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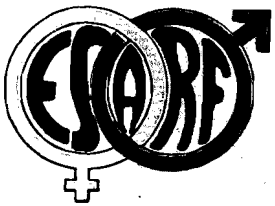

TENTH ANNUAL CONGRESS

Egyptian Soc. Anim. Reprod. Fert.
Tenth Annual Congress
Giza 3 - 5 February, 1998

CLINICAL, CYTOGENETIC AND HISTOMORPHOLOGIC STUDIES ON CAPRINE HERMAPHRODITISM

A. Selmi, M.E.A. Abou-El-Roos *, and A.E. Abdel - Ghaffar*
Department of Theriogenology (Zagazig and Moshtohor)*
Faculty of Veterinary Medicine, Zagazig University

ABSTRACT

Hermaphrodite goats (n = 33) were recognized during screening young goats for the presence of abnormalities in the external genitalia. Incidence of hermaphroditism in the present study was 4.7%. Testicular hermaphrodites (exhibiting male external genitalia, n = 24) were much frequently observed than ovarian hermaphrodites(exhibiting female external genitalia, n = 9). However, true hermaphroditism was diagnosed in two out of the nine cases of ovarian hermaphrodites after application of hCG challenge test.

Cytogenetic analysis revealed that all hermaphrodite cases recorded in the present study were genotypically females, where the chromosomal constitution being 60, XX. However, histomorphological examination of testicular hermaphrodites revealed that the genital system was dominating male. It was characterized by underdeveloped male reproductive organs with hypospadias penis (male pseudohermaphrodites). Whereas, true hermaphrodite goat had a female genital tract together with clitorial enlargement and bilaterally conjoined ovary and testis. However, the remaining ovarian hermaphrodites revealed the same features of normal females, except for masculine appearance and clitorial enlargement (female pseudohermaphrodites).However, both testicular and ovarian hermaphrodites were polled

Microscopic examination of the testis in male pseudohermaphrodites or true hermaphrodite exhibited Sertoli cells only - tubules without evidence of spermatogenesis. Whereas, ovarian stroma in true hermaphrodite goat revealed the presence of various stages of follicular development, follicular atresia and luteal tissues formation. Detailed histomorphological findings were presented. Moreover, the possible causes and prevention of such undesirable condition were considered and fairly discussed.

INTRODUCTION

Intersexes are individuals in which the diagnosis of the sex is confused because of congenital abnormalities and anatomical variations in the genital organs. Hermaphroditism is considered one of the intersexes conditions (gonadal dysgenesis, freemartinism, and abnormalities of the accessory genital organs) presented by Roberts (1986). It is usually classified on the bases of gonadal sex (Hafez, 1980). It may be true or pseudo (male or female pseudohermaphrodites), depending on the dominant part of their reproductive organs. However, the frequency of male

pseudohermaphrodite in animals was higher than true or female pseudohermaphrodites (Roberts, 1986).

Hermaphroditism has been reported with high frequencies in goats (Ramadan and El-Hassan, 1988) and pigs (Backstrom and Henricson, 1971). In goats, this condition is a simple sex-limited recessive character linked with hornlessness or polledness (Shelton, 1978 & Smith, 1980). Reports concerned with caprine hermaphroditism are few and dealt with individual cases recorded here and there. Therefore, The present communicating study aimed to throw light on some aspects of caprine hermaphroditism. Clinical observations, histomorphological features together with cytogenetic analysis were undertaken. The economic significance and prevention of such undesirable condition were also discussed.

MATERIAL AND METHODS

The present study was conducted on young goats (n = 700) of the local Egyptian breed belong to different localities at Sharkia and Monofia Governorates. They were screened for the presence of abnormalities in the external genitalia. Those cases suspected to be hermaphrodites were subjected for further clinical, morphological, and cytogenetic studies. Cases exhibiting masculine or female phenotypes with male external genitalia were suspected to be male pseudohermaphrodites or testicular hermaphrodites. However, predominantly females showing a tendency towards clitoridean enlargement and/or vulvar and vaginal abnormalities were assumed to be ovarian hermaphrodites (true or female pseudohermaphrodites). In order to recognize true from female pseudohermaphrodites, cases classified as ovarian hermaphrodites were subjected for a human chorionic gonadotrophin (hCG) stimulation test to detect the presence of functional testicular tissue (Paulsen et al., 1970). Each goat was intramuscularly injected with 500 iu hCG (Pregnyl, The Nile Co. for Pharmaceuticals and Chemical Industries, Cairo, ARE). Testosterone hormone was measured by radioimmunoassay (El-Banna et al., 1991) in the sera of those cases before and one hour after hCG administration.

Cytogenetic analysis was performed for ovarian and testicular hermaphrodites to determine their genetic sex. This was done using a whole blood culturing technique after the modified method adopted by Umrikar et al. (1995). Briefly, 0.5 ml of peripheral blood was poured into tissue culture tube containing 5 ml tissue culture medium (RPMI 1640, Seromed, Germany) supplemented with 20% homologous plasma, gentamycin (100μg/ml), and 0.2 ml phytohemagglutinin. The cultures were set up in duplicate under strict hygienic measures and incubated

at 37°C for 72 hours. Colchicine was then added at a final concentration of 0.5 μg/ml for two hours before harvesting to arrest mitosis. Hypotonic (0.56 % Kcl) treatment for 10 minutes was followed by fixation in methanol acetic acid (3 : 1). Slides were prepared by air-drying technique and stained in 2% Giemsa for 30 minutes. Spread metaphase cells (20/animal) were examined under oil immersion lens.

Anatomical and histological examinations, on the other hand, were conducted on selected cases representing either forms of hermaphroditism. Those cases were slaughtered following completion of cytogenetic analysis and testosterone assays. Urogenital system was excised, macroscopically examined and photographed. Reproductive tissue were fixed immediately in buffered formol saline and histological preparations were made in a routine manner. Paraffin sections (6 μm thick) were prepared and stained with haematoxylin and eosin.

RESULTS

1-Incidence of hermaphroditism :

Number of hermaphrodites following screening 700 young goats was 33 (4.7%). The frequency of testicular hermaphrodites (n = 24, 72.7%) was higher than ovarian hermaphrodites (n = 9, 27.3%). However, hCG challenge test conducted for ovarian hermaphrodites, to determine the presence of testicular tissue, was almost negative except in two cases. Serum testosterone concentrations recorded in these two cases were 2.1& 2.9 (before) and 2.5 & 3.1 ng/ml (after) hCG challenge, respectively. Whereas, testosterone levels in the negative cases of ovarian hermaphrodites (n = 7) averaged 0.2 or 0.5 ng/ml after hCG challenge indicating absence of testicular tissue.

