Review Report

Laparoscopic-assisted cryptorchidectomy in South American camelids and Nigerian dwarf goats

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Abstract

Cryptorchidism is a common sexual development disorder in males with a potential hereditary origin in goats and camelids. Cryptorchid animals should be removed from breeding and castrated to eliminate male behavior. The objective of this paper is to describe the presentation and procedure of laparoscopic-assisted cryptorchidectomy in goats and South American camelids. Records of 18 Nigerian dwarf goats and 16 camelid cases that were presented to the WSU Theriogenology Services were included. Goats ranged in age from 2 months to 1 year and camelids (14 alpacas and 2 llamas) were between 15 months and 5 years of age. In goats, 15/18 (83%) were unilateral cryptorchids while 3/18 (17%) were bilateral. The right testicle was retained abdominally in 73.3% (11/15) of the unilaterally cryptorchid goats. All the camelids presented as unilateral cryptorchids with abdominally retained testis. The left testis was retained in 9/16 (56.25%) cases while the right was retained in 7/17 (43.75%). Laparoscopic-assisted cryptorchidectomy was performed under general anesthesia in all cases. The remaining scrotal testicle was castrated using a closed technique. There were no surgical complications. Ability to confirm the presence of cryptorchid testis without laparotomy, smaller incision, lesser intraabdominal manipulation, and lesser-no post/surgical complications advocate the use of this technique for cryptorchidectomy.

Keywords: Goats, alpacas, llamas, testis, surgery

Introduction

Cryptorchidism is one of the most common congenital disorder of sexual development in males.[1] In alpacas, an abattoir study on 792 animals reported a 3% incidence of unilateral cryptorchidism (58.3% left and 41.7% right).[2] Bilateral cryptorchism is rare in camelids and has been described in an *Sry*-negative XX, sex reversal case in a llama with multiple congenital abnormalities.[3] Monorchism, absence of one testicle, has been reported in alpacas and is accompanied by agenesis of the ipsilateral kidney.[2] In goats, a 3% incidence of cryptorchidism has been reported in slaughtered goats in India.[4] The incidence of cryptorchidism is higher in West African dwarf goats and ranges from 33 to 66% in some regions.[5–7] Nigerian dwarf goats are a popular breed as companion animals in the USA and one of the most common breeds to visit hospital for cryptorchidism (A Tibary, clinical observation).

Cryptorchid animals produce normal levels of testosterone and display normal male behavior and mating ability.[8] In one case of bilateral cryptorchidism in a dromedary camel, rutting, mating, ejaculation, and induction of ovulation were like normal camels although the ejaculates from the affected camel were azoospermic (A Tibary, clinical observation). Unilaterally affected males can be fertile if the descended testicle is not removed. Unilateral cryptorchid Nigerian dwarf goats are fertile but show an increased percentage of sperm abnormalities.[6,7]

Diagnosis of cryptorchidism is based on history and clinical examination of the scrotal and inguinal regions. However, in animals displaying male-like behavior with unclear history of castration and no testicles in the scrotun or inguinal region, ultrasonographic examination and endocrine evaluation are necessary to detect the presence of testicular tissue. Ultrasonography of the suspected cryptorchid goat or camelid has not been described thoroughly in the literature but it does allow the clinician to determine the location, size, and morphology of the retained testes. Endocrine diagnosis has been used mainly in camelids and is based on the response to a human Chorionic Gonadotropin (hCG) stimulation test.

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Citation line: Clinical Theriogenology 2023, 15, 9638, http://dx.doi.org/10.58292/CT.v15.9638

At least a twofold increase in serum testosterone concentration is observed 8 h following administration of hCG (3,000 to 5,000 IU, IV) to confirm presence of testicular tissue.[9–11]

Cryptorchidism is suspected to be hereditary in South American camelids[2,12] and Nigerian dwarf goats.[7] Three cases of cryptorchidism were described in closely related males from a herd of captive vicunas.[13] A high incidence of cryptorchidism (66%) has been reported in Nigerian dwarf bucks where cryptorchid animals are used for breeding.[5] Therefore, cryptorchid animals should be eliminated from breeding due to hereditary concerns. Castration also has the benefit of eliminating male behavior and the risk for induction of ovulation in camelids[8] along with the undesirable buck smell found in intact companion goats.

