in the tropics and Aguirra *et al.* (2015) in bitches and queens. In bitches, the serosal cyst of the uterus develops during the postpartum period over the involution process following rapid contractions of the myometrium, but its clinical impact is unknown (Sathiamoorthy *et al.*, 2014).

The obtained rate of the infundibular cysts was 2.4 % representing an incidence of 12.1%. The surveys performed at slaughterhouses at different countries showed variable impact of hydrobursitis. Low prevalence of 1.33 % (Hamouda *et al.*, 2011) and 1.95 % (Al-Afaleq *et al.*, 2012) or high rate of 16.0 % (Ali *et al.*, 1992) was reported in Saudi Arabia. Similarly in UAE, the prevalence of ovarian bursitis ranges from 2.25 % (Quershi and Al-Jabouri, 2009) to 13.9 % (El Khoully *et al.*, 1990). However, the obtained prevalence was higher than 0.43 % recorded by Melaku *et al.* (2015) in Ethiopia and close to that reported by Benaissa *et al.* (2015) and Ali *et al.* (2011) in Algeria and Saudi Arabia, respectively. Clinical studies indicated high prevalence of 15.2 % in Somalia (Nur, 1984) and 16.5 % - 30.2 % in Saudi Arabia (Ali *et al.*, 2017). The pathogenesis of this disease is not yet clear. Infectious, parasitic or functional factors remain to be studied (Al-Eknah and Ali, 2001; Ali *et al.*, 2010; Ali *et al.*, 2012; Zaher *et al.*, 2017; Khalifa *et al.*, 2018).

This study showed one she-camel suffering from clinical cervicitis i.e. prevalence of 0.6 % and incidence of 3.0 %. Our result was lower than the incidence reported by Benaissa *et al.* (2015) in the same study area (7%). Generally, the low incidence of cervical affections may be due to good defense action of the cervix mucous secreting epithelium against bacterial invasion (Moustafa *et al.*, 2004).

A total of five cases of periovarian and periuterine adhesions had prevalence of 3.0 %

and incidence of 15.2 % in this study. The incidence of these genital lesions was in agreement with that earlier reported on the same camel population of our study area (Benaissa *et al.*, 2015). On the other hand, Ali *et al.* (2010) reported a high prevalence of 16.1 % of clinically vaginal adhesions contributing to various problems of reproduction in camels. These genital tract lesions may occur as a result of hemorrhage due to improper manipulation of the genital tract, attempts to rupture a cystic follicle or as a result of oophoritis, peritonitis and ovario-hydrobursitis (Tibary and Anouassi, 2001; Hamouda *et al.*, 2011).

The studied genital diseases did not depend on particular age, season or BCS category ($p > 0.05$). The high frequency of females with genital diseases were recorded during the dry season, age group > 10 years and $BCS \geq 3$. The reports regarding the frequencies of genital diseases according to risk factors in camels remain scarce. In a study conducted in the same area of our study with higher sampling revealed a significant effect of the age and BCS on the distribution of she-camels with genital diseases (Benaissa *et al.*, 2015). These authors reported increased genital disorders in females aged > 10 years (70.4 %). However, they obtained a significant high frequency of affected females during the wet season and in animals with low BCS (≤ 2) (Benaissa *et al.*, 2015).

One case of hydrobursitis was associated with ovarian cyst. Nourani and Khodakaram-Tafti (2004) suggested hypothesis that the occurrence of ovarian hydrobursitis is due to hemorrhage from atretic follicle. On the other hand, the association between the hydrobursitis, oophoritis and adhesions had been reported by Rodriguez *et al.* (2014) as a result of an extension of peritonitis or perimetry which is characterized by a loss of follicular activity and presence of adhesions between the ovarian surface and the surrounding tissues, including the ovarian bursa and uterine tube. The hypertrophy and the torsion of the oviduct is a normal consequence of the traction exerted by heavy follicular or infundibular cyst.