2- Cytogenetic analysis :

Cytogenetic analysis revealed that all hermaphrodites examined in the present study were genotypically females. The chromosomal constitution was 60, XX (Fig.1). The chromosome complement consisted of 60 acrocentric chromosomes that varying gradually in length from the longest to the shortest (Fig. 2). However, X - chromosomes were the second longest acrocentric pair of the karyotype and could be distinguished from the acrocentric autosomes by their pale and dark staining regions.

3- Morphological features of testicular hermaphrodites :

Young kids exhibiting such form of hermaphroditism (n = 5) were polled and developed an abnormal pouch on the prepubic area behind the area of scrotum. This pouch was pinkish, glistening and when filled with urine appeared as a cyst with a small protruding process (Fig. 3). Manual compression on such a cyst like structure had emptied the fluid

but was re-distended again. Those cases usually suffered from urine incontinence. Surgical dilatation to the external urethral orifice was performed for treating urine incontinence (Fig. 4). However, some dealers stated that this cyst like pouch is not disturbing and usually disappeared as the kid grow or may be ruptured during evacuation of urine without any complications. Those cases had no scrotum but the penis was abnormally short. Whereas, the external urethral orifice open just cranial to the ischial arch or behind the scrotal area (Fig. 3 & 4).

Older cases (n = 19) were also homless and exhibiting either feminine (n = 2) or masculine (n = 17) appearance. The external genitalia consisted of small subcutaneously located testes and the scrotum was seldom developed in feminine cases (Fig. 5). In masculine type, the scrotum was underdeveloped, covered with short hair and divided into two symmetric halves (Fig. 6). Each half contained freely movable and underdeveloped testis and epididymis. A distinct raphe of varying length (depending on the age of the kid) extended from the anus to the external urethral orifice. The raphe was reddish in colour and was devoid of hairs. The penis was short and markedly corrugated without a distinct sigmoid flexure (hypospadias penis). The free end of the penis showed no urethral process and the urethral orifice terminated caudal to the apex of the penis. Whereas, the terminal part of the penis (galea glandis) was bent upwards, protruded from the sheath and abnormally located caudal to the scrotum. However, the free end of the penis joined the sheath by a persistent frenulum. Sexual libido and hyperactive state were seen in those cases, but inability to copulate was evident. Whereas, urine stream was abnormally directed towards the ischeal arch instead of its normal downward flow.

Gross examination of the urogenital system in old cases revealed normal urinary organs. However, the genital system was predominantly male (Fig. 7). A pair of underdeveloped testes was found attached to the underdeveloped scrotum by the gubernaculum testis ligament. The testes were spherical or kidney shaped, flattened and enclosed in a tough capsule (tunica albuginea). On cut surface, the mediastinum testes was always missing. However, pampiniform plexus was clearly visible and the epididymal head as well as the tail were enlarged. Two vasa deferentia were found joined the epididymal tails and opened separately on the root of the pelvic urethra at the neck of the urinary bladder. Ampullae, vesicular glands and bulbourethral glands were also recognized but were underdeveloped or extremely hypoplastic. Whereas, the penis was markedly corrugated without sigmoid flexure, but retractor penis muscle was developed.

Fig.1 :Photomicrograph for a metaphase spread showing the diploid number of chromosomes (2n = 60) in a hermaphrodite goat (Giemsa, X 10 x 100).

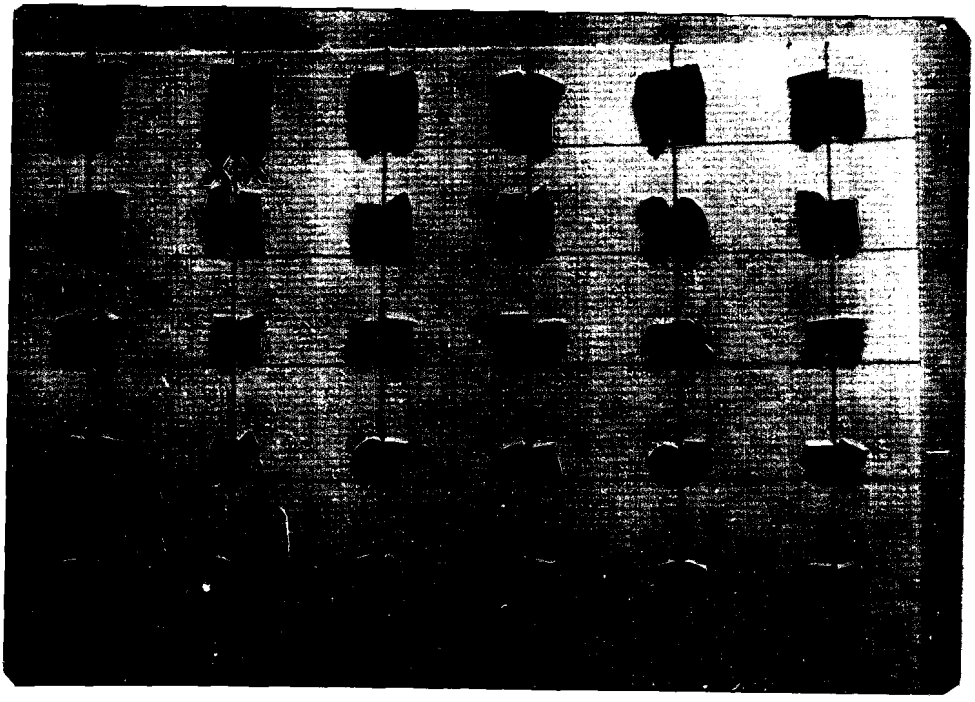

Fig.2 : Karyotypic profile in a hermaphrodite goat (60 , XX).

Fig.3 : Photograph for a polled male pseudohermaphrodite kid showing a cyst-like structure with a small protruding process.

Fig.4 : Photograph for a female polled goats with their newborn (normal male, right; normal female, left; and male pseudohermaphrodite kid, middle). The last kid suffered urine incontinence and was surgically treated (lower panel).