Several surgical techniques for removal of the retained testis via laparotomy have been described.[14–16] In camelids and small size goats such as Nigerian dwarfs, these techniques can be challenging and are associated with increased post-surgical complications. The objectives of this paper are to describe an ultrasonographic approach to diagnosis of cryptorchidism and a minimally invasive laparoscopic-assisted approach for cryptorchidectomy in South American camelids and goats.

Material and methods

Records of South American camelids (14 alpacas and 2 llamas) and Nigerian dwarf goats (n = 18) that presented for cryptorchidectomy to the Comparative Theriogenology service at Washington State University Veterinary Teaching Hospital were included in this retrospective study. Camelids ranged in age from 15 months to 5 years of age and goats were between 2 months and 1 year of age. All goats were acquired by owners for the purpose of serving as companion animals. Two goats were purchased as wethers and the owners became concerned when the males began to display male-like behavior and buck odor at 6 months of age. A bilaterally cryptorchid goat also presented which was presumed to have been castrated by elastic banding by the breeder at 1 week of age.

All animals were in good health upon presentation. After physical examination, males were examined by transcutaneous ultrasonography (Sonoscape® with a 5 MHz frequency linear or curvilinear transducer) to determine the location of the retained testis prior to surgery. The animals were examined while in dorsal recumbency. The transducer was placed over the external inguinal ring and the entire region from the inguinal ring to midline was imaged on each side. Endocrine diagnosis (hCG stimulation test) was performed in only one alpaca that had a history of castration. Total protein concentration and hematocrit were determined in all patients prior to surgery.

For laparoscopic-assisted cryptorchidectomy, camelids were fasted for 24 h, and water was withheld for 12 h prior to surgery. Total protein concentration and hematocrit were determined in all patients prior to surgery. Anesthesia was induced with an intramuscular injection of ketamine (4 mg/kg; Ketaset®, Zoetis, Kalamazoo, MI), xylazine (0.4 mg/kg; AnaSed®, Akorn, Lake Forest, IL) and butorphanol (0.04 mg/kg; Torbugesic®, Zoetis, Kalamazoo, MI) in combination, intubated and maintained with isoflurane (Piramel, Talangana, India) in oxygen as needed. The patient was positioned in dorsal recumbency. The abdominal area from the xyphoid process to the inguinal region was clipped and aseptically prepared and draped for surgery. The patient was placed in Trendelenburg position to allow cranial displacement of the abdominal viscera, reduce the risk of damage to underlying organs, and aid in visualization of the retained testis. A 5 mm skin incision was made on the umbilical scar and a teat cannula was inserted into the abdomen for insufflation with carbon dioxide (CO_2) to a pressure of 15 mm Hg. The same incision site was used to create a portal for the endoscope using a 10 mm diameter trocar and cannula. A second skin incision was made in the parainguinal region on the same side as the retained testis to create a new portal for insertion of an atraumatic forceps. Once the testis was located and isolated with the forceps, it was grasped at the level of the gubernaculum and brought in proximity to the body wall. The parainguinal incision was enlarged to allow exteriorization of the testis. The testis, its respective vascular cone and the gubernaculum were exteriorized. The vascular cone was transfixed with absorbable material (polyglactin 910, #0; Vicryl®, Ethicon, Guaynabo, Puerto Rico) and the testicle was excised (Figure 1). The body wall and skin incision were closed in routine fashion with resorbable material. Post-surgical management includes procaine penicillin G (PenOne Pro®, VETone®, MWI, Boise, ID) 22,000 IU/kg SC SID for 3 days or ceftiofur crystallin-free acid 6.6 mg/kg SC once) and non-steroidal anti-inflammatories (flunixin meglumine 1.1 mg/kg IV SID for 2 days; Banamine®, Merck, Madison, NJ).