Conclusion: This study assessed of the genital pathological conditions prevalence and severity

in Sahraoui she-camels presented for slaughter in southeastern Algeria. Ovarian, uterine and bursal affections were the most commonly recorded. Further studies are needed to identify the risk factors (genetic, infectious, parasitic, functional, metabolic, etc.) of these genital abnormalities. Their contribution in the reduction of fertility rate and fecundity in local camel livestock remain to be demonstrated.

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REFERENCES

- ABDUSSAMAD, A. M., HOLTZ, W., GAULY, M., SULEIMAN, M. S. and BELLO, M. B. (2011). Reproduction and breeding in dromedary camels: insights from pastoralists in some selected villages of the Nigeria-Niger corridor. *Livestock Research for Rural Development*, 23(8): Article #178. Retrieved September 4, 2019, from http://www.lrrd.org/lrrd23/8/abdu23_178.htm.
- AGUIRRA, L. R. V. M., MARSOLLA, E. H., BERNAL, M. K. M., DA SILVA, S. K. S. M. and PEREIRA, W. L. A. (2015). Occurrence and macro and microscopic aspects of uterine serosal inclusion cysts in bitches and queens. *Archives of Veterinary Science*, 20(1): 62 – 67.
- AL-AFALEQ, A. I., HEGAZY, A. A., HUSSEIN, M. F. and AL-DUGHAYM, A. M. (2012). Pathological disorders of the female reproductive system in slaughtered camels (*Camelus dromedarius*) in Saudi Arabia. *Comparative Clinical Pathology*, 21(3): 245 – 251.
- AL-EKNAH, M. M. and ALI, A. M. A. (2001). Infundibular cysts jeopardize reproduction in the camel (*Camelus dromedarius*). *Emirates Journal of Agricultural Science*, 13: 52 – 56.

- ALI, A., MEHANA, E. E., AHMED, A. F., EL-TOOKHY, O., AL-SOBAYIL, A. and AL-HAWAS, A. (2011). Ovarian hydrobursitis in female camels (*Camelus dromedarius*): clinical findings, histopathology and fertility after unilateral surgical ablation. *Theriogenology*, 76: 492 – 499.
- ALI, A., AL-SOBAYIL, F. A., HASSANEIN, K. M. and AL-HAWAS, A. (2012). Ovarian hydrobursitis in female camels (*Camelus dromedarius*): the role of *Chlamydophila abortus* and a trial for medical treatment. *Theriogenology*, 77(9): 1754 – 1758.
- ALI, A., AL-SOBAYIL, F. A., THARWAT, M., AL-HAWAS, A. and AHMED, A. F. (2010). Causes of infertility in female camels (*Camelus dromedarius*) in middle of Saudi Arabia. *Journal of Agricultural and Veterinary Sciences, Qassim University*, 2(2): 59 – 66.
- ALI, A., DERAR, D., ALSAMRI, A. and AL-SOBAYIL, F. (2017). Echography of clinically relevant disorders in the genital tract of female dromedary camels. *Animal Reproduction Science*, 182: 123 – 133.