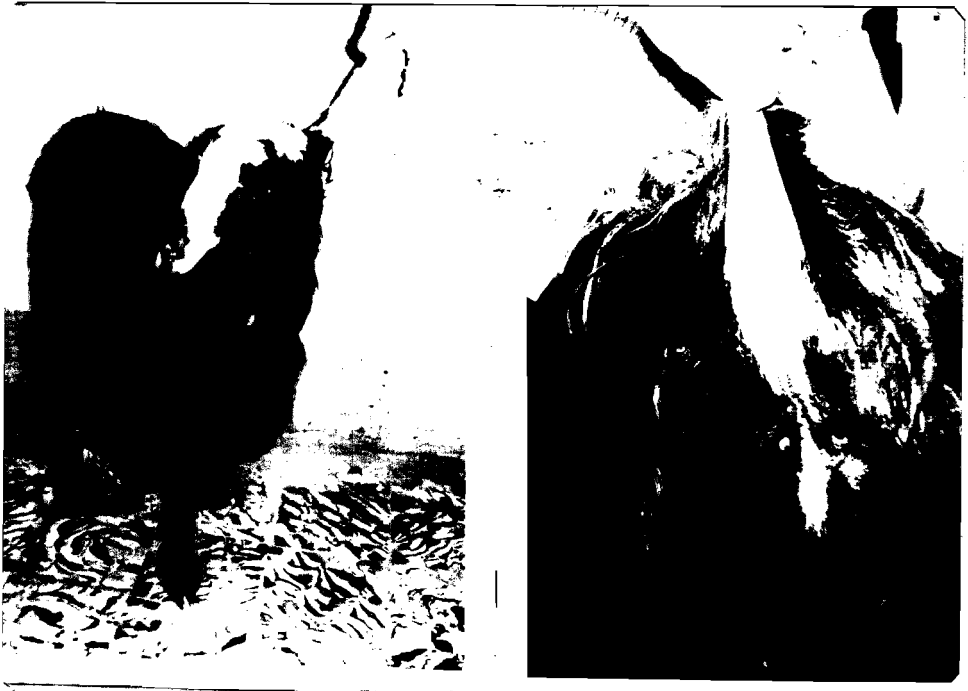

Fig.5 :Photograph for a polled male pseudohermaphrodite goat with hypospadias showing the feminine appearance and subcutaneously located testes..

Fig- 6 :Photograph for a polled male pseudohermaphrodite with hypospadias showing the masculine appearance and underdeveloped scrotum.

The male reproductive system of testicular hermaphrodites was associated with the presence of underdeveloped female genital tract (Fig. 7). Two uterine horns were found adherent to the vasa deferentia and extended carnially and terminated in the spermatic cord. They were supported with a thin serrous membrane similar to the broad ligament. A slender uterine body was situated between the vasa deferentia and dorsal to urinary bladder. The terminal part of the uterine body opened by a narrow duct into the roof of the urethra. Whereas, uterine caruncles were not recognized. Moreover, the underdeveloped female genital tract was associated with the presence of paired ovarian like nodules. These nodules were connected with thread like structures (may be fallopian tubes) that merged from the spermatic cord (Fig. 7).

Microscopically, the testes showed no evidence of spermatogenesis. The seminiferous tubules were small in diameter and lined by a single layer of Sertoli cells (Fig. 8). Some tubules appeared as densely packed with hyperchromatic Sertoli cells that arranged in a palisading manner consistent with that of Sertoli cell tumor. Some other tubules appeared collapsed and contained eosinophilic material. However, interstitial Leydig cells seemed to be increased and hyperplastic. Moreover, the epididymal duct, in either head or tail region, was void of spermatozoa (Fig. 9).

Ovarian like nodules, on the other hand, did not exhibit the characteristics of ovarian tissue. However, tubular parts of the male (ductus deferense) or female (uterine horn) reproductive tract had pseudostratified mucosa and thick muscular submucosa (Fig. 10 A & B). Uterine glands were found underdeveloped in the submucosa (Fig. 10 B), but caruncles were not macroscopically or microscopically recognized in the uterine horns. Whereas, male and female tracts were separated by a connective tissue conjunction.

4- Morphological features of ovarian hermaphrodites :

Since, predominantly female phenotypes may be missed at an early ages because of minimal or no testicular tissue, cases of ovarian hermaphrodites recorded in the present study were around the age of maturity (10-12 months). Phenotypically, ovarian hermaphrodites (n = 9)were also polled, but exhibited apparently normal external genitalia.

Challenge with hCG revealed the presence of testicular tissue in two of them. These two cases (may be true hermaphrodites) exhibited the appearence of more masculine type, but the external genitalia was of the female type (Fig. 11). Each had an enlarged clitoris, abnormally small labia vulvae and a slit like vaginal opening. The enlarged clitoris block up the slit like opening of the vagina so that the urine could not freely flow and accumulated intravaginally with consequent

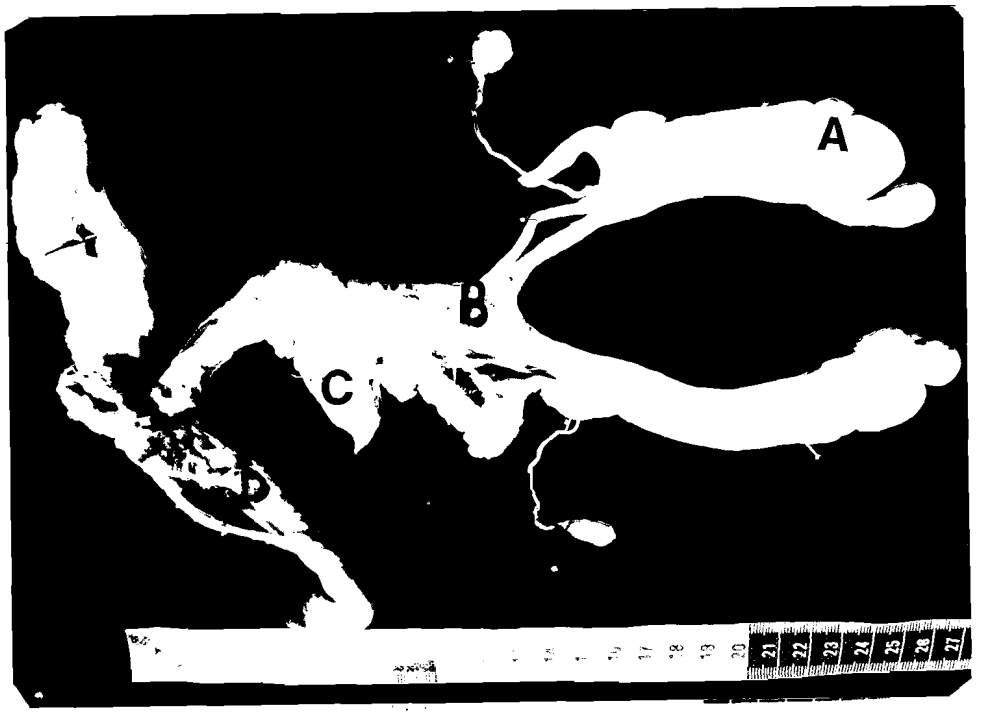

Fig.7 :Photograph for the reproductive system of a male pseudohermaphrodite kid showing : A) Testis, epididymis and pampiniform plexus, B) Ductus deferense (outer) and uterine horn (inner) c) urinary bladder. D) Hypospadias penis with retractor penis muscles.