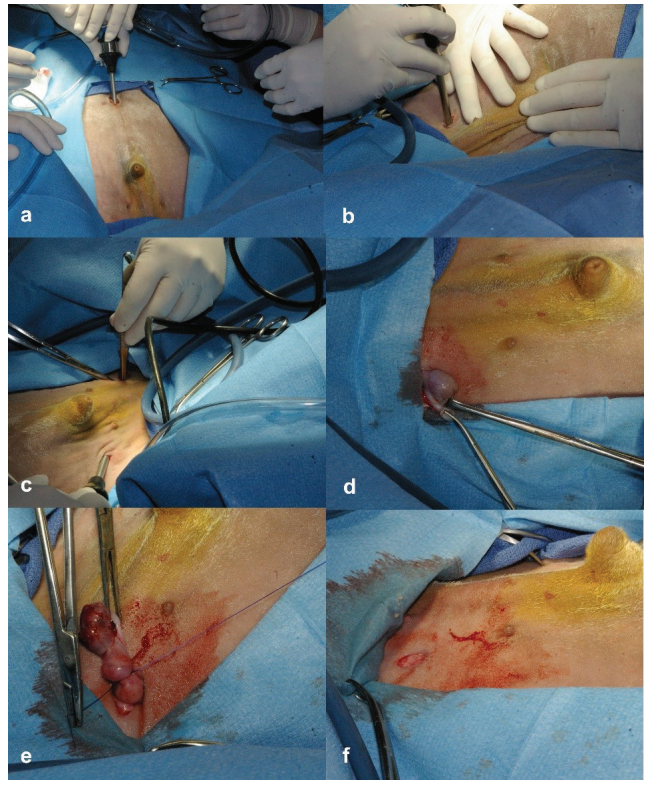

Figure 1. Laparoscopic-assisted cryptorchidectomy, (a) placement of the endoscope portal over the umbilical scar, (b) placement of the forceps portal, (c) parainguinal incision for exteriorization of the testicle, (d) exteriorization of the retained testicle, (e) transfixation and removal, (f) incision site for exteriorization of the testis.

Goats were fasted for 18 to 24 h. Anesthesia was induced either with ketamine (1 mg/kg IM; Ketaset®, Zoetis) xylazine (0.1 mg/kg IM; AnaSed®, Akorn) and butorphanol (0.01 mg/kg; Torbugesic®, Zoetis) in combination or with propofol (4 mg/kg IV; PropoFlo®, Zoetis, Kalamazoo, MI) after sedation with butorphanol (0.2 mg/kg IV; Torbugesic®, Zoetis) and midazolam (0.1 mg/kg IV; Almaject, Morristown, NJ). Anesthesia was maintained with isoflurane in oxygen after endotracheal intubation and draped as previously described. Animals were placed in dorsal recumbency, and the scrotum and ventral abdomen prepared aseptically. A 1 cm skin incision was made about 4 to 6 cm lateral to midline, contralateral to the side of the retained testis. The abdominal cavity was insufflated with medical grade CO_2 through a teat cannula prior to insertion of a 6 mm trocar and canula which served as the laparoscope portal. The patient was placed in Trendelenburg position. A second incision was made parallel to the inguinal ring ipsilateral to the retained testis. Babcock forceps were introduced into the second portal and the testis was grasped at the level of the gubernaculum (Figure 2). The incision length was extended to allow exteriorization of the testicle. The spermatic cord was transfixed with 0 PDS suture (Ethicon, Guaynabo, Puerto Rico), transected with Metzenbaum scissors and the testis was removed. The incision was sutured in two planes with 2-0 PDS (Ethicon, Guaynabo, Puerto Rico) to close the body wall with a simple continuous pattern and skin with an intradermal pattern. A single cruciate suture was used to close the laparoscope portal incision. The scrotal testis was castrated using a standard closed technique. For bilaterally cryptorchid cases, both testes were removed from a single paramedian incision instead of a parainguinal incision. Post-surgical management includes antibiotics (procaine penicillin G; PenOne Pro®, VETone®; 22,000 IU/kg SC SID for 3 days or ceftiofur crystalline-free acid; Excede®, Zoetis, Kalamazoo, MI; 6.6 mg/kg SC once) and non-steroidal anti-inflammatories (flunixin meglumine; Banamine®, Merck; 1.1 mg/kg IV SID for 2 days).

