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OBSTETRICAL AND POSTPARTUM COMPLICATIONS IN LESSER MADAGASCAR HEDGEHOG TENRECS (*ECHINOPS TELFAIRI*): FOUR CASES

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Abstract: Currently, little is known about diseases and health concerns in tenrecs, family Tenrecidae. During the past 10 yr of breeding lesser Madagascar hedgehog tenrecs (*Echinops telfairi*) at a single zoological institution, a diverse range of obstetric and postpartum complications have been observed: pyometra, metritis, retained fetal membranes, retained fetus, perinatal mortality, and maternal neglect with subsequent successful hand-rearing of neonates. Treatment of these problems is complicated in tenrecs because of their small size and secretive behavior. Some of the cases reported in this article had successful resolution by ovariohysterectomy or cesarean section. The four cases described in this report overall help to disseminate options and outcomes for the diagnosis, treatment, and management of obstetric and postpartum complications in this small, secretive, nondomestic species.

Key words: Dystocia, *Echinops telfairi*, obstetrics, ovariohysterectomy, reproduction, tenrec.

INTRODUCTION

Lesser Madagascar hedgehog tenrecs (*Echinops telfairi*) belong to the newly formed, large, and diverse superorder Afrotheria, despite their similar appearance to hedgehogs, subfamily Erinaceinae, through convergent evolution.[4–6] Within the family Tenrecidae, are 34 species of tenrecs, with *E. telfairi* being the most commonly kept species in captivity. Overall, very little information exists on diseases and health concerns of tenrecs.[9,12] The most commonly reported disease in tenrecs is neoplasia.[9,11,12,14] To the authors' knowledge, no reports currently document postpartum and obstetric complications as a significant cause of morbidity in tenrecs. In this report, the authors use the term "tenrec" henceforth to refer solely to *E. telfairi*.

Tenrecs are considered seasonal breeders, with breeding typically beginning after completion of torpor.[4] Tenrec lifespan range is up to 18 yr old, but the average is 7–11 yr.[12] Tenrecs have a bicornuate uterus with hemochorial placentation. The anus and urogenital tracts share a common opening referred to as a cloaca, which is a very rare trait in placental mammals. Females become sexually mature at 1 yr old, but based on findings at Potter Park Zoo, sexual maturity may occur earlier.[4,6,10] The litter size may range between 1 and 10, with an average of three to five neonates.[9,15] Typical litter size observed at the authors' institution was one to four neonates. Tenrec gestation is disproportionately long compared with other similar-sized species.[4] Their gestation period has a mean of 67.5 days and a wide range of 50–79 days, which can further complicate the diagnosis of dystocia in a tenrec.[9,15] The institution in this report typically houses a male and female together year-round, except the male is removed before birthing and then replaced back with the female after the neonates are fully weaned and removed.

Based on 10 yr of breeding *E. telfairi* at a single zoologic institution, a high frequency of obstetric and postpartum complications were observed in this captive born colony. The four animals in this report represent four out of six of the breeding females during the 10-yr period at the institution, which includes five parturition events. The two females not included in this report had five parturitions with no complications. Difficulties in assessing the health status of a tenrec include: their secretive behavior, predilection for obesity, ability to exhibit torpor, small size, and presence

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Table 1. Summary information about the obstetric and postpartum complications that occurred in the five litters from four tenrec dams presented in this article.

Case	No. of litters	Age litters produced (yr)	No. per litter	Complications	Outcome
1	1	11	2	Perinatal mortality and retained fetus	Ovariohysterectomy
2	1	11	1	Cloacal discharge and retained fetal membranes	Cesarean section and neonate hand-raised
3	2	3	3	Rejected neonates	Neonates hand-raised
		5	4	Retained placenta	Neonates hand-raised and ovariohysterectomy
4	1	1	4	Prolonged intermittent cloacal discharge, anemia	Metritis resolved with antibiotics

of spines. Anesthesia is typically required for complete physical examination, diagnostics, and sample collection. The small size of a female tenrec, typically weighing 100–160 g, makes obstetric problems even more of a challenge to diagnose and manage compared with larger species. The following report describes the obstetric and postpartum complications that were observed in four tenrecs at a single zoologic institution: pyometra, metritis, retained fetal membranes (RFM), retained fetus (dystocia), perinatal mortality, and maternal neglect with subsequent hand-rearing of neonates (Table 1). Also included are the descriptions of successful ovariohysterectomies (OVH) and cesarean sections.

CASE SERIES

Case 1

An 11-yr-old, nulliparous animal gave birth to a single neonate that expired shortly after birth. Radiographs showed the presence of a second fetus. Over the following 72 hr the female failed to deliver the second fetus, became lethargic, and developed a purulent cloacal discharge. The tenrec was anesthetized with isoflurane via chamber followed by facemask (Isothesia, 1.5–5%; Butler Animal Health Supply, Dublin, Ohio 43017, USA), and OVH was performed by veterinarians at Michigan State University College of Veterinary Medicine (MSU CVM) via a midline abdominal incision. Hemoclips (Vera-Clip, Pitman-Moore Inc., Washington Crossing, New Jersey 08560, USA) were used to ligate the ovarian pedicles and uterine body. The uterus contained one retained deceased fetus. Small amounts of fibrin were present within the lumen of the uterus and the abdominal cavity. The abdomen was flushed with saline and then closed with 4-0 polydioxanone (PDS, Ethicon, Somerville, New Jersey 08876, USA). Postoperative treatment included fluids (LRS with 2.5% dextrose, 6 ml s.c.; Hospira Inc., Lake Forest, Illinois 60045, USA), enrofloxacin (Baytril, 10 mg/kg p.o. b.i.d. for 10 days; Bayer, Shawnee Mission, Kansas 66021, USA), and ketoprofen (Ketofen, 0.9 mg/kg i.m. b.i.d. for 3 days; Merial, Duluth, Georgia 30096, USA). The tenrec's appetite and behavior returned to normal within a few days after surgery with no further complications. The uterus, ovaries, fetus, and placenta were not submitted for histopathology.

Case 2

A primiparous 11-yr-old tenrec presented with a 24-hr history of brown cloacal discharge. Radiographs showed a possible increased "bony detail" within the abdomen, which was suspected to be a fetus. Ultrasound was performed by MSU CVM, and one viable neonate was detected (Fig. 1). The animal was anesthetized with isoflurane as previously described. The tenrec was placed in dorsal recumbency on an external heating source, clipped, and prepped for surgery. Pulse oximetry was successful on a thoracic foot. A cesarean section was performed via a midline abdominal incision. The uterus was located and contained a single neonate which was removed through a full-thickness incision into the uterine body. A swab was collected for culture and sensitivity, and the uterus and abdomen were closed with 4-0 polydioxanone (PDS). Culture of the uterus resulted in moderate growth of *Escherichia coli, Morganella morganii, Proteus* spp., and nonhemolytic *Streptococcus.* All were susceptible to enrofloxacin. The dam was treated with meloxicam (Metacam, 0.27 mg/kg s.c. s.i.d. for 4 days; Boehringer Ingelheim, St. Joseph, Missouri 64506, USA) and enrofloxacin (12 mg/kg p.o. b.i.d. for 14 days). The neonate was revived with stimulation and doxap-

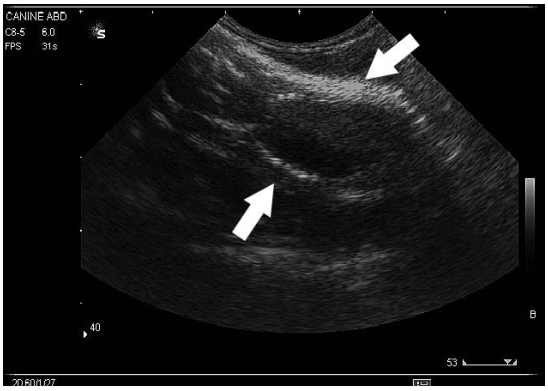

Figure 1. Ultrasound image of a single viable fetus from an 11-yr-old tenrec (Case 2). The outline of the ribs is faintly visible on this image (arrows), demonstrating the difficulty in evaluating pregnancy status via diagnostic imaging in tenrecs.

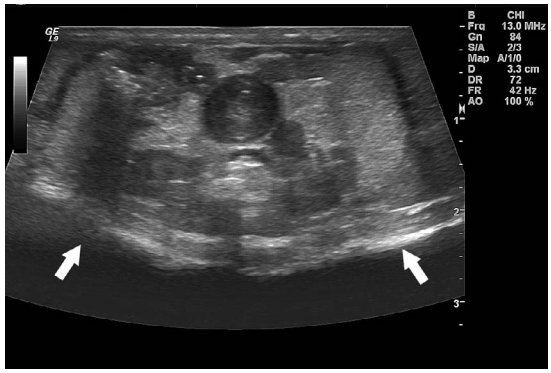

Figure 2. Ultrasound image of the uterus of a postpartum 5-yr-old tenrec (Case 3) showing an enlarged uterus of mixed echogenicity with a moderate amount of anechoic fluid (surrounded by arrows). Differentials included a blood clot, retained fetal membranes, or inflammation. This animal was diagnosed with retained fetal membranes 6 wk later.

ram hydrochloride (Dopram, 1 drop topically at the base of the tongue; Fort Dodge Animal Health, Fort Dodge, Iowa 50501, USA) and hand-reared successfully. This neonate went on to reproduce as an adult and successfully raised three litters of offspring.

Case 3

Maternal neglect was exhibited by this tenrec dam during the first litter at 3 yr of age. The neonates were consequently hand-reared successfully. The tenrec was unsuccessfully bred at 4 yr of age. At 5 yr of age, the tenrec gave birth to four neonates and initially exhibited good maternal care. Within 24 hr, the dam stopped tending to the neonates and developed lethargy, anorexia, and pale mucous membranes. The neonates were removed and successfully hand-reared. Radiographs taken showed no additional fetuses. Treatment included oxytocin (Oxojet, 0.2 IU/kg i.m. once; IVX Animal Health Inc., St. Joseph, Missouri 64507, USA) for possible retained placenta, subcutaneous fluids (LRS with 2.5% dextrose 5–10 ml s.c. s.i.d.), assisted feeding, and enrofloxacin (5 mg/kg s.c. or p.o. b.i.d. for 14 days). Forty-eight hours later, the animal passed a 1-cm-diameter red tissue composed of hemorrhagic clots, some fibrin, and degenerated fetal membranes identified by histopathology.

Abdominal ultrasound (13-MHz linear transducer probe) by veterinarians at MSU CVM showed a mildly enlarged uterine body with mixed echogenicity and right horn with a moderate amount of anechoic fluid (Fig. 2). Visualization of the left horn was unsuccessful and there was no evidence of a retained fetus. Differentials based on ultrasound included retained fetal membranes, blood clot, or severe inflammation. Blood work showed a mild regenerative anemia (HCT= 38%, moderate polychromasia and nucleated red blood cells) with a moderate leukocytosis (28,380 cells/μl, reference range 10,110 ± 3,280 cells/μl) with mature neutrophilia (22,704 cells/μl, reference range 3,430 ± 1,000 cells/μl]).[9] The animal's condition continued to improve over the next week.

Four weeks postpartum, the tenrec developed mild to moderate cloudy white cloacal discharge but maintained a normal attitude and appetite. Culture of the discharge grew numerous *M. morganii*, which were susceptible to enrofloxacin. Treatment with enrofloxacin was initiated (5 mg/kg p.o. b.i.d. for 14 days). One week later, the tenrec became lethargic with a decreased appetite. On abdominal ultrasound, a mixed echogenicity structure was present on the right side, midabdomen, which was suspected to be an abnormal right uterine horn. An exploratory laparotomy was performed under general anesthesia. Microophthalmic surgical instruments and hemoclips were used to perform an OVH and ligate the uterine body and the ovarian pedicles. Because of the unique cloacal anatomy of the tenrec, the bladder lies in closer proximity to the uterine body than in other species. The surgeon must take care to identify the bladder, which may be only 0.5 cm in diameter (Fig. 3, arrow), and ensure that the bladder and ureters are not included in the hemoclip placement. The left horn of the uterus

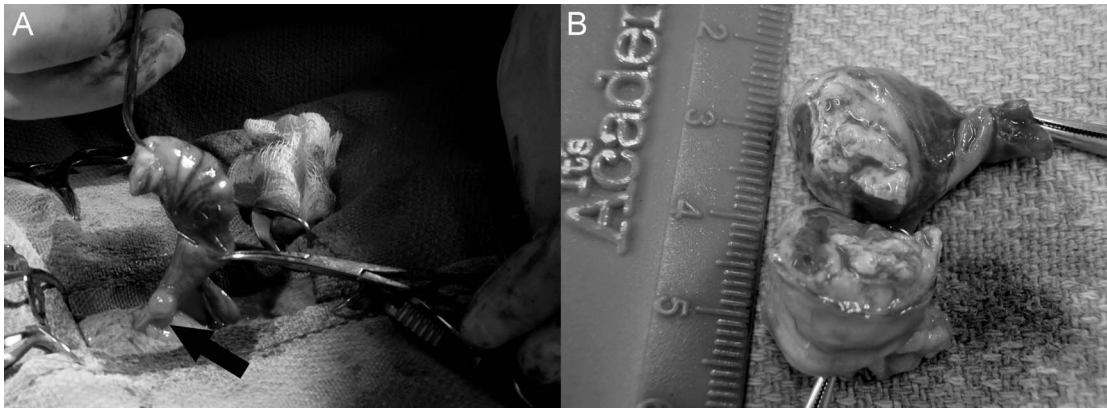

Figure 3. Images from ovariohysterectomy performed on a 5-yr-old tenrec (Case 3) that had retained fetal membranes for 6 wk postpartum. Image shows surgical removal of the uterus with the aid of hemoclips. Because of the unique cloacal anatomy of a tenrec, care must be taken during surgery to place ligatures on the uterine body, making sure to not include the urinary bladder (arrow pointing to small empty bladder). The right horn of the uterus was grossly enlarged and firm and contained fetal membranes on the cut surface from the same tenrec as Figure A.

appeared unremarkable and measured 0.2 × 0.2 × 0.3 cm in size. The right horn was severely enlarged (1 × 2 × 3 cm) and firm and, on cut surface, had a mottled white, tan, and red appearance (Fig. 3B). Histopathology revealed severe transmural necrotizing and suppurative pyometra and metritis with intralesional fetal membranes consistent with a retained placenta. Postoperative treatments included subcutaneous fluids, assist feeding, meloxicam (0.15 mg/kg p.o. s.i.d. for 5 days;), and enrofloxacin (5 mg/kg p.o. s.i.d. for 28 days). The tenrec's appetite returned to normal in the next few days.

Case 4

This tenrec's first parturition was at 1-yr-old. There were no complications until 7 wk postpartum, when this animal developed a very mild intermittent hemorrhagic cloacal discharge. Physical examination showed no other clinical signs. The mild discharge was suspected to be due to subinvolution of placental sites (SIPS). The animal was closely monitored with serial physical exams and for any changes in behavior, appetite, or increased hemorrhage, which is the initial recommendation for mild to moderate cases of SIPS in humans.[20] As the intermittent discharge persisted during the subsequent weeks, the tenrec was anesthetized with sevoflurane via chamber and facemask (SevoFlo, 3–7%; Abbott Animal Health, Abbott Park, Illinois 60064, USA). Physical exam was unremarkable except for mucopurulent cloacal discharge, which consisted of neutrophils with marked degeneration and intracellular bacteria, as well as extracellular cocci and rods. Culture revealed numerous *M. morganii*, and based on sensitivity, the tenrec was started on enrofloxacin (10 mg/kg, p.o. s.i.d. for 30 days) for suspected metritis. Complete blood count showed no abnormalities except for a moderate leukocytosis (white blood cell count = 27,460 cells/μl, reference range 10,110 ± 3,280) with mature neutrophilia (12,830 cells/μl, reference range 3,430 ± 1,000) and lymphocytosis (13,460 cells/μl, reference range 6,180 ± 2,650).[9] The chemistry profile had no significant abnormalities. Throughout the following weeks, the tenrec continued to have normal behavior and appetite. Sequential ultrasounds, however, were suspicious for an abnormal right uterine horn, and the discharge failed to resolve completely, so an exploratory laparotomy was performed.

During surgery, the right uterine horn was slightly enlarged with two intramural masses that were both about 2 mm in size. Complete excision of the masses was performed with mini-tenotomy scissors for full-thickness biopsies of the uterine wall, and sites were closed with 5-0 PDS. The abdominal wall and subcutaneous layer were closed with 4-0 PDS in a simple continuous pattern, and the skin with 5-0 PDS in an intradermal pattern. Postoperative treatments included meloxicam (0.1 mg/kg s.c. s.i.d. for 3 days), buprenorphine (0.1 mg/kg s.c. b.i.d. for 3 days), and enrofloxacin (10 mg/kg, i.m. once then p.o. s.i.d. for 10 days). There was no growth of bacteria on aerobic and anaerobic culture of the uterus. On histopathology, minimal hemosiderin was present, with lymphatic dilation present

within the uterine walls, which were consistent with involution of placentation sites. Neither RFM nor metritis was evident at the time of the surgery. The tenrec had no further complications, and the discharge resolved.

DISCUSSION

Little information is available in the literature about the management of obstetric and postpartum complications in small, secretive nondomestic species. Tenrecs present many challenges for clinical treatment that are inherent to their small size. Based on the authors' experiences with tenrecs, it can be challenging to diagnosis pregnancy or dystocia via radiographs or ultrasound, even in late-term gestation (Fig. 1). Evaluation of the uterus requires a high-frequency probe (e.g., 13 MHz) with a small footprint (linear) and a high-quality ultrasound. Abdominal palpation in well-socialized tenrecs and monitoring of weight gain may also