Fig.8 :Photomicrograph for a cross section (CS) in the testis of a male pseudohermaphrodite showing Sertoli cells only tubules without evidence of spermatogenesis and Leydig cells hyperplasia (H & E, X 10 x 40).

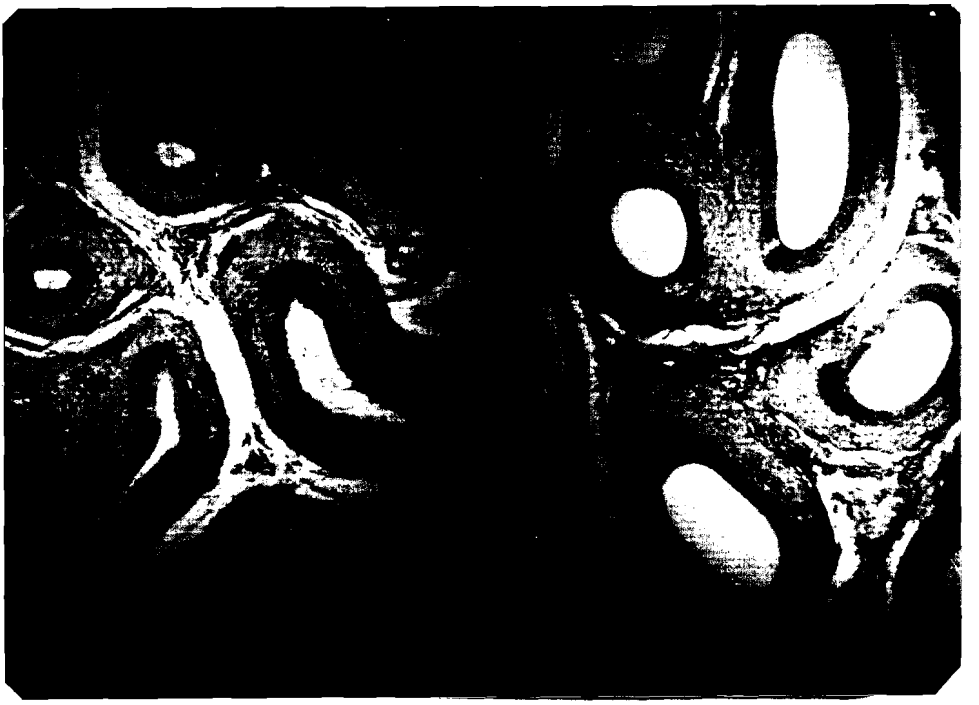

Fig.9 :Photomicrograph for CS in the head (A) and tail (B) regions of the epididymis (CS) of a male pseudohermaphrodite goat exhibiting normal lining epithelium, but was void of spermatozoa. (H &E, X 10 x 40).

Fig.10: Photomicrograph for CS in the ductus deferense (A) and uterine wall (B) of a male pseudohermaphrodite goat (H & E, X 10 x 10).

urination problem. Moreover, urination was accompanied by straining and urine stream was flushed upward instead of normal downward flow. Sexual libido and hyperactive state were seen in those cases. They frequently mount other goats from time to time as reported by the owners. Unfortunately, one case was the only available for growth morphological examination of the internal genitalia.

Gross examination of the urogenital system of such a case revealed normal urinary organs, but the reproductive gonads were of mixed type. Bilateral and firmly conjoined ovary and testis were recognized and confirmed following microscopic examination (Fig. 12 & 14). Whereas, the excurrent duct system of the male was only represented by epididymis that joined the apex of the uterine horn. The testis and epididymis together with pampiniform plexus were underdeveloped. Female genital tract, on the other hand, consisted of a vulva, vagina, cervix, uterine body, and two asymmetric uterine horns (Fig. 12). Both uterine body and uterine horns were supported by a thin serous membrane (the broad ligament). Whereas, Fallopian tubes were not recognized in the mesosalpinx. Following dissection, the vaginal cavity exhibited ventral diverticulum and the cervical canal showed no cervical features (Fig. 13). Moreover, line of demarcation was not seen between cervix and vagina or between cervix and uterine body. Whereas, uterine caruncles were not macroscopically recognized in the endometrium (Fig. 13).

Histological examinations of the firmly attached ovary and testis (Fig. 14) revealed underdeveloped seminiferous tubules in the testicular portion. The seminiferous epithelium comprised a single layer of Sertoli cells without evidence of spermatogenesis. The microscopical picture of the testis or epididymis in such a case was, in general, similar to that observed in testicular hermaphrodites. Whereas, the ovarian portion (Fig. 14 & 15) exhibited the presence of different stages of follicular development and atresia at one pole and luteal tissues at the other pole. Microscopic examination of the uterus, on the other hand, revealed normal uterine tissues. Moreover, endometrial glands and uterine caruncles were microscopically seen (Fig. 16).

The remaining ovarian hermaphrodites revealed the same features of normal females except for masculine appearance and clitorial enlargement. The reproductive system was quite normal and the ovaries exhibited follicular (normal or atritic)and luteal structures. They were considered female pseudohermaphrodites.

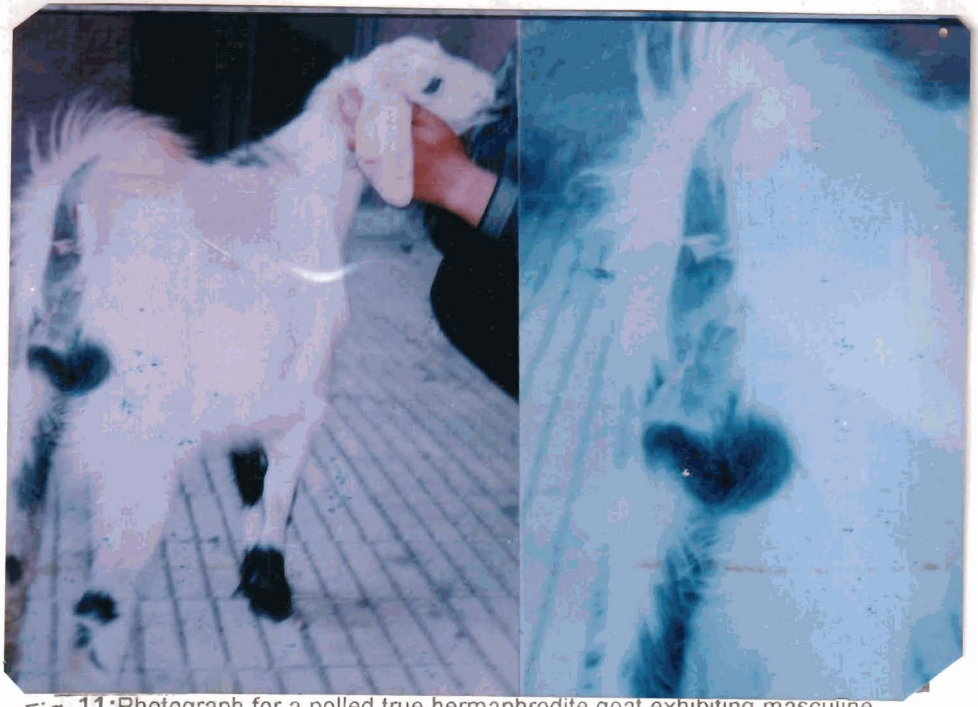

Fig 11:Photograph for a polled true hermaphrodite goat exhibiting masculine appearance and underdeveloped female external genitalia.