Results

All camelids in this case series presented with a unilateral abdominally retained testis. Testicular identification by transabdominal inguinal ultrasonography was possible in all cases. All testes were in the abdominal position near the inguinal region or close to the bladder (Figure 3). The left testis was retained in nine cases (56.25%), while the right was retained in seven cases (43.75%). The surgical procedure was completed in 35 ± 12 min (Mean ± SD). The animals recovered uneventfully, and no complications were reported after discharge from the hospital.

In goats, 15 (83%) cases were unilateral and 3 (17%) were bilateral cryptorchids. Of the 15 unilateral cryptorchid cases, 11 were right (73.33%) and four were left (26.67%). All unilaterally affected males were identified by the owner as suspect cryptorchid before presentation and diagnosis was confirmed by ultrasonography (Figure 4). In this case series there were three full brothers (2 bilateral cryptorchid, 1 unilateral cryptorchid) and five half-brothers (all unilateral cryptorchid with

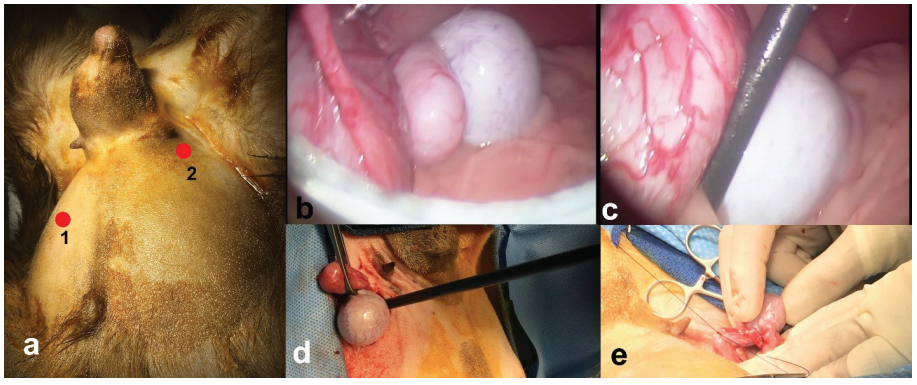

Figure 2. Laparoscopic-assisted cryptorchidectomy, (a) site of placement of the endoscope portal (1) and forceps portal (2), (b) abdominal testis visualized by laparoscopy, (c) abdominal testis grasped by the gubernaculum, (d) exteriorization of the retained testicle. (e) transfixation of spermatic cord and removal.

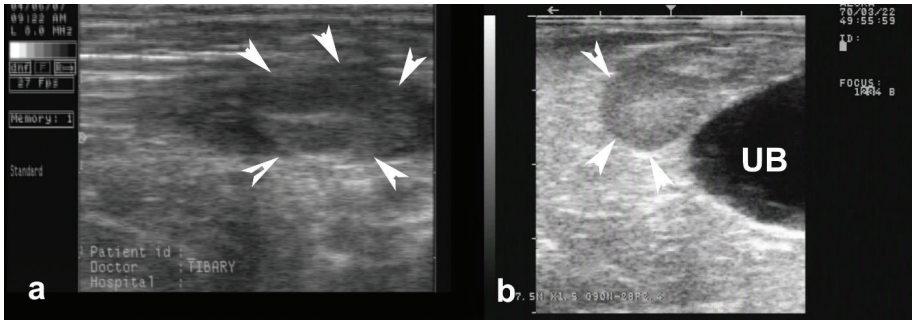

Figure 3. Transcutaneous ultrasonographic localization of the retained testis in a cryptorchid alpacas. Arrow indicated the retained testis, UB = urinary bladder.