- ALI, A. M. A., EL SANOUSI, S. M., AL EKNAH, M. A., GAMEEL, A. A., DAFALLA, E. A., HOMEIDA, A. M. and RADWAN, Y. M. (1992). Studies on the infundibular cysts of the uterine tube in camel (*Camelus dromedarius*). *Revue D'élevage et de Médecine Vétérinaire des pays Tropicaux*, 45(3-4): 243 – 253.
- AL-QARAWI, A. A. (2005). Infertility in the dromedary bull: a review of causes, relations and implications. *Animal Reproduction Science*, 87(1-2): 73 – 92.
- BALLAIS, J. L. (2010). Des oueds mythiques aux rivières artificielles: l'hydrographie du Bas-Sahara algérien. *Physio-Géo. Géographie Physique et Environnement*, 4: 107 – 127.
- BENAISSA, M. H., FAYE, B. and KAIDI, R. (2015). Reproductive abnormalities in female camel (*Camelus dromedarius*) in Algeria: relationship with age, season, breed and body condition score. *Journal of Camel Practice and Research*, 22(1): 67 – 73.
- CHEN, B. X., YUEN, Z. X., PAN, G. W., HUANG, Y. M. and GAO, Y. H. (1983). Studies on the ovulation mechanism in the Bactrian camel. II. The role of semen in induction of ovulation. *Acta Veterinaria et Zootechnica Sinica*, 14: 161 – 166.
- DAWOD, A. and ELBAZ, H. T. (2018). Ovarian reproductive affections in she-camels. *Journal of Veterinary Science and Technology*, 9(5): 1000562. <https://doi.org/10.4172/2157-7579.1000562>
- EL KHOULY, A. A., EL NASR, A., ONTABLI, A. and GADIR, F. A. (1990). Some pathologic affections of camel ovaries in UAE. *The Zagazig Veterinary Journal*, 18: 210 – 217.
- EL-DEEB, E. D. E. (1995). *Studies on the Genital Infections of She-Camel in Relation to Age and Season*. Ph.D. Thesis, Faculty of Veterinary Medicine, Zagazig University, Benha Branch, Egypt.
- EL-HASSANEIN, E. (2003). An invention for easy semen collection from dromedary camel, El-Hassanein camel dummy. In: SKIDMORE, J. and ADAMS, G. P. (Eds.). *Recent Advances in Camel Reproduction*. International Veterinary Information Service (IVIS). Document 2003; Number A1014.0203.
- EL-WISHY, A. B. (1990). Genital abnormalities in camels (*Camelus dromedarius*). Pages 163 – 174. In: *Proceedings of Workshop on "Is it Possible to Improve the Reproductive Performance of the Camel?"* Paris, France.
- EPPIG, J. J., KOZAK, L. P., EICHER, E. M. and STEVENS, L. C. (1977). Ovarian teratomas in mice are derived from oocytes that have completed the first meiotic division. *Nature*, 269(5628): 517 – 518.
- FAYE, B., BENGOUNI, M., CLERADIN, A., TABARANI, A. and CHILLIARD Y. (2001). Body condition score in dromedary camel: a tool for management of reproduction. *Emirates Journal of Agricultural Science*, 13: 01 – 06.

