

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

## Journal of Exotic Pet Medicine

journal homepage: [www.elsevier.com/locate/jepm](http://www.elsevier.com/locate/jepm)

## Case Report

Intra-abdominal torsion of a neoplastic testicle in a rabbit (*Oryctolagus cuniculus*) with cryptorchidism

Shanna Wong, BA<sup>a,b</sup>, Nicola Di Girolamo, DMV, MSc, PhD, Dip. ECZM(Herp)<sup>a,b,\*</sup>,  
Carrie Kuzma, DACVR<sup>a</sup>, Lenox Yim, BA<sup>b</sup>, Corinne Wong, RVN<sup>b</sup>, Katriona Bradley, BVMS<sup>b</sup>,  
Drury Reavill, DVM, DABVP (Avian and Reptile & Amphibian Practice), DACVP<sup>c</sup>

<sup>a</sup> Center for Veterinary Health Sciences, Oklahoma State University, Stillwater, OK, USA

<sup>b</sup> Tai Wai Small Animal and Exotic Hospital, Hong Kong, Hong Kong

<sup>c</sup> Zoo/Exotic Pathology Services, Carmichael, CA, USA

## ARTICLE INFO

## Keywords:

Rabbit  
Pet  
Lagomorph  
Torsion  
Cryptorchid  
Neoplasia

## ABSTRACT

**Background:** Testicular torsion is a relatively common complication of cryptorchidism in domestic mammals but is currently unreported in rabbits. **Case presentation:** A 7-year-old Dutch rabbit was examined for sudden anorexia and lethargy. The rabbit was previously diagnosed with unilateral cryptorchidism 5 years earlier; however, the owner declined surgical treatment at that time. Transabdominal ultrasonography showed a structure consistent with an enlarged testis, with decreased echogenicity, and absent blood flow upon color Doppler ultrasonography. After induction of general anesthesia and during preparation for surgery, the patient had an episode of cardiac arrest. After successful resuscitation, bilateral cryptorchidectomy continued as planned. A ventral midline laparotomy was performed and confirmed presence of an enlarged, dark red left testicle torsed on its spermatic cord. The contralateral testicle was atrophic. Both testicles were removed after standard hemostasis. Recovery was uncomplicated. Histopathologic examination revealed a diagnosis of Sertoli cell tumor and extensive hemorrhage and necrosis in the torsed testicle. **Conclusions and Clinical Relevance:** Based on literature search, this is the first reported case of intra-abdominal torsion of a neoplastic testicle in a cryptorchid rabbit. Early elective cryptorchidectomy before the potential development of life-threatening complications may be beneficial in rabbits as in other species.

## Introduction

In rabbits, testes descend into the scrotum between 3 and 22 days of age [1,2]. Current textbooks define cryptorchidism as an animal with uni- or bilateral undescended testes at 12–16 weeks of age [3,4]. Affected dogs have been reported to be at increased risk for developing testicular neoplasia [5,6]. Additionally, an intra-abdominal cryptorchid testicle may rotate on the spermatic cord axis, producing testicular torsion [7,8]; which typically results in acute abdomen and requires prompt surgical treatment [9]. Therefore, early elective orchidectomy is currently recommended in cryptorchid animals to prevent this and other potentially life-threatening complications [10]. The purpose of the present report is to describe a case of intra-abdominal torsion of a neoplastic testicle in a cryptorchid rabbit.

## Case presentation

A 7-year-old, 1.08 kg, intact male, Dutch rabbit (*Oryctolagus cuniculus*) was examined at the Tai Wai Small Animals & Exotics Hospital, Hong Kong, with a 4 day history of anorexia and lethargy. Additional medical history included dental disease, bilateral grade 1/5 pododermatitis of the forelimbs and cryptorchidism. Unilateral, left-sided cryptorchidism was diagnosed approximately 5 years previously (age, 2 years) because only the right testicle and hemiscrotum were evident on physical examination. At that time, the rabbit had developed acute onset anorexia 3 days prior; however diagnostic tests, hospitalization, and surgery was declined by the owner.

