Topographical anatomy and desensitization of the pudendal nerve in adult male dromedary camels

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Received 8 February 2011; received in revised form 14 March 2011; accepted 23 March 2011

Abstract

The objectives of this study were to describe the topographical anatomy of the pudendal nerve and to develop techniques of its blocking in adult male dromedary camels. Two cadavers and 30 adult male dromedary camels were used for the description of topographical anatomy and pudendal nerve block techniques, respectively. Results revealed that the pudendal nerve arises from the ventral branches of the 2nd and 3rd sacral spinal nerves. The nerve had three divisions; dorsal, middle, and ventral. The caudal rectal nerve was a branch of the dorsal division. Three blocking techniques were developed according to the results of topographical anatomy. The first technique was 15 cm cranial to the tail base and 7 cm lateral to the midline. The second was 12 cm cranial to the tail base and 7 cm lateral to the midline. The third was about 3 cm on either sides of the anus. Details and complications of each technique were reported. In conclusion, the anatomy of the pudendal nerve was different from that of cattle and horse. The second technique (12 cm cranial to the tail base and 7 cm lateral to the midline) for pudendal nerve block was superior among the three methods. Duration of nerve blocking was suitable for examination and for performing some surgical procedures in male dromedary camels.

Keywords: Pudendal nerve; Anatomy; Block; Dromedary; Camel

1. Introduction

In general, infertility conditions with emphasis on penile affections have been reported to be common problems encountered by adult male dromedary camels [1,2]. It is difficult to withdraw the camel penis out of the prepuce because of the strong paired retractor penis muscles. Innervation of the penis and its muscles is derived from the pudendal (pubic) nerves and the pelvic plexus of the sympathetic system [3,4].

The anatomy of the pudendal nerve has been reported in detail in cattle [3] and horses [4] and briefly in camels [5]. Various techniques have been reported to be used for exteriorization of the penis in large animals including epidural anesthesia, administration of tranquilizers (e.g., phenothiazine) or sedatives (e.g., alpha2-agonists), and general anesthesia [6–9]. However, with epidural anesthesia, the volume of anesthetic solution required to cause complete penile exposure may result in interference with motor coordination of the hind limbs [6]. Moreover, penile prolapse has not been reported in male camels after phenothiazine or xylazine administrations [10]. Risk of tympany and respiratory...
compromise has been reported to be a potential side effect of general anesthesia in ruminants [11].

Until now, there was no detailed data about the anatomy of the pudendal nerves in male camels. Moreover, there was no information about the techniques of pudendal nerve block in these animals. The purposes of this study were to describe the topographical anatomy of the pudendal nerve and to develop techniques to block it in adult male dromedary camels.

2. Materials and methods

2.1. The anatomy of the pudendal nerve

The topographical anatomy of the pudendal nerve (Fig. 1) was described after careful dissection of two cadavers of adult healthy male camels preserved with 10% formalin solution as per Grossman’s technique [12].

2.2. The pudendal nerve block

While the animal was in sternal (setting) position, the hair over the sites of injection was shaved and aseptically prepared. Three different techniques were suggested for the pudendal nerve block according to the sites of injection. In each technique, 10 adult healthy male dromedary camels were used to block the pudendal nerves. Lidocaine 2% (Norbrook Laboratories, UK) was used as a local anesthetic agent. Description of the techniques follows.

The first technique utilized a point that located lateral to the sacral region 15 cm cranial to the base of the tail and 7 cm lateral to the midline in both sides (Fig. 2A).

The second technique utilized a point that located lateral to the sacral region 12 cm cranial to the base of the tail and 7 cm lateral to the midline in both sides (Fig. 2A).

For the first and second techniques, a 16 gauge, 5 to 6 cm long needle was used for injection. Before inserting the needle, the rectum was evacuated and the skin over the chosen site was desensitized using 1 to 2 ml of lidocaine 2%. The needle was inserted ventrally through the skin and in a caudomedial direction. Rectal palpation was performed immediately after inserting the needle in the blocking site to be sure that the needle did not penetrate the wall of the rectum. Approximately 20 ml of anesthetic agent were deposited around the nerves. The needle was then withdrawn 2 to 3 cm and an additional 10 ml of lidocaine 2% were injected.