Citation line: Clinical Theriogenology 2023, 15, 9638, http://dx.doi.org/10.58292/CT.v15.9638

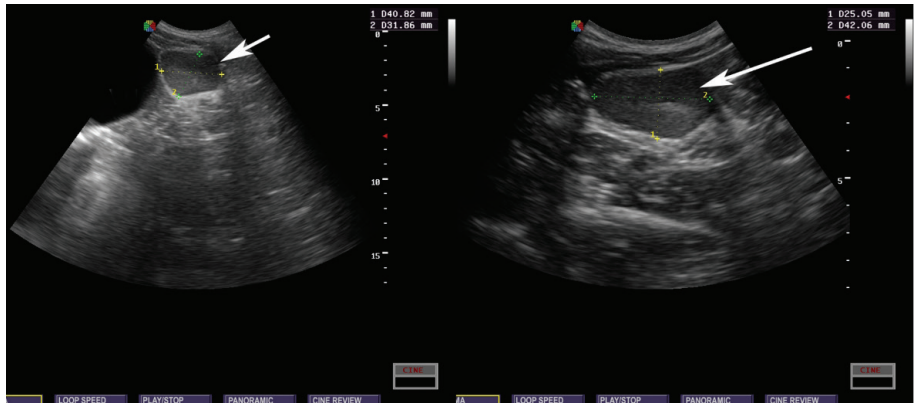

Figure 4. Transcutaneous ultrasonographic localization of the retained testis in a cryptorchid goats. Arrow indicated the retained testis.

same sire). The retained testes were located intra-abdominally near the bladder and identified by transabdominal inguinal ultrasonography in all cases. The retained testis length and width were 21.8 ±2.1 mm and 18.3 ± 1.5 mm (Mean ± SD), respectively. All animals recovered uneventfully from surgery and were discharged 1 day post-operatively from the hospital. No complications were reported on follow-up calls to the owners.

Discussion

Cryptorchidism is not an infrequent complaint in veterinary practice. Although unilaterally cryptorchid animals may have some fertility, the consensus is to eliminate these animals from breeding population as the disorder is suspected to be heritable. Diagnosis of cryptorchidism is based on history and clinical examination in most cases with or without the use of transabdominal ultrasound. In alpacas, diagnosis of cryptorchidism may be challenging as male-like behavior and mating are possible in males that have been castrated at an older age. In these cases, endocrine evaluation helps in differentiating between geldings displaying male-like behavior and cryptorchid animals. The diagnosis is based on determination of serum testosterone concentration before and 8 h after administration of hCG (3000 IU).[9,10,13] Recently, it has been shown that determination of Anti-Müllerian hormone on a single serum sample allows diagnosis of cryptorchidism in hemicastrated alpacas.[10,17] In the present case series, endocrine testing was performed in only one alpaca as in all the other cases cryptorchidism was evident from the history (lack of castration) and confirmed by percutaneous ultrasonography.

In the present study, unilateral cryptorchidism in goats affected predominately the right testicle. This agrees with other reports on West African dwarf goats.[5,6,14] A study of 29 small ruminant cases (20 sheep and 9 goats) found cryptorchidism was bilateral in 27.6% of cases and unilateral in 72.4%. Among unilateral cases, the right testis was affected in 85.7% and the left testis in 14.3%.[14] The study included Boer (77.8%), La Mancha (11.1%), and mixed breed (11.1%). It is not clear why cryptorchidism is predominantly right-sided.

Several surgical techniques have been described for cryptorchidectomy in camelids and goats including a parainguinal, paramedian and caudal paramedian approaches. In camelids, the parainguinal approach for cryptorchidectomy is common.[15,16] Caudal paramedian approach for cryptorchidectomy was also described in small ruminants less than 4 months old with 6.9 and 3.4% minor and major complications respectively. Finding and exteriorizing the testis using the laparotomy technique can be challenging and require larger incisions. Additionally, a second incision is often necessary in bilaterally cryptorchid cases.[14] This results in increased surgical time and risks for complications. The laparoscopic-assisted technique described here was not associated with any complications.

Conclusion

Laparoscopic-assisted cryptorchidectomy is a safe, quick, and effective method for cryptorchidectomy in South American camelids and Nigerian dwarf goats. It allows proper localization, manipulation, and removal of retained testicles while reducing surgical time and post-operative complications. Clients breeding Nigerian dwarf goats should be educated about the high prevalence of cryptorchidism in this breed and its potential hereditary component. Cryptorchidism may be missed by some owners during early castration by elastic banding.

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