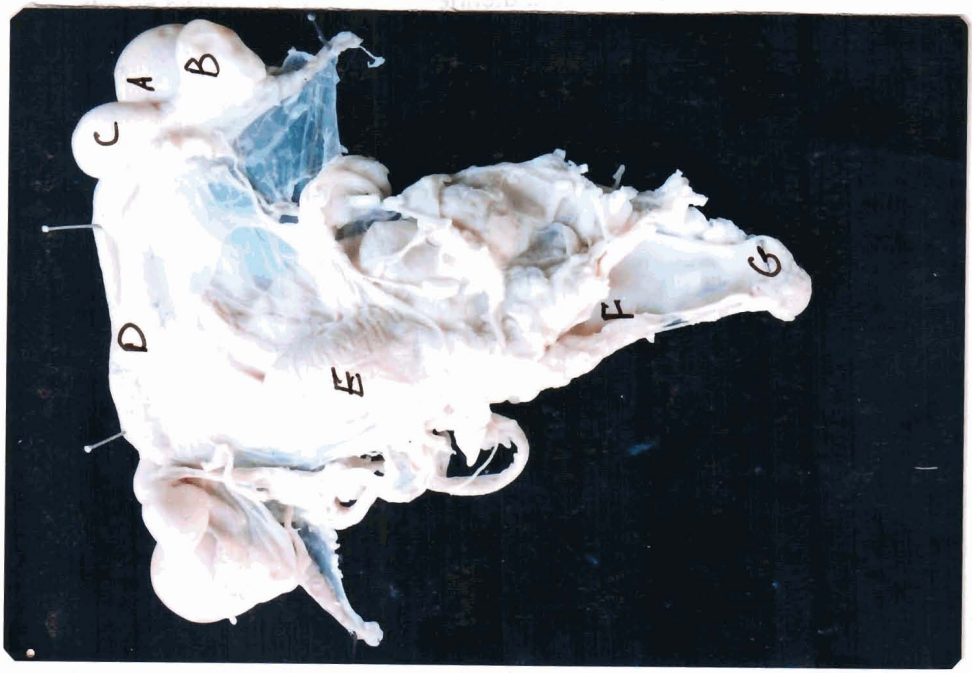

Fig.12: Photograph for the reproductive organs (ventral view) of a true hermaphrodite goat showing : A) Testis, B) Ovary and the attached pampiniform plexus together with thin serrous membrane , C) Epididymis, D) Uterus, E) Urinary bladder, F) Vagina, and G) Clitoris.

Fig.13: Photograph for the reproductive organs of a true hermaphrodite goat following dissection showing absence of both endometrial caruncles and cervical features.

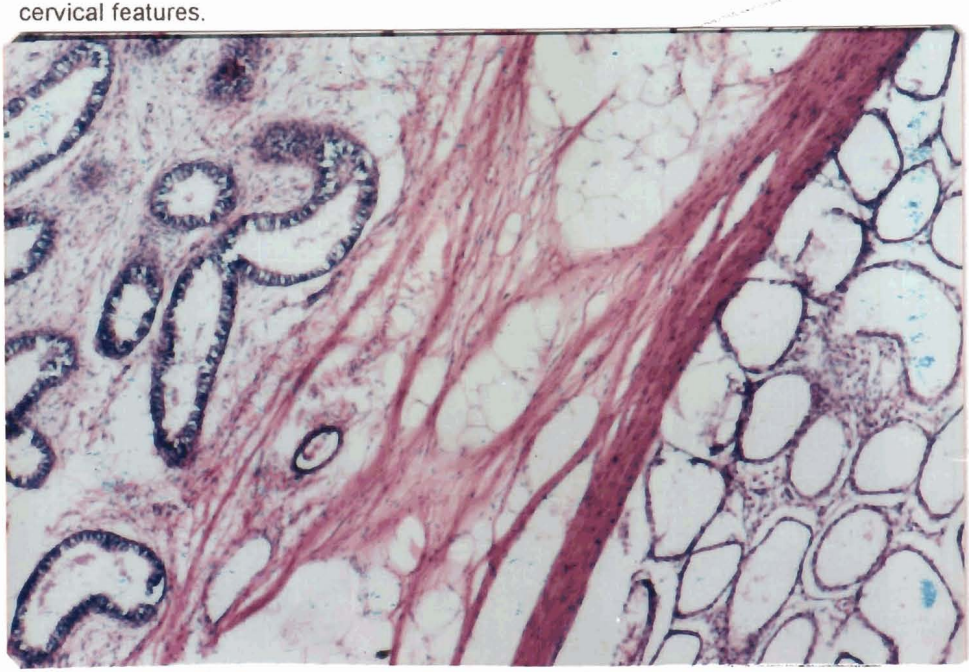

Fig.14: Photomicrograph for CS in the conjoined ovary and testis showing: A) Various stages of follicular development in the ovarian portion, B) Connective tissue conjunction, and C) Sertoli cells only tubules without evidence of spermatogenesis in the testicular portion (H & E, X 10 x 10).