- GHERISSI, D. E., AFRI-BOUZEBDA, F., BOUZEBDA, Z. and BONNET, X. (2018). Are female camels capital breeder? Influence of age, seasons, and body condition on reproduction in an extremely arid region. *Mammalian Biology*, 93: 124 – 134.
- HAMOUDA, M. M., AL-HIZAB, F. A. and HASSEEB, M. M. (2011). Pathologic studies on ovarian abnormalities in nagas (*Camelus dromedarius*) in Al-Ahsa, Saudi Arabia. *Scientific Journal of King Faisal University (Basic and Applied Sciences)*, 12(1): 265 – 276
- HANAFI, E. M., AHMED, W. M., BASANDY, M. M., OMAR, M. A. and DESSOUKY, M. I. (1999). Observations in blood and genital organs of she-camels (*Camelus dromedarius*) suffering from endometritis. *Egyptian Journal of Comparative Pathology and Clinical Pathology*, 12: 88 – 105.
- HANZEN, C. (2015a). Semiology: Propaedeutic of female ruminant reproductive system. Pedagogical documents: course notes and syllabus 2015. University of Liege, Belgium. https://orbi.uliege.be/bitstream/2268/70541/1/R03_Propedg_nitale_femelle_2016.pdf
- HANZEN, C. (2015b). Pathologies of the female ruminants genital tract. Pedagogical documents: course notes and syllabus 2015. University of Liège, Belgium. http://www.therioruminant.ulg.ac.be/notes/200910/R15_Pathologies_TG_femelle2010.pdf
- HEGAZY, A. A., AL-EKNAH, A. M. and ISMAIL, S. (2004). Studies on pituitary-ovarian axis in the female camel with special reference to cystic and inactive ovaries. *Journal of Camelid Science*, 1: 16 – 24.
- HEGAZY, A. A., EL-SHAZLY, M. O. A., WAHBAH, M. A., AMER, H. A. and HASSAN, O. F. (1998). Pathological studies on the uteri of she camels in relation to bacteriological infection. *Egyptian Journal of Comparative Pathology and Clinical Pathology*, 11: 13 – 21.
- HUSSEIN, N. A. and SAAD, A. M. (2017). Pathological disorders of the ovaries and uterine tubes in camels (*Camelus dromedarius*) slaughtered at Tamboul abattoir, Sudan. *Journal of Camel Practice and Research*, 24(3): 251 – 256.
- KAUFMANN, B. A. (2005). Reproductive performance of camels (*Camelus dromedarius*) under pastoral management and its influence on herd development. *Livestock Production Science*, 92(1): 17 – 29.
- KHALAFALLA, A. I., EKNAH, M. M., ABDELAZIZ, M. and GHONEIM, I. M. (2017). A study on some reproductive disorders in dromedary camel herds in Saudi Arabia with special references to uterine infections and abortion. *Tropical Animal Health and Production*; 49(5): 967 – 974.
- KHALIFA, I. A., ALSHAIKH, M. A., ALJUMAAH, R. S., JARELNABI, A. and HUSSEIN, M. F. (2018). Serological prevalence of abortifacient agents in female Mijaheem camels (*Camelus dromedarius*) in Saudi Arabia. *Journal of Animal Research*, 8(3): 335 – 343.
- KUBAR, H. and JALAKAS, M. (2002). Pathological changes in the reproductive organs of cows and heifers culled because of infertility. *Journal of Veterinary Medicine A, Physiology, Pathology, Clinical Medicine*, 49(7):365 – 372.
- KUMAR, N. and SINGH, B. (1984). Some neoplasms involving female genitalia of buffaloes. *Indian Veterinary Journal*, 61: 185 – 187.
- MELAKU, S. K., MELAKU, M., FEYISA, A., DEMISSIE, T., REGASSA, F., MEKONNEN, G. A., ALMAW, G., TESSEMA, T. S., KASSA, T. and DAWO, F. (2015). Pathological and bacteriological study on abnormalities of female internal reproductive organ of *Camelus dromedarius* slaughtered at Akaki Abattoir, Ethiopia. *American-Eurasian Journal of Scientific Research*, 10(4): 193 – 202.
- MONACO, D., PADALINO, B. and LACALANDRA, G. M. (2015). Distinctive features of female reproductive physiology and