The third technique was achieved by inserting a long needle (16 gauge, 15 cm length) about 3 cm on either side of the anal opening (Fig. 2B). The area was aseptically prepared and the skin over the chosen site was desensitized using 1 to 2 ml local anesthetic. The nee-
dle was directed craniodorsally and advanced toward the region just below the wing of the ilium. Approximately 30 ml of local anesthetic agent was deposited at each site during slow withdrawal of the needle.

The amount of anesthetic solution was selected according to that frequently used in cattle and horses [13,14].

Quantitative data (onset and duration) of the three techniques were expressed as means ± SD. Differences among means were analyzed by ANOVA using a statistical program [15].

3. Results

3.1. The anatomy of the pudendal nerve (Fig. 1)

The pudendal nerve arises from the lumbosacral plexus and supplies mainly the penis, the penile muscles, and the prepuce. It is formed from contributions of the ventral branches of the second and third sacral spinal nerves. Before their combination, the branch of the pudendal nerve that emerges from the second sacral spinal nerve combines with the ventral spinal branch of the caudal femoral cutaneous nerve and the ventral spinal branch of the sciatic nerve. The ventral spinal branches of the caudal cutaneous femoral nerve arise from the second and third sacral spinal nerves. The ventral spinal branches of the sciatic nerve arise from the ventral branches of the seventh lumbar, first, and second sacral spinal nerves. The ventral branches of the third sacral spinal nerve are thicker than the second branch. The pudendal nerve courses caudally and ventrally but lateral to the sacrosciatic ligament and medial to middle and deep gluteal muscles and levator ani muscle.
When it reaches the caudal end of the tendon of the internal obturator muscle, the pudendal nerve divides into three branches: the dorsal, the middle and the ventral branches. The dorsal branch courses dorsally and caudally to the levator ani muscle. It gives branches to supply the external sphincter muscle and the first part of the retractor penile muscle. It also gives a branch called the caudal rectal nerve that innervates the caudal end of the rectum. At the ventral aspect of the anus, the right and left branches course in a groove formed between the two branches of the ventral aspect of the retractor penis muscle. These two nerves give branches to innervate the sigmoid flexure, the prepuce, and the tissues around the penis. Approximately 8 cm caudal to the glans penis, the fibers of the two nerves merge and end at the preputial orifice.

The middle branch of the pudendal nerve is called the deep perineal nerve. It gives branches to innervate the tunica albuginea, scrotal sac, and the fascia of the penis, musculocavernous and urethrocavernous muscles, and the pelvic urethra. It also innervates bulbourethral (Cowper’s) gland and the spermatic hill at the urinary bladder. After that the nerve continues as the deep perineal nerve where it innervates the perineal muscles, the fascia, and the skin at the perineal region.

The ventral branch of the pudendal nerve innervates the prostate gland, fibro-elastic corpus of the penis, scrotal sac, and the prepuce. In both sides, the ventral branch of the pudendal nerve gives the right and left dorsal branches of the penis that course in the dorsal sulcus of the penis. They give branches to innervate the root, body, and the glans of the penis. The two nerves end 3 to 4 cm cranial to the insertion of the retractor penis muscle.

3.2. The pudendal nerve block

The penis did not protrude spontaneously from the prepuce in all techniques. However, it was felt by a finger near the preputial orifice. A lubricated sponge forceps, wrapped at its jaws with a piece of cotton and adhesive plaster, were used to exteriorize the penis outside the prepuce. The penis was exteriorized completely with unfolding of the preputial layers. The free end of the penis remained exteriorized out of the prepuce and was desensitized. Data about the time of onset and duration of the penile paralysis for each blocking technique were summarized in Table 1. There was no significant difference in the time of onset between techniques. However, there was a highly significant difference in the duration time between the first and second techniques and between the first and third techniques (P = 0.001) (Table 1). Complications were recorded in 5 camels with the first technique (15 cm cranial to the tail base and 7 cm lateral to the midline) in the form of mild hind-limb ataxia. The third technique (about 3 cm on either sides of the anus) was repeated successfully in 4 camels to attain the nerve block. Results revealed that the second technique (12 cm cranial to the tail base and 7 cm lateral to the midline) for the pudendal nerve block was superior to the first and third techniques.

4. Discussion

It seems that this study was the first to report techniques for pudendal nerve block in male dromedary camels. Moreover, detailed information about pudendal nerve anatomy in male dromedary camels was also first described here.