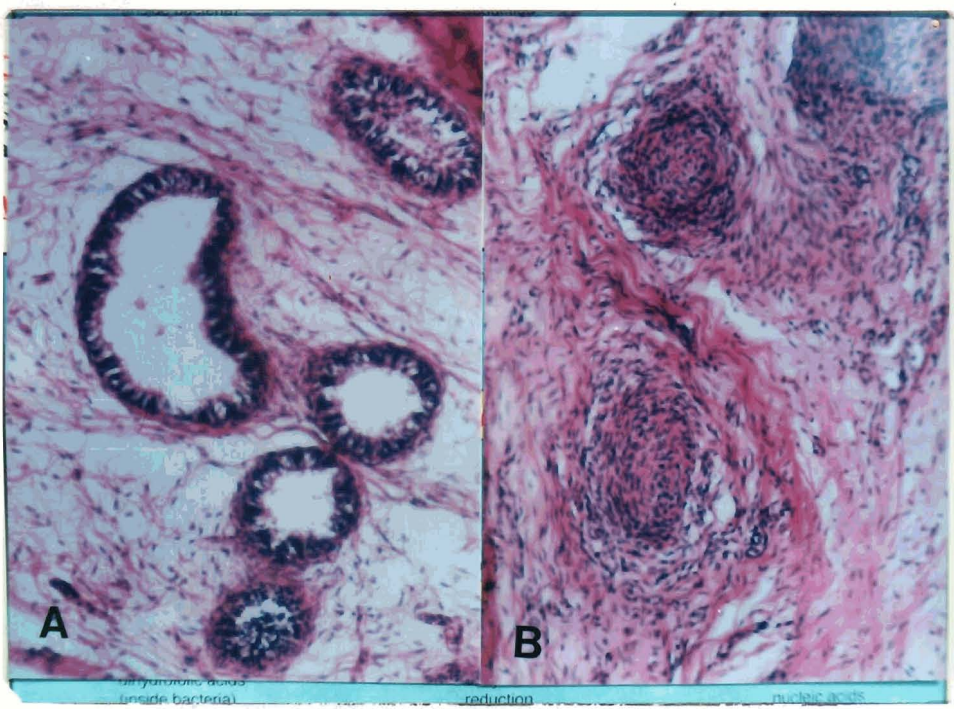

Fig.15: Photomicrograph for CS in the ovarian portion showing : A) Various stages of follicular development, and B) Luteal structures inside the ovarian stroma (H & E, X 10 x 40).

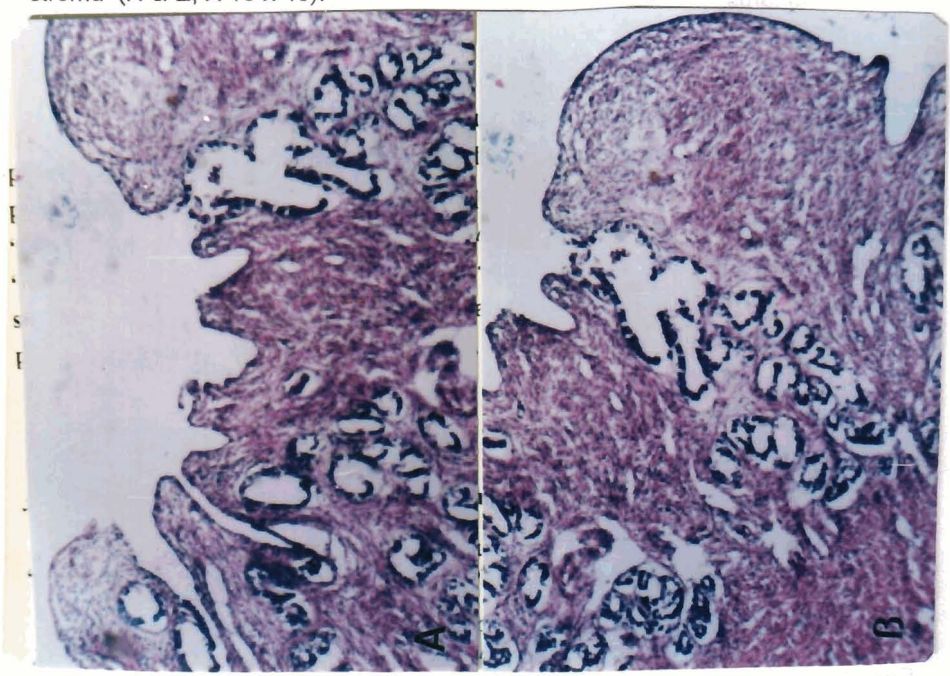

Fig.16: Photomicrograph for CS in the uterine wall showing the presence of endometrial caruncle exhibiting the concave external surface (A), endometrial glands and the neck (B) of the endometrial caruncle (H & E, X 10 x 10).

DISCUSSION

The sex of an individual was suggested to be determined at three levels, genetic, gonadal, and accessory genital organs (Roberts, 1986). An intersex state may results when sexual determination differs at these levels during development. In goats, an autosomal recessive gene associated with autosomal dominant gene for polledness was hypothesized to be the cause of intersexuality (Shelton, 1978 & Smith, 1980). This gene was suggested to have variable penetrance and be responsible for sex reversal of genetic females to phenotypic males. This hypothesis may however agree with our results because all cases exhibited hermaphroditism were genotypically females (60, XX Karyotype) and were polled in nature. A correlation between polledness and intersexuality in goats was also recorded by Ramadan and El-Hassan (1988), Karras et al. (1992), and Shivaprakash et al. (1995). Moreover, the history of three male pseudohermaphrodite kids revealed the heriditary predisposition, since their mothers had kids exhibited such syndrome in the previous parturition. Thus, raising of such females causes economic loss and reduced fertility of the herd through dissemination of such recessive gene inducing hermaphroditism as well as delivery of hermaphrodite kids. Since, these kids are mostly infertile, its holding causes further economic loss. Moreover, substantial loss caused by increased other congenital abnormalities which may be associated with hermaphroditism such as hypospadias and cryptorchidism (Selden et al., 1978).

Incidence of intersexuality in goats was ranged from 6 to 14.9 percent, with a sex ratio of 55.1 percent males, 30 percent females, and 14.9 percent pseudohermaphrodites (Roberts, 1986). Incidence of hermaphroditism in the present study was 4.7 percent. Testicular hermaphrodites were much frequently observed than ovarian type (n = 24 VS 9). However, true hermaphroditism was only observed in two goats following hCG challenge test conducted for ovarian hermaphrodites. The remaining 7 cases were considered female pseudohermaphrodites.

The genital organs of true hermaphrodite goat observed in the present study had many similarities to that recorded for a true hermaphroditic ewe reported by Fayrer et al. (1992) and Smith et al. (1996). Those ewes were found infertile owing to the presence of unilateral (right or left) ovotestis. However, the sheep was cycled normally and produced triplets following removal of unilateral ovotestis (Fayrer et al., 1992). In goats, true hermaphroditism lacking reports, but was frequently observed in pigs (Pfeffer and Winter, 1977). Those pigs are often fertile (O'Reilly, 1979), but the developed follicles in ovarian portion of the ovotestes exhibited atretic changes or cystic

degeneration (Backstrom and Henricson,1971). Similar observations were recorded in the present study following microscopic examination of the reproductive gonads of the true hermaphrodite goat .