- artificial insemination in the dromedary camel species. *Emirates Journal of Food and Agriculture*, 27(4): 328 – 337.
- MOSTAFA, T. H., ABD EL-SALAAM, A. M., ABDOON, A. S. S. and ABDEL-KHALEK, A. E. (2016). Improving fertility of Maghrabian she-camels treated with different hormonal treatments during breeding season in Egypt. *IOSR Journal of Agriculture and Veterinary Science*, 9(10): 20 – 28.
- MOUSTAFA, S. A., TANTAWY, A. A. and IBRAHIM, M. F. (2004). An abattoir survey of female genital disorders of camels (*Camelus dromedarius*) in Kalyoubia, Egypt. In: *Proceeding of the First Scientific Conference of Faculty of Veterinary Medicine*, September 1 – 4, 2004, Zagazig University, Moshtohor, Benha-Ras Sedr, Egypt.
- MSHELIA, G. D., ABBA, Y., VOLTAIRE, Y. A. C., AKPOJIE, G., MOHAMMED, H. and AONDONA, D. U. (2013). Comparative uterine bacteriology and pathology of camels (*Camelus dromedarius*) and cows in north-eastern Nigeria. *Comparative Clinical Pathology*, 22(6): 1195 – 1200.
- NIELSEN, F. C., GAMMELTOFT, S. and CHRISTIANSEN, J. (1990). Translational discrimination of mRNAs coding for human insulin-like growth factor II. *Journal of Biological Chemistry*, 265(23): 13431 – 13434.
- NOURANI, H. and KHODAKARAM-TAFTI, A. (2004). Pathological study of ovaries of non-pregnant camels (*Camelus dromedarius*) slaughtered in Iran. *Journal of Camel Practice and Research*, 11(2): 109 – 113.
- NUR, H. M. (1984). Some reproductive aspects and breeding patterns of the Somali camel (*Camelus dromedarius*). Pages 91 – 110. In: *Proceeding of the Workshop on Camel Pastoralism in Somalia*. Somali Academy of Science and Arts, Baydhabo, Mogadishu, Somali.
- OLIVEIRA, F. G., DOZORTSEV, D., DIAMOND, M. P., FRACASSO, A., ABDELMASSIH, S., ABDELMASSIH, V., GONÇALVES, S. P., ABDELMASSIH, R. and NAGY, Z. P. (2004). Evidence of parthenogenetic origin of ovarian teratoma: case report. *Human Reproduction*, 19(8): 1867 – 1870.
- ORTEGA-PACHEEO, A., SEGURA-CORREA, J. C., JIMENEZ-COELLO and M., LINDE FORSBERG, C. (2007). Reproductive patterns and reproductive pathologies of stray bitches in the tropics. *Theriogenology*, 67(2): 382 – 390.
- PADALINO, B., MONACO, D. and LACALANDRA, G. M. (2015). Male camel behavior and breeding management strategies: how to handle a camel bull during the breeding season? *Emirates Journal of Food and Agriculture*, 27(4): 338 – 349.
- PANDE, M. C., KUMAR, D. G., SINGH, R. K., RAMTEKE, S. S., KHAN, F. A., KUMAR, H., RAJORIYA, J. S. and SRIVASTAVA, N. S. (2016). Ovarian teratoma in a water buffalo (*Bubalus bubalis*). *Buffalo Bulletin*, 35(4): 557 – 562.
- PATIL, S., KAISER-MCCAW, B., HECHT, F., LINDER, D. and LOVRIEN, E. (1978). Human benign ovarian teratomas: chromosomal and electrophoretic enzyme studies. *Birth Defects Original Article Series*, 14(6B): 297 – 301.
- QUERSHI, Z. I. and AL-JABOURI, A. (2009). Clinical prevalence of reproductive disorders in dromedary camel under field conditions. In: *Proceedings of the 2nd Conference of the International Society of Camelid Research and Development (ISOCRD)*, March, 2009, Djerba, Tunisia.
- RABAGLIATI, D. S. (1924). *The Dentition of the Camel*. Egypt Ministry of Agriculture, Cairo, Egypt.
- RODRIGUEZ, J. S., PEARSON, L. K. and TIBARY, A. (2014). Infertility and subfertility in the female camelid. Chapter 20, Pages 216 – 243. In: CEBRA, C., ANDERSON, D. E., TIBARY, A., VAN SAUN, R. J. and JOHNSON, L. W. (Eds.). *Lama and Alpaca Care: Medicine, Surgery, Reproduction, Nutrition and Herd Health*. Elsevier Health Sciences, Amsterdam.

