Histological study of cartilaginous cells in the body of penis in one-humped camel (*Camelus dromedarius*)

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Abstract:

BACKGROUND: Several investigations showed cartilaginous cells in fibrous tissue of the free part of the penis in one humped camel. **OBJECTIVES:** The aim of this study was accurate assessment of existence of cartilaginous cells in penis shaft of one-humped camel. **METHODS:** Six camel penises from matured camels more than 3 years-old were collected from an abattoir. Different specimens were prepared from each penis and kept in 10% formalin container for fixation. After passing different stages of histotechnique methods, several slides were prepared from each specimen, stained with Haematoxylin Eosin and studied. **RESULTS:** Results showed that the majority of cartilaginous cells were inside the collagen fibers of tunica albuginea and around corpus cavernosum and corpus spongiosum of penis and their distributions were dissimilar in different parts of the penis shaft. This survey further showed that in penis shaft length, the majority of cartilaginous cells were inside tunica albuginea, which is surrounded by corpus spongiosum and particularly, the ventral surface of urethra. **CONCLUSIONS:** The number of cartilaginous cells decreased gradually from distal extremity towards the proximal extremity of the body of the penis and increased gradually from external layer of tunica albuginea towards the internal layer of tunica albuginea and centre of corpus cavernosum penis. Existence of cartilaginous cells inside the leaf tissue of the penis was seen with aging and puberty.

Introduction

Several studies have described the microscopic and macroscopic structures of camel's penis so far (Abdelraouf and Elnaggar, 1964; Degen and Lee, 1982; Gilanpour, 1984; Yousefi and Gilanpour, 2003). The free part of the camel penis is attached to the internal layer of prepuce sheath normally after birth and at the age of 2-3 years old gets free (Skidmore, 2000). They start their coitus at the age of 3 years-old and will gain their optimum seminal power at the age of 6 (Nova, 1979). Degen and Lee (1982) classified camel penis as a fibro-elastic type which has three parts of root, body and free part and they also stated that the camel penis has sigmoid flexure in its body which is situated prescrotal. Yousefi and Gilanpour (2003) classified camel's penis as a fibro-elastic type because of its fibrous structure and its hardness before erection, the same as cattle and pig penis. Mobarak et al. (1972) considered the camel penis as an intermediate type and also called the end knob, glans. In camel's penis, corpus spongiosum (C.S.P) and corpus cavernosum (C.C.P) are surrounded by tunica albuginea which is elongated in penis length and has two layers of lateral (longitudinal) and internal (circular) (Nagpal et al.,

1987 and Yousefi, 2003). Nagpal et al. (1987) and Yousefi and Gilanpour, (2003) stated that there is a dense tissue in the dorsal part of urethra which consists of elastic fiber and can support urethra against corpus cavernosum pressure in erection time. Degen and Lee (1982) explained that bended collagen fibers have been seen by longitudinal layer of tunica albuginea. Mobarak et al. (1972) reported that penis's vascular tissues are limited to root and the last free part of penis and the penis shaft are formed by fibrous tissue. Digen and Lee (1982) reported that C.C.P consists of sinusoid covered by endothelium. These sinusoid have different size and by irregular fibrous walls that contain elastic fibers, separate from each other. Nagpal et al. (1987) showed that these walls are formed by connective tissue which has muscular fibers. Yousefi and Gilanpour (2003) reported that penis's C.S.P in shaft has big cavernosum spaces (longitudinal sinuses) which settle under urethra. Mobarak et al. (1952) report a cartilage circle around the distal part of penis. Tayeb (1952) explained that there are cartilaginous cells around the distal part of penis.

Materials and Methods

In this survey six camel penises from matured camels which had more than 3 years-old were collected from an abattoir and used. Penises shafts were separated and four of the following specimens were prepared from each penis:

1. Proximal extremity of body
2. Dorsal bend of sigmoid flexure
3. Ventral bend of sigmoid flexure
4. Junction of sigmoid to free part of penis (or distal extremity of body)

Each specimen was kept in 10% formalin container for fixation. After passing different stages of histotechnique, several slides were prepared from each specimen (in total 240), stained with Haematoxylin Eosin and studied.

Results

This study showed that the majority of cartilaginous cells are inside the collagen fibers of tunica albuginea and also are around C.C.P and C.S.P and their distribution is dissimilar in different part of penis shaft. This survey also showed that in penis shaft length, the majority of cartilaginous cells are inside tunica albuginea which is surrounded by C.S.P and particularly the ventral surface of urethra (Figure 6).

In the region of C.C.P, the majority of cartilaginous cells were in tunica albuginea attached to C.C.P. In other words, the number of cartilaginous cells of tunica albuginea which are surrounded by C.C.P, increase from surface to depth so these cells are more often seen in the internal layer of tunica albuginea (Figures 1-7). In different sections of penis shaft, penetration of cartilaginous cells was seen in the inter cavernosum spaces of C.C.P (Figures 2-3).

Histological study of the proximal extremity of penis body showed that several cartilaginous cells present in tunica albuginea attached to C.C.P, penetrated inside C.C.P (Figures 1-3).

In total view, in the proximal extremity of the body of penis, the numbers of cartilaginous cells were minimum and the distribution of cartilaginous cells around C.S.P and in the ventral surface of urethra were more than those around the C.C.P (Figures 4-5). Also, the number of cartilaginous cells inside erectile bodies compared to those in tunica albuginea which surrounded the erectile bodies were more.

Histological study of the sections which were prepared form dorsal bend of sigmoid flexure showed that distribution of cartilaginous cells is similar to the proximal extremity of the body but the total number of cartilaginous cells and their spread were more. Further, the scattering of these cells inside the C.C.P was more than tunica albuginea that surrounded C.C.P. In this zone, the number of cartilaginous cells similar to the proximal extremity of the body was higher in the ventral surface of urethra (Figure 5).

Study of the slides prepared from ventral bend of sigmoid or end of penis shaft that attached to proximal extremity of the free part, showed that the number and scatter of cartilaginous cells in this region are significantly more than proximal extremity of the body and the distribution of cartilaginous cells in this area is similar to the proximal extremity of the body. In other words, maximum number of cartilaginous cells was under urethra and the minimum number of these cells was in external layer of tunica albuginea. Analysis of tissue sections in sigmoid flexure showed that distribution of cartilaginous cells from ventral bend of sigmoid towards the dorsal bend of sigmoid

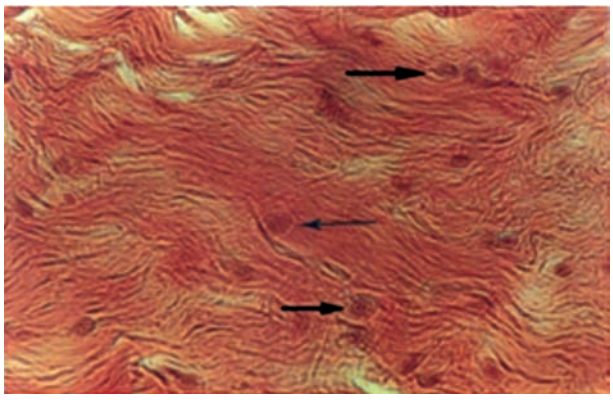

Figure 1. Body of penis (Proximal extremity); Cartilaginous cells in tunica albuginea around C.C.P. (arrow).

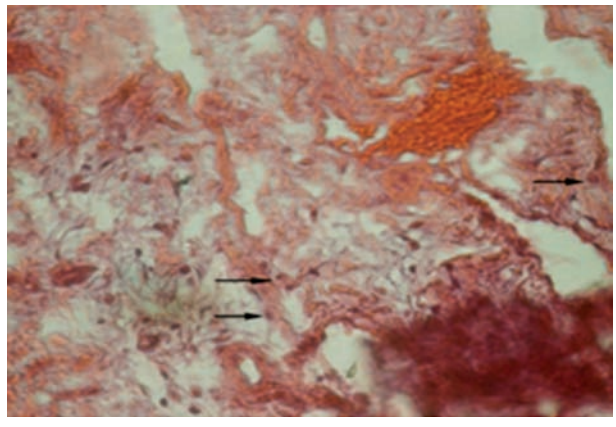

Figure 2. Body of penis (Proximal extremity); Cartilaginous cells in C.C.P. (arrow).

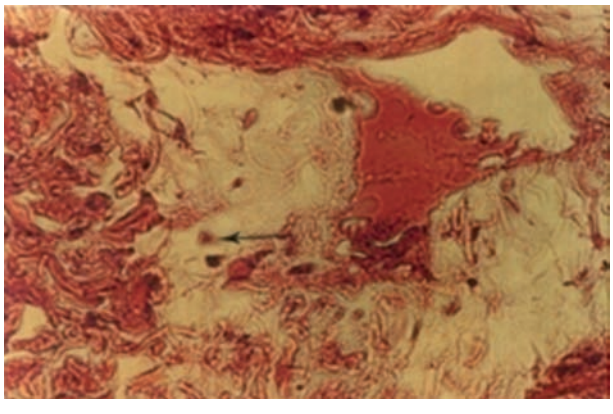

Figure 3. Body of penis (Proximal extremity); Cartilaginous cells in C.C.P. (arrow).

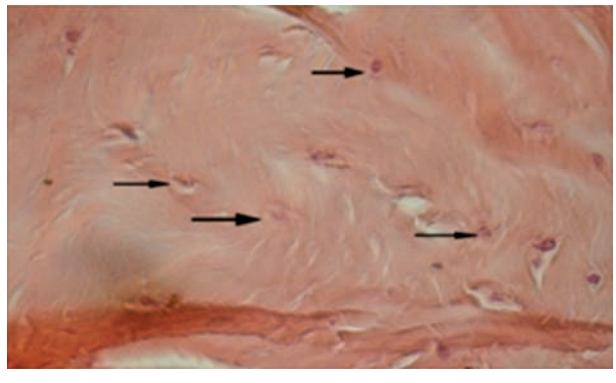

Figure 4. Body of penis (Proximal extremity); Cartilaginous cells in dorsal surface of urethra (arrow).

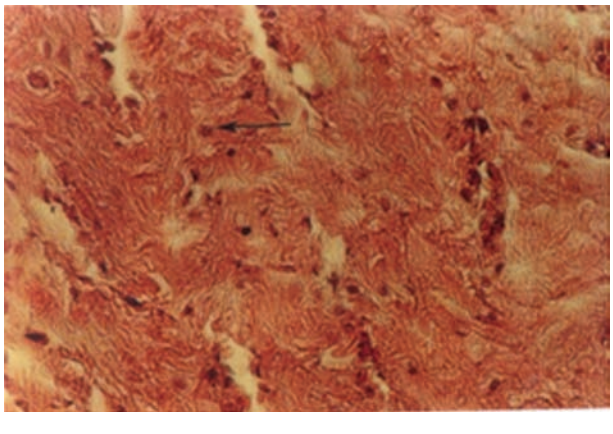

Figure 5. Body of penis (Proximal extremity); Cartilaginous cells in ventral surface of urethra (arrow).

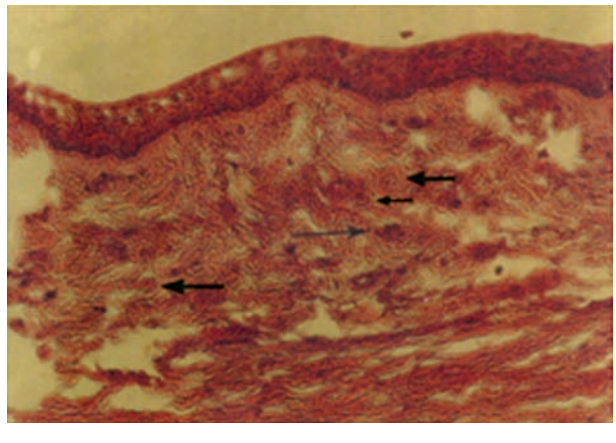

Figure 6. Body of penis (Sigmoidal flexure); Cartilaginous cells in ventral surface of urethra (arrow).

gradually decreased.

Investigation of these tissue sections showed that the number and distribution of cartilaginous cells in penis shaft in older camels are more than the younger ones.

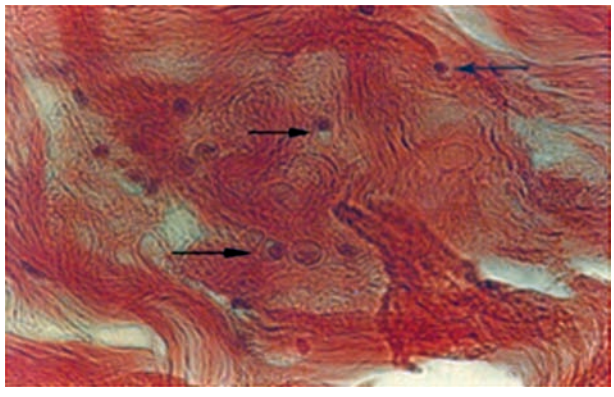

Figure 7. Body of penis (Sigmoidal flexure); Cartilaginous cells in tunica albuginea around C.C.P (arrow).

Discussion

This investigation showed that in penis shaft of one humped camel, cartilaginous cells exist in the collagen fibers of penis structure. This study also revealed that cartilaginous cells exist around and inside C.C.P and C.S.P but their numbers and distributions vary in different parts of penis shaft. Degen and Lee (1982) reported that the leaf structure of penis's C.C.P converts to cartilaginous. Mobarak et al. (1972) and Tayeb (1952) also reported the existence of cartilage in glans of penis.

Yousefi (2003) stated that cartilaginous cells exist inside of tunica albuginea which is around C.C.P, C.S.P in penis's free part and glans, he also mentioned that the number of cartilaginous cells decrease from distal extremity to proximal extremity of the free part (sigmoid flexure).

Existence of several chondrocyte in tunica albuginea which is attached to corpus cavernousum of the penis shaft is reported by Nagpal et al. (1987), whichis compatible with the results of this survey.

Degen and Lee (1982) reported that the cartilage structure in glans of penis is hyaline which, based on this survey, the penetration of cartilaginous cells in collagen fiber resembles fibrocartilage. This investigation revealed that maximum cartilaginous cells in tunica albuginea were in ventral surface of urethra which has not been reported so far. Regarding the point that urethra in erection and ejaculation is under pressure of blood volume in C.S.P, existence of a strong and hard fibrous tissue around urethra is essential; therefore. cartilaginous cells in leaf tissue around urethra cause strength in this tissue particularly in the ventral surface of it. Nagpal et al. (1987) and Yousefi (2003) described that there is a dense leaf tissue in dorsal surface of urethra which contains elastic fibers and supports urethra against the pressure of C.C.P in erection time. This study revealed that cartilaginous cells in tunica albuginea of ventral surface of urethra are more than in the dorsal surface . In other words, the factor of urethra strength against pressure of C.S.P is cartilaginous cells in tunica albuginea of ventral surface of urethra and the factor of urethra strength against pressure of C.C.P is a dense elastic fiber and leaf tissue in dorsal surface of urethra. This survey showed that in the body of camel penis, the number of cartilaginous cells in tunica albuginea around C.S.P is more than tunica albuginea around C.C.P.

Yousefi and Gilanpour (2003) reported that C.S.P in penis shaft contain large carvernosum spaces (longitudinal sinuses) which is under urethra.

Regarding this point, the pressure of blood volume in longitudinal sinuses in erection and ejaculation time can cause urethral obstruction, hence existence of large number of cartilaginous cells in tunica albuginea around urethra for prevention of urethral obstruction is rational.

Results of this survey revealed that in penis shaft and in C.C.P the maximum number of cartilaginous cells in the internal layer of tunica albuginea was found, so the increase in tunica albuginea strength is justifiable. This investigation showed that the number and dispersal of cartilaginous cells decrease from the distal extremity of body (junction of sigmoid to free part) to proximal extremity of body. Yousefi and Gilanpour (2003) explained that penetration of cartilaginous cells in tunica albuginea decrease from distal extremity of free part to the proximal extremity of free part and the results of this investigation showed this situation exists in the penis shaft.

This survey showed that the number of cartilaginous cells in leaf tissue structure increase with aging. In other words, the number of cartilaginous cells in the penis structure and penis strength has a direct relation with age and that the number of cartilaginous cells increases with age.

In conclusion, based on the results of this survey and previous reports, it can be mentioned that in the

penis of one humped camel, the existence of cartilaginous cells inside the leaf tissue is seen with aging and puberty. These cartilaginous cells first appear in penis glans and with aging gently penetrate towards the penis root, therefore the number of cartilaginous cells in glans is more than the body and root, and is very stiff. Vaughan and Tibary (2006) suggested that during copulation, the male penetrates the cervix with his penis and deposits semen during multiple ejaculations into both uterine horns using mild thrusting movements. Tibary and Vaughan (2006) showed that the curved nature of the cartilaginous process of the camelid penis allows penetration of the cervical rings through combined rotational (corkscrew) and thrusting movements.This concept is conformable with the structure of the free part. In younger camels, the maximum number of cartilaginous cells is present in tunica albuginea around the glans but in the depth of glans these cells are seen less. In the shaft and the beginning of the free part of penis, the maximum number of cartilaginous cells is seen in leaf tissue around C.S.P, urethra, tunica albuginea around C.C.P and in C.C.P respectively.

Regarding the process of increasing the cartilaginous cells in penis structure simultaneously to aging, penis strength increases and endurance of increase in blood

volume in corpus cavernosum by fibrous tissue also increases.

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ارزیابی بافتی توزیع سلول‌های غضروفی در ناحیه بدنه پنیس شتر نر یک کوهانه (*Camelus dromedarius*)

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چکیده

زمینه مطالعه: وجود سلول‌های غضروفی در ساختار بافتی ناحیه آزاد پنیس شتر یک کوهانه طی مطالعات متعدد صورت گرفته، بیان شده است. **هدف:** هدف این تحقیق بررسی دقیق وجود سلول‌های غضروفی در ناحیه بدنه پنیس شتر یک کوهانه می‌باشد. **روش کار:** تعداد ۶ پنیس از شتر بالغ دارای بیش از سه سال سن، از کشتارگاه تهیه و از ناحیه بدنه پنیس نمونه‌هایی جهت تهیه مقاطع بافتی انتخاب و در محلول فیکساتیو (فرمالین ۱۰٪) قرارگرفت. پس از طی فرایندهای مختلف تهیه نمونه‌های بافتی و رنگ‌آمیزی با هماتوکسیلین ائوزین، اسلایدهای آماده‌شده مورد مطالعه قرار گرفتند. **نتایج:** نتایج حاصله نشان داد که در ساختمان بافت لیفی و الیاف کلاژن ناحیه بدنه پنیس شتر یک کوهانه، سلول‌های غضروفی به طور پراکنده وجود دارند، بطوریکه به ترتیب بیشترین تعداد سلول‌های غضروفی در بافت لیفی اطراف جسم اسفنجی و بخصوص در سطح شکمی میزراه، اطراف جسم غاری پنیس بخصوص در لایه داخلی غشاء آلبوژینه چسبیده به جسم غاری پنیس، دیده شد. **نتیجه‌گیری نهایی:** این مطالعه نشان داد که تعداد سلول‌های غضروفی از انتهای دور بدنه پنیس به طرف انتهای نزدیک بدنه پنیس کاهش یافته و از لایه‌های خارجی غشاء آلبوژینه به طرف لایه داخلی و جسم غاری پنیس افزایش می‌یابد. وجود سلول‌های غضروفی در بافت لیفی پنیس با افزایش سن و بلوغ دیده می‌شود.

واژه‌های کلیدی: شتر، بافت‌شناسی، پنیس، غضروف

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