On physical examination, the rabbit was bright, alert, and responsive, but appeared restless. Tachycardia was present (heart rate, 400

\* Corresponding author.

E-mail address: [nicoladiggi@gmail.com](mailto:nicoladiggi@gmail.com) (N. Di Girolamo).

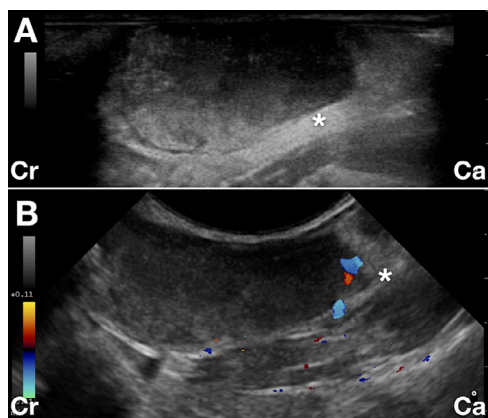
Financial Disclosure: The authors disclose any financial interests with companies that manufacture products that are the subject of the present research or with companies that manufacture competing products.

Emeraid Intensive Care Herbivore, EmerAid, Cornell, IL.

Oxbow Critical Care, Oxbow Animal Health, Omaha, NE.

<https://doi.org/10.1053/j.jepm.2019.11.008>

1557-5063/© 2020 Elsevier Inc. All rights reserved.

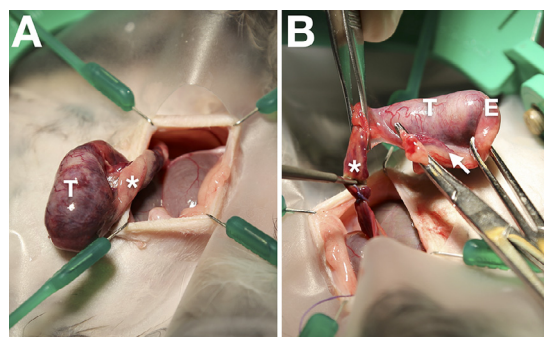


**Fig. 1.** B-Mode transabdominal ultrasonographic images of a 7-year-old Dutch rabbit that was examined for sudden anorexia and lethargy and had been diagnosed with unilateral (left) cryptorchidism 5 years earlier. Note the presence of a heterogeneous hypoechoic ovoid structure, surrounded by hyperechoic mesentery along the dorsal surface (asterisk). Length of the structure on its longitudinal axis was 28 mm. Portions of the mesentery exhibit distal acoustic shadowing. (A) Thin, linear hyperechoic striation is seen centrally, with amorphous hyperechoic material at the peripheral margins. The dorsal margin of the structure is moderately hyperechoic with central hypoechoic regions. (B) Color flow doppler ultrasonographic image of the abdomen. Minimal blood flow was evident at both cranial and caudal poles along the peripheral edges of the structure. No color flow was seen centrally or extending within the peripheral portions of the structure. Cr = cranial; Ca = caudal.

beats per minute; reference interval, 198–330 beats per minute) [11]. Oral examination performed with a vaginal speculum demonstrated minimal overgrowth of premolars and molars of all four arcades and minimally irregular incisors, but no evidence of lesions or ptyalism. The conjunctiva were moderately pale. On palpation of the abdomen the stomach and cecum were subjectively normal in size; however, a soft tissue mass was palpable in the caudal abdomen and pelvic region. The rabbit elicited signs of discomfort when the caudal abdomen was palpated. The testicles were not visible; penis conformation was similar to that of immature or castrated rabbits.