The remaining cases of ovarian hermaphrodites were, in many aspects, similar to normal female goats except for masculine behavior and clitorial enlargement. They were considered to be female pseudohermaphrodites. Increased circulatory androgens from ovarian or adrenal tumor in the dam or administration of drugs with androgenic properties to pregnant females was suggested to be the cause of female pseudohermaphroditism (Hafez, 1980 & Roberts, 1986). Moreover, androgen administration to pregnant ewes masculinized the external genitalia of their female lambs together with the presence of Wolffain duct derivatives, but the gonadal development was not affected.(Alifakiotis et al., 1976). Our findings, on the other hand, were in general agreement with those reported in pigs (Pfeffer and Winter, 1977). Those cases may passed unnoticed because of normal female phenotypic appearance. Moreover, the genital system of female pseudohermaphrodite pigs was found normal, but the developed ovarian follicles were mostly atretic (Backstrom and Henricson, 1971). However, Scofield et al. (1969) observed cyclic changes in the ovaries and pregnancies in female pseudohermaphrodite pigs.

The most characteristic features of testicular hermaphrodites, on the other hand, were abnormal shortening of the penis (hypospadias penis) and the essentially male internal organs with some female features. It was proposed that the fetal testes may fail in varying degree to elaborate sufficient amounts of hormones responsible for complete differentiation of the male reproductive tract with consequent development of variable degree of feminization. Whereas, the masculine type male pseudohermaphrodites were seen much frequently in the present study than feminine type. Our findings with masculine type were, in many aspects, similar to those reported by Ramadan and El-Hassan(1988) and Shivaprakash et al. (1995). However, feminine type was only reported in a goat by Ramadan et al. (1991). The gonadal sex of such a case was of male type, but the genital tract was of female type. Whereas, our feminine cases were similar to masculine type male pseudohermaphrodites except for female looking and subcutaneously located testes. However, the masculine nature, sexual libido, and hyperactive state observed in most cases exhibiting male pseudohermaphroditism may be attributed to the androgen secreted from apparently hyperplastic Leydig cells which observed on histological examination of the testes.

The most significant findings observed in the testes of hermaphrodite goats were the lack of spermatogenesis and the

seminiferous tubules were lined with a single layer of Sertoli cells. Similar findings were reported by Ramadan and El-Hassan (1988) and Ramadan et al. (1991). Whereas, Shivaprakash et al. (1995) observed primary and secondary spermatocytes without evidence of spermatids formation in the seminiferous tubules of male pseudohermaphrodite goats with hypospadias. Since, XX germ cells do not transform into spermatogonia and can not survive in the testicular environment (Short, 1979), the failure to detect spermatogenesis in the testes of our hermaphrodites not only prove but would strongly confirms our previous findings that these goats were genotypically female (60, XX Karyotype).

Now, we addressing the following question, how testicular tissue could be developed despite the female karyotyping recorded in our male pseudohermaphrodite goats?

It has been reported that testicular tissues formation can be theoretically attributed to the presence of histocompatibility antigen (H-Y antigen) produced by the genes in the XY cell lines (Silvers and Wachtel, 1977). The presence of mosiacism, 66 XXXY (Gluhovschi et al., 1970) or 65 XXY (Bouters et al., 1972), and mixoploidy 63 XO/64 XX / 65 XXY (Fretz and Hare, 1976) in male pseudohermaphrodite horses may, therefore, indicate that the presence of a Y chromosome seems to be invariably associated with some degree of testicular development even when the X chromosome complement exceeding that of the normal female. Whereas, Ovotestes formation observed in a bovine true hermaphrodite (Dunn et al., 1968) or in a true hermaphrodite Welsh pony (Dunn et al., 1981) was attributed to the presence of whole body chimerism, the presence of both (XX and XY) cell lines. Thus, area in the genital ridge with a Y chromosome, H-Y antigen will induce seminiferous tubules and testicular formation. Whereas, area devoid Y - chromosome (XX) will result in ovarian tissue formation with the resultant ovotestes formation. H-Y antigen expressed on Y chromosome may, therefore, be account for the development of testicular tissues in the intersex cases.

Contradictorily, testicular development was recorded in the present study despite XX Karyotype in our male pseudohermaphrodite cases. Moreover, ovotestis was recorded in a true hermaphrodite goat exhibited XX karyotype without evidence of chimerism. Similar findings were recorded in equine (Bornstein, 1967 & Gerneke and Gourbrough, 1970), in dog (Selden et al., 1978), in pig (Potter et al., 1980), in sheep (Smith et al., 1996), and in goat (Shivaprakash et al., 1995) intersexes despite their XX karyotype. The presence of testicular tissues despite XX Karyotype may also attributed to the presence of H-Y antigen. This suggestion was confirmed by the findings of Selden et al. (1978) in dogs and Shalev et al. (1980) in intersex polled goats. These two

reports had revealed the presence of H-Y antigen despite XX Karyotype. Moreover, H-Y antigen was also expressed on the cells of male voles developed testes despite XO (monosomy X) Karyotype (Nagi and Ohno, 1977). Sex reversed gene (Sry) detected in sterile XX male mice may be responsible for the expression of H-Y antigen in such animals (Bennett et al., 1977 & Peter et al., 1990).Moreover recessive sex-determining genes were also reported in human XX male syndrome (de la Chapelle et al., 1978). Thus H-Y antigen detected in the intersex polled goats by Shalev et al. (1980) may be due to the autosomal recessive gene proposed early by Shelton (1978) and Smith (1980).

Several hypotheses have been proposed by Tracy et al. (1986) to explain the presence of H-Y antigen in the absence of the Y chromosome. These hypothesis include : 1- Mutant autosomal genes, 2-Interchange between X and Y chromosome during meiosis of spermatocytes, 3- Translocations from Y-to-autosomes, 4-X-chromosome deletions, 5- Undetected XY cells, 6- An original XY Zygot with consequent loss of the Y chromosome, 7 - An original XXY zygote with consequent loss of Y Chromosome, and 8- Mosaicism with an undetected XXY bearing cells. The first hypothesis (mutant autosomal genes) coincide with the previous suggestion of Shelton(1978) and Smith (1980), and may explain the development of testicular tissues despite female karyotyping in our male pseudohermaphrodites. Whileas, the development of bilaterally conjoined ovary and testis despite female karyotyping in our true hermaphrodite goat remains to be determined, although recessive gene linked with polledness may be incriminated.

In order to determine such mutant autosomal genes for purpose of selection, each polled female goat should be screened for the presence of H-Y antigen before breeding. This suggestion was also based on the observations of Selden et al. (1978). They found that female XX hermaphrodite bitch expressed H-Y antigen had a litter of 3 (one pup died, one was an XX male with hypospadias and unilateral cryptorchidism, and one was XX phenotypic female). Moreover, mothers of 3 male pseudohermaphrodites in the present study had delivered Kids with the same features in the previous parturition. Therefore, the hereditary predisposition for hermaphroditism may be partially eliminated through detection of H-Y antigen (expressed by the presence of mutant genes) in the female polled goats before breeding. However, Roberts (1986) stated that prevention of this condition is assured if either the sire or the dam is horned.