- SATHIAMOORTHY, T., RANGASAMY, S., ARUNMOZHI, N., BISWAL, S. S. and KULASEKAR, K. (2014). Uterine serosal inclusion cysts coupled with pyometra in a bitch. *Indian Journal of Animal Reproduction*, 35(1): 648 – 655.
- SHALABY, S. (1986). *Some Pathological Changes in Reproductive Performance of Female Camel in Relation to Hormone Imbalance*. M.V.Sc. Thesis, Faculty Veterinary Medicine, Cairo University, Egypt.
- SHAWKI, M. M., EL-HARIRRI, M. N. and OMAR, M. A. (1985). Endometritis of she-camel in Sharkia province. *Egyptian Journal of Veterinary Sciences*, 22: 169 – 172.
- SHAWKY, A. M., AHMED, A. T. and MONA, F. I. (2004). An abattoir survey of female genital disorders of camels (*Camelus dromedarius*) in Kalyoubia, Egypt. Pages 342 – 356. *In: Proceeding of the First Scientific Conference of Faculty of Veterinary Medicine*, September 1 – 4, 2004, Zagazig University, Moshtohor, Benha-Ras Sedr, Egypt. <https://pdfs.semanticscholar.org/96a3/9654768ece97d37002d9d9ba33b031d27d21.pdf>
- SHELDON, I. M., LEWIS, G. S., LEBLANC, S. and GILBERT, R. O. (2006). Defining postpartum uterine disease in cattle. *Theriogenology*, 65(8): 1516 – 1530.
- SKIDMORE, J. A. (2005). Reproduction in dromedary camels: an update. *Animal Reproduction*, 2(3): 161 – 171.
- SKIDMORE, J. A., BILLAH, M. and ALLEN, W. R. (1995). The ovarian wave pattern in the mated and non-mated dromedary camel (*Camelus dromedarius*). *Journal of Reproduction and Fertility*, 49: 545 – 548.
- SURTI, U., HOFFNER, L., CHAKRAVARTI, A. and FERRELL, R. E. (1990). Genetics and biology of human ovarian teratomas. I. cytogenetic analysis and mechanism of origin. *American Journal of Human Genetics*, 47(4): 635 – 643.
- THRUSFIELD, M. (2005). *Veterinary Epidemiology*. 2nd Edition, Blackwell Science, United Kingdom.
- TIBARY, A. (2018). Monitoring and controlling follicular activity in camelids. *Theriogenology*, 109: 22 – 30.
- TIBARY, A. and ANOUASSI, A. (1997). Reproductive disorders of the female Camelidae. Pages 317 – 368. *In: TIBARY, A. (Ed.). Theriogenology in Camelidae: Anatomy, Physiology, BSE, Pathology and Artificial Breeding*. Actes Editions, Institut Agronomique et Vétérinaire, Hassan II.
- TIBARY, A. and ANOUASSI, A. (1998). Reproductive study of 113 cases of ovario-bursal adhesion in the female dromedary (*Camelus dromedarius*). Page 136. *In: Proceeding of the Annual Meeting of the Society of Theriogenology*, Nashville.
- TIBARY, A. and ANOUASSI, A. (2000a). Ultrasonography of the genital tract in camels (*Camelus dromedarius* and *Camelus bactrianus*). Pages 431 – 465. *In: GHALOT, T. K. (Ed.). Selected Topics in Camelid Medicine*. The Camelid Publishers, Bikaner, India.
- TIBARY, A. and ANOUASSI, A. (2000b). Reproductive disorders in the female camelid. *In: SKIDMORE J. A. and ADAMS G. P. (Eds.). Recent Advances in Camelid Reproduction*. International Veterinary Information Service (IVIS), Ithaca, New York, USA.
- TIBARY, A. and ANOUASSI, A. (2001). Retrospective study on an unusual form of ovario-bursal pathology in the camel (*Camelus dromedarius*). *Theriogenology*, 56(3): 415 – 424.
- VURAL, S. A., HALIGUR, M. and OZENC, E. (2004). Uterine serosal inclusion cysts in dogs: Pathomorphological and immunohistochemical findings (in German). *Kleintierpraxis*, 49: 375 – 377.
- WAHEED, M. M., GHONEIM, I. M., HASSEEB, M. M. and AL-MUHASEN, F. M. (2017). Behavioural, hormonal and histopathological changes accompanying the oversized follicles in camels (*Camelus dromedarius*). *Journal of Camel Practice and Research*, 24(1): 27 – 34.

- WAJID, S. J. (2015). A pathological abattoir survey of the reproductive tracts of non-pregnant camels (*Camelus dromedarius*) in Iraq. *IOSR Journal of Pharmacy and Biological Sciences*, 10(3): 84 – 90.
- YATES, D., MOORE, D. and MCCABE, G. (1999). *The Practice of Statistics*. Freeman, New York. USA.
- ZAHER, H. A. M., SWELUM, A. A., ALSHARIFI, S. A. M., ALKABLAWY, A. H. and ISMAEL, A. B. (2017). Seroprevalence of chlamydiosis in Abu Dhabi dromedary camel (*Camelus dromedarius*) and its association with hemato-biochemical responses towards the infection. *Journal of Advanced Veterinary and Animal Research*, 4(2): 175 – 180.



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