The rabbit was sedated with midazolam (1 mg/kg, intramuscularly) for diagnostic tests. With the exception of mild neutrophilia, results of a complete blood count were within reference limits; serum biochemical analysis was normal. Whole body radiographs revealed a moderately homogeneously fluid and gas filled stomach, with heterogeneous soft tissue opaque material. The cecum contained a moderate amount of heterogeneous soft tissue opaque material admixed with gas, as would be expected in a healthy rabbit. Large partially formed, fecal balls were seen. Within the caudal abdomen, at the cranioventral margin of the pelvic inlet, there was a roundish, homogeneously soft tissue opaque structure, likely representing a minimally filled urinary bladder. Transabdominal ultrasonography revealed normal liver and renal structures and the presence of a heterogeneous hypoechoic ovoid structure, surrounded by hyperechoic mesentery along the dorsal surface with central hypoechoic regions (Fig. 1). Portions of the mesentery exhibited distal acoustic shadowing. A thin, linear hyperechoic striation was seen centrally, with amorphous hyperechoic material at the peripheral margins. Color flow Doppler ultrasonography indicated minimal blood flow at both cranial and caudal poles along the peripheral edges of the structure, with no evidence of blood flow centrally.

On the basis of history, physical examination, and diagnostic imaging findings, the provisional diagnosis was abdominal cryptorchidism with additional pathologic features and cryptorchidectomy was recommended. The patient was hospitalized and stabilized with fluid therapy (0.9% NaCl; 5 mL/kg/hour intravenously [i.v.]) administered via a catheter placed in the marginal ear vein, buprenorphine (0.03 mg/kg intramuscularly every 8 hours), meloxicam (0.5 mg/kg subcutaneously



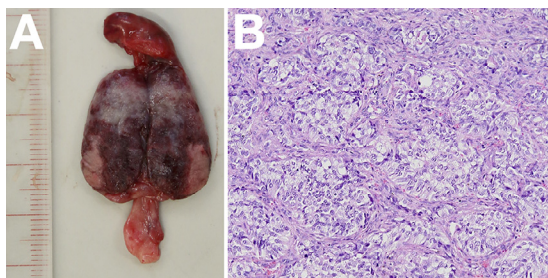
**Fig. 2.** Intraoperative photographs of an intra-abdominal torsed and neoplastic testicle in the patient in Figure 1. Images during ventral midline laparotomy, the patient is positioned in dorsal recumbency. (A) Note enlargement and reddening of the cryptorchid testicle (T) and torsion of the spermatic cord (asterisk) on its axis. (B) The ligament of the testicle (arrow) has been ligated and excised distal to the epididymus (E). A suture has been placed on the spermatic cord (asterisk) and the cord is being excised with bipolar cautery.

every 12 hours), and assisted feeding with commercially available powdered formulas (1:1, Emerald Intensive Care Herbivore, EmerAid, Cornell, IL., Oxbow Critical Care, Oxbow Animal Health, Omaha, NE., 15 mL orally five times per day).

The following day, the rabbit was premedicated with dexmedetomidine (0.03 mg/kg intramuscularly), ketamine (10 mg/kg intramuscularly), and midazolam (1 mg/kg intramuscularly). Intravenous fluid rate was increased to 10 mL/kg/hour. The patient was intubated endoscopically and maintained on 2–3% isoflurane in oxygen; monitoring included doppler, pulse oximetry, capnography, rectal temperature, and non-invasive blood pressure. The rabbit was placed in dorsal recumbency and the abdomen was shaved and surgically scrubbed. During surgical preparation, approximately 5 minutes after induction of general anesthesia the patient had an episode of cardiac arrest. Intravenous fluid therapy rate (0.9% NaCl) was increased to 45 mL/hour, bolus doses of atropine sulfate (0.5mg/kg, 0.54 mg/mL), and adrenaline (0.2 mg/kg, 1 mg/mL) were given i.v. and manual positive pressure ventilation was maintained at 60 breaths per minute. After approximately 2 minutes, resuscitative measures were successful and the patient's heart rate was stable at 250 bpm. The intravenous fluid rate was decreased and maintained at 15 mL/hour.

The owner was contacted via phone by a veterinary technician, informed about the cardiac arrest, and given the option to either continue or abort the procedure. The owner agreed to continue the procedure. The rabbit was moved into the operating room, positioned in dorsal recumbency, and draped in standard fashion. A 3 cm ventral midline incision was made on the caudal abdomen. The urinary bladder and both testicles were visualized. The left testicle was red and enlarged with torsed vessels (Fig. 2), and the right testicle was notably atrophied. The ligaments of the both testicles and the spermatic cords were ligated with 3-0 vicryl. Hemostasis was applied with bipolar cautery and both testicles were removed. The abdominal wall was closed 2 layers with 3-0 vicryl and 5-0 monocryl, both in a simple continuous pattern. Recovery was prolonged but otherwise uncomplicated. Postoperative intravenously fluids were provided overnight at (0.9% NaCl, 8 mL/hour) and then reduced to 2 mL/hour for 24 hours before transitioning to a subcutaneous fluid bolus (20 mL twice daily) until discharge. The rabbit also received buprenorphine (0.03 mg/kg intramuscularly every 8 hours) and meloxicam (0.5 mg/kg subcutaneously every 12 hours) for analgesia, enrofloxacin (5 mg/kg diluted subcutaneously every 24 hours) and assisted oral feeding (15 mL orally five times per day), postoperatively.

The left testicle, which measured 2.5 cm × 1.5 cm × 1.4 cm in size; spermatic cord, measured 1.5 cm in length, was submitted for histopathologic examination. Histologic examination revealed extensive areas of hemorrhage and bands of fibrous connective tissue extending through the stroma (Fig. 3). The testicle contained multiple small irregular nests



**Fig. 3.** (A) Gross appearance of the left testicle removed from the patient in Figure 1. Longitudinal section has been performed. The scale on the left of the image is in mm. (B) Histopathologic examination shows extensive areas of hemorrhage as well as bands of fibrous connective tissue extending through the stroma. Multiple small irregular nests and trabeculae of cells supporting indistinct cytoplasmic borders and abundant vacuolated cytoplasm with an oval to round cell nucleus having a lightly stippled chromatin pattern and variably distinctly basophilic nucleoli. These were separated by small to moderate amounts of dense fibrous connective tissue. The mitotic count was low (01 per high-power field).

and trabeculae of cells that with indistinct cytoplasmic borders and abundant vacuolated cytoplasm containing oval to round cell nuclei having a lightly stippled chromatin pattern and variably distinctly basophilic nucleoli. These were separated by small to moderate amounts of dense fibrous connective tissue. The mitotic count was low at 01 per high-power field. Additionally, there were prominent areas of cellular necrosis within the extensive areas of hemorrhage. The final histopathologic diagnosis was a testicular Sertoli cell tumor. The extensive hemorrhage and necrosis were deemed likely secondary to the testicular torsion.

The patient was hospitalized for 3 days after surgery. Throughout, the rabbit was quiet, alert and responsive; the abdomen was soft, and the surgical wound was dry and did not appear inflamed. Treatments were transitioned to oral administration for hospital discharge: meloxicam (0.5 mg/kg orally every 12 hours for 4 days) and enrofloxacin (5 mg/kg orally every 12 hours for 5 days). The patient returned for a follow-up examination two days after hospital discharge. At that time, it was bright, alert, and responsive, reported to have a good appetite, therefore the assisted feeding was discontinued. The surgical wound was dry with no evidence of blood or discharge from the site. The feces were normal in size and quantity. Seven days after surgery the patient returned for a final examination. It again appeared bright, alert, and responsive with normal appetite and regular feces, and appeared more active. Abdominal palpation was soft, and the surgical wound was completely healed. All courses of postoperative medications had been completed and no new treatments were warranted.

## Discussion

On the basis of literature searches (Medline, CAB abstracts, and annual Association of Exotic Mammal Veterinarian proceedings [2003–2018]); we are not aware of prior published case reports of intra-abdominal testicular torsion in cryptorchid rabbits, nor cases of testicular torsion. This report describes the successful treatment of testicular torsion in a rabbit with intra-abdominal cryptorchidism and concurrent testicular neoplasia, suggesting the benefit of early cryptorchidectomy. Testicular torsion is a relatively common complication of cryptorchidism in other companion animals [12–15] and we suggest it be included in the differential diagnoses of cryptorchidism in rabbits also.

It is commonly recommended for cryptorchid dogs to undergo elective prophylactic cryptorchidectomy [13–15], in an attempt to prevent the future development of testicular neoplasia and other subsequent morbidities [13–15]. This issue has been debated [16] and a subsequent study published in 2002 reported a decision analysis tree that evaluated the benefit of preventative orchiectomy in cryptorchid dogs [17]. The risks of

general anesthesia and surgery were compared with the risks associated with testicular neoplasia in cryptorchid dogs. The study concluded that the life expectancy between the groups was similar, suggesting that early elective orchidectomy in cryptorchid dogs did not have a significant benefit in terms of morbidity and mortality, compared with dogs that did not undergo surgery. However, those authors did not consider testicular torsion. Furthermore, the risks associated with general anesthesia in companion animals have decreased in the last 30 years [18,19]. In light of these factors; clinical experience and limited recent published evidence, indicates that cryptorchidectomy at the time of initial diagnosis is currently the treatment of choice for cryptorchid animals [12].

There are multiple steps of the medical treatment of this rabbit in this report that are anecdotal due to limited evidence of the effectiveness of medical interventions in pet rabbits. The choice of intravenous fluid administered (0.9% NaCl) was made on the basis of attending clinician preference, since there is currently limited evidence of optimal fluid therapy in diseased pet rabbits with no abnormalities in clinical laboratory (blood) testing. Furthermore, whereas the choice to administer antimicrobial treatment to this rabbit during and after surgery may seem questionable this was to prevent possible infectious complications following surgery. Although the surgery was performed with full sterile techniques (a clean procedure); at the outset we lacked a histopathologic diagnosis and infectious orchitis could not be discarded a priori on the basis of results of history, physical examination and diagnostic imaging.

Early elective cryptorchidectomy in affected rabbits would likely reduce the risks associated with general anesthesia; in view of the likelihood of avoiding anesthesia patients with more advanced systemic disease. The rabbit of the present report was initially diagnosed with unilateral abdominal cryptorchidism at 2 years of age but did not undergo elective surgery at the time of diagnosis. On the basis on the medical records, the owner was informed of both risks and benefits of cryptorchidectomy and opted to postpone the procedure. Since the first examination when the rabbit was initially diagnosed with cryptorchidism, an additional 15 physical examinations were found in the medical records. Detailed medical records suggested that the cryptorchid status of the rabbit was not mentioned again in any of those subsequent examinations. Unfortunately, the delay in treatment resulted in additional complications, including an episode of cardiac arrest during general anesthesia. In this case, cardiopulmonary resuscitation was implemented successfully, using a protocol similar to the one described in a recent article [20]. However, we suggest that performing the cryptorchidectomy near the time of diagnosis, before the onset of testicular torsion, may prevent severe intraoperative and anesthetic complications including the need for emergency surgery in future cases. The present case also highlights the importance of periodically discussing overall health history and the importance of prophylactic surgical procedures where indicated, with reluctant or uncompliant owners. Education and information sharing with clients may assist veterinarians to better understand their needs and allow them to come to a timely decision, i.e., in the best interests of the patient.

## Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:[10.1053/j.jepm.2019.11.008](https://doi.org/10.1053/j.jepm.2019.11.008).

## References

- [1] Rajfer J. Endocrinological study of testicular descent in the rabbit. *J Surg Res* 1982;33:158–63.
- [2] Amann RP, Veeramachaneni DNR. Cryptorchidism in common eutherian mammals. *Reproduction* 2007;133:541–61.
- [3] Klaphake E, Paul-Murphy J. Disorders of the reproductive and urinary systems. In: Quesenberry K, Carpenter JW, editors. *Ferrets, rabbits and rodents: clinical medicine and surgery*. 3rd ed. St. Louis: Elsevier Saunders; 2012. p. 217–31.
- [4] Varga M. *General surgical principles and neutering. Textbook of rabbit medicine*. 2nd ed. Elsevier; 2014. p. 432.

- [5] Reif JS, Maguire TG, Kenney RM, Brody RS. A cohort study of canine testicular neoplasia. *J Am Vet Med Assoc* 1979;175:719–23.
- [6] Wallace LJ, Cox VS. Canine cryptorchidism. In: Kirk RW, editor. *Current veterinary therapy VII small animal practice*. Philadelphia: W.B. Saunders; 1980. p. 1244–6.
- [7] Pearson H, Kelly DF. Testicular torsion in the dog: a review of 13 cases. *Vet Rec* 1975;97:200–4.
- [8] Liang J, Harari J, Smith CJ. Spermatic cord torsion and Sertoli cell tumor in a dog. *J Am Vet Med Assoc* 1983;183:879–81.
- [9] Ford RB, Mazzaferro E. Emergency care. *Kirk & Bistner's handbook of veterinary procedures and emergency treatment*. 9th ed. St. Louis: Elsevier Saunders; 2012. p. 141.
- [10] Fonte LM, Martins-Bessa A. Reproductive emergencies in males. In: Ettinger SJ, Feldman EC, Côté E, editors. *Textbook of veterinary internal medicine*. 8th ed. St. Louis: Elsevier; 2017. p. 615.
- [11] Lord B, Boswood A, Petrie A. Electrocardiography of the normal domestic pet rabbit. *Vet Rec* 2010;167:961.
- [12] Bufalari A, Proni A, Moretti G, Meo Di, Pirico S. The lameness in a cryptorchid dog with intra-abdominal torsion of one of the two neoplastic testicles: a case report. *Veterinarni Medicina* 2015;60:456–9.
- [13] Post K, Kilborn SH. Canine Sertoli cell tumor: a medical records search and literature review. *Can Vet J* 1987;28:427–31.
- [14] Romagnoli S. Canine cryptorchidism. *Vet Clin North Am Small Anim Pract* 1991;21: 533–44.
- [15] Mostachio GQ, Apparici M, Vicente WRR, Cardilli DJ, Motheo TF, Toniollo GH. Intra-abdominal torsion of a neoplastic testicle and prostatic cyst in a cryptorchid dog. *Schweizer Archiv für Tierheilkunde* 2007;149:408–12.
- [16] Bosch AG, von Sluijs FJ, van Nes JJ. Medical decision analysis in veterinary practice. An introduction with reference to the problem: to operate or not in cryptorchidism in dogs. *Tijdschr Diergeneeskde* 1989;114:369–75.
- [17] Peters MAJ, von Sluijs FJ. Decision analysis tree for deciding whether to remove an undescended testis from a young dog. *Vet Rec* 2002;150:408–11.
- [18] Clarke KW, Hall LW. A survey of anaesthesia in small animal practice: AVA/BSAVA report. *J Assoc Vet Anaesthetists* 1990;17:4–10.
- [19] Brodbelt DC, Pfeiffer DU, Young LE, Wood JL. Results of the confidential enquiry into perioperative small animal fatalities regarding risk factors for anesthetic-related death in dogs. *J Am Vet Med Assoc* 2008;233:1096–104.
- [20] Onuma M, Kondo H, Ono S, Murakami A, Harada T, Sano T. Retrospective investigation of cardiopulmonary resuscitation outcome in 146 exotic animals. *J Vet Med Sci* 2017;79:1611–4.