REFERENCES

Alifakiotis T.A., Call J.W., and W.C. Foote (1976): Androgen induction of intersexuality in sheep. Theriogenology, 6 : 21- 23.

Backstrom L. and B. Henricson (1971): Acta Vet. Scand., 12 : 257. (Cited after pfeffer and winter 1977).

Bennett D., Matheson B.J., Scheid M., Yanagisawa K., Boyse B.A., Wachtel S., and B.M. Cattanach (1977): Serological evidence for H-Y antigen in Sxr, XX sex-reversed phenotypic males. Nature, 263 : 255 - 257.

Bornstein S. (1967): The genetic sex of two intersexual horses and some notes on the karyotype of normal horses. Acta Vet. Scand., 8 : 291 -300.

Bouters R., Vandeplassche M., and A. deMoor (1972): An intersex (male pseudohermaphrodite) horse with 64 XX / 65 XXY mosaicism. Equine Vet. J., 4 : 150 - 153.

de la Chapelle A., Koo G.C., and S.S. Wachtel (1978): Recessive sex - determining genes in human XX male syndrome. Cell, 15 : 837 - 842.

Dunn H.O., Kenney R.M., and D.H. Lein (1968): XX/XY chimerism in a bovine true hermaphrodite : an insight into the understanding of freemartinism. Cytogenetics, 7 : 390 - 402.

Dunn H.O., Smiley D., Duncan J.R. and K. McEntee (1981): Two equine true hermaphrodites with 64, XX /64, XY and 63, XO/64, XY Chimerism. Cornell Vet., 71 : 123 - 135.

El-Banna I.M., Gamal M.H., and H.A. El Afrag (1991): Dexamethasone as a blocking agent in radioimmunoassay of unextracted serum estradiol 17-β and testosterone.Isotopenpraxis, 27 : 38 - 41.

Fayrer R.A., Hubes T.L., Miller D.M., Thompson F.N., and A.B. Caudle (1992): Infertility in a ewe as a result of ovotestis. J. Am. Vet. Med. Assoc., 200 : 1528 - 1529.

Fretz P.B. and W.C. Hare (1976): A male pseudohermaphrodite horse with 63 XO/ 64 XX / 65 XXY mixoploidy. Equine Vet. J., 8 : 130 - 132.

Gerneke W.H. and R.L. Courbrough (1970): Intersexuality in the horse. Ondersteport. J. Vet. Res., 37 : 211 - 216.

Gluhovschi N., Bistriceanu M., Sucui A., and M. Bratu (1970): A case of intersexuality in the horse with type 2 A + XXXY chromosome formula. British Vet. J., 126 : 522 - 525.

Hafez E.S.E. (1980): Reproduction in Farm Animals. 4th ed., Lea and Febiger, Philadelphia, P. 494 - 499.

Karras S., Madransky P., and B. Welker (1992): Surgical correction of urethral dilatation in an intersex goat. J. Am. Vet. Med. Assoc., 201 : 1584 - 1586.

Nagai Y., and S. Ohno (1977) : Testis - determining H-Y antigen in XO males of the male-Vole (Ellobius lutescens). Cell, 10 : 729-731.

O'Reilly P.J. (1979): Oestrous cycles and fertility in porcine hermaphrodites. Vet. Rec., 104 : 196.

Paulsen C.A., Espeland D.H., and E.L. Michaels (1970): Effects of hCG, hMG, and hGH administration on testicular function. Adv. Exp. Med. Biol., 10 : 547 - 562.

Peter K., Andrea M., Blanche C., Nigel V., and L. Robin (1990): Expression of a candidate Sex - determining gene during mouse testis differentiation. Nature, 348 : 450 - 452.

Pfeffer A., and H. Winter (1977): Hermaphrodites in Australian Pigs : Occurrence and morphology in an abattoir survey. Australian Vet. J., 53 : 153 - 162.

Potter W.L., Cooper J.W., and A.W. Blackshaw (1980): Cytogenetical studies of infertile pigs. Australian Vet. J., 56 : 133 - 136.

Ramadan R.O. and A.M. El-Hassan (1988): Intersexuality in goats. New Zealand. Vet. J., 367 : 120 - 124.

Ramadan R.O., Gameel A.A., Dafalla E.A., and A.K. Galil (1991): Bilateral scrotal hystrocele in an intersex goat. J.Vet. Med.(A), 38 : 441 - 444.

Roberts S. J. (1986): Veterinary Obstetrics and Genital Diseases. 3rd ed., Ithaca, N.Y., Published by the Author. P. 72, 673.

Scofield A.M., Cooper K.J., and G.E. Lamming (1969): (Cited after Pfeffer and Winter, 1977).

Selden J.R., Wachtel S.S., Koo G.C., Haskins M.E., and D.F. Patterson (1978): Genetic basis of XX male syndrom and XX true hermaphroditism : Evidence in the dog. Science, 201 : 644 - 646.

Shalev A., Short R.V., and J.L. Haemerton (1980) : (Cited after Shivaprakash et al., 1995).

Shelton M. (1978): Reproduction and breeding in goats. J. Dairy Sci., 61 : 994 - 1010.

Shivaprakash B.V., Kasaralikar V.R., Ramkrishana V., Kumar S.P., and A.M. Nainar (1995): Familial urethral dilatation, hypospadias and intersex condition in Osmanabadi - Bidri Strain goats. Indian Vet. J., 72 : 718 - 722.

Short R.V. (1979): Sex determination and differentiation. British Med. Bull., 25 : 121 - 127.

Silvers W.K., and S.S. Wachtel (1977): H-Y antigen : Behavior and function. Science, 195 : 956 - 960.

Smith K.C. (1980): Caprine Reproduction. In Current Therapy in Theriogenology. 1st ed., D. Morrow (Ed.), W.B. Saunders Co., Philadelphia. P., 971 - 1004.

Smith K.C., Lond S.E., and T.J. Parkinson (1996): A case of true hermaphroditism in a sheep. Vet. Rec., 138 : 497 - 498.

Tracy N.T., Olson P.O., and J.H. Poul (1986): Lateral hermaphroditism and seminoma in a dog. J. Am. Vet. Med. Assoc., 189 : 1596 - 1597.

Umrikar U.D., Natarajan N., Thiagarajan, Navayanakhedkar S.G., and A.R. Krishnan (1995): C and Q banding based karyotyping of Indian domestic goat. Indian Vet. J., 72 : 1162 - 1165.

Wachtel S.S. (1977): H-Y antigen and the genetics of sex determination. Science, 198 : 797 - 799.