The present study revealed that the pudendal nerve in dromedary camels arises mainly from the 2nd and 3rd sacral spinal nerves, which differ from that of cattle and horses. The pudendal nerve in horses and cattle has been reported to arise from the ventral branches of the 2nd through the 4th sacral spinal nerves [3,4,14]. Moreover, it is currently divided into 3 branches; dorsal, middle, and ventral, which also differs from that of horses and cattle. The caudal rectal nerve in camels of the present study was a branch of the dorsal division of the pudendal nerve. In horses and cattle, it has been reported that the caudal rectal nerve arises from the ventral branches of the 4th and 5th sacral spinal nerves with connections with the pudendal nerve [3,4].
The pudendal nerve block has been indicated in the male when anesthesia of penis, prepuce, or retractor muscles of the penis is desired [7,16,17]. It also has been indicated for surgical procedures on the penis of the standing, restrained bull, and provided the animal’s temperament permits [14].

The paired retractor penis muscle originates from the ventral surface of the coccygeal vertebrae. It inserts in the penis at the second bend of the sigmoid flexure [18]. Relaxation of this muscle allows the sigmoid flexure to relax and the mildly engorged penis to protrude from the sheath. Anesthesia of the penis and relaxation of the retractor muscles can be achieved by blocking the pudendal and caudal rectal trunks [16].

The first and second techniques used in the current study were developed according to the results of the topographical anatomy of the camel cadavers. The two techniques utilized dorso-lateral approaches to the pudendal nerve block. The depth at which the needle was inserted to block the pudendal nerves in the current study varied according to the thickness of the subcutaneous fat and musculature. Lateral approach to the pudendal nerve block has been reported to be quicker, to produce fewer side effects, and to reduce the danger of local damage [19]. However, the third technique used in the present study was a modification of a technique that has been used in horses [13] and cattle [9,14]. Mild ataxia was currently noticed in the hind limbs accompanying the first technique. This complication might be due to the contribution of the pudendal nerve with the sciatic nerve at 2nd sacral spinal nerve. Similar results have been recorded in a horse due to extension of the anesthetic agent to the sciatic nerve [7].

The volume of anesthetic solution chosen for these camels was based upon that frequently used in cattle and horses [13,14]. Smaller volumes of anesthetic solution may be needed to prevent this complication, and further experimental evaluation of this hypothesis should be undertaken. The third technique was repeated successfully in 4 camels due to its failure. It has been reported that desensitization of the pudendal nerve was not achieved in two horses even after repeated attempts [7]. Lack of success may have been the result of placing the needle tip laterally rather than medially to the sacrosciatic ligament [7]. Desensitization of both right and left nerves was necessary to achieve adequate anesthesia of the genitalia and extrusion of the penis in camels of the present study. In addition to the complications mentioned, these nerve blocks are more cumbersome to administer than epidural anesthesia. However, despite the drawbacks to the pudendal nerve blocks, they can be a valuable alternative to epidural anesthesia, especially in cases where epidural refractiveness has occurred. This block is an alternative to general anesthesia for surgical procedures of the glans penis and penile layer of the prepuce because of its dual action for retractor penis muscle relaxation and for penile anesthesia [16].

The mean onset of effect was in general less than 8 min and the duration of the pudendal nerve block in the current study was enough and suitable for penile and preputial examination as well as most surgical procedures, such as excision of fibromatas, severing fibrous bands, and amputation of glans penis which have been cited elsewhere [7,14,20]. The relatively shorter duration after the first technique is currently suitable for andrological examination. However, the relatively long duration of the second technique is currently suitable for surgical procedures. In food animals, the duration of anesthesia takes 2–3 h; however the penis may remain exteriorized for up to 12 h due to the improper function of the retractor muscles [6]. The penis has been reported to remain extruded for 1–4 h in horses [7].

In conclusion, the anatomy of the pudendal nerve was different in its origin, divisions, and distribution from that of cattle and horse. Three different techniques were developed for pudendal nerve block, which are necessary to exteriorize and anesthetize the penis for examination and some surgical procedures in male dromedary camels. The second technique (12 cm cranial to the tail base and 7 cm lateral to the midline) was superior to the first and third ones. Duration of anesthesia was suitable for such procedures.

Acknowledgment

The study was funded by Scientific Research Deanship, Qassim University; Research Project number SR-D-009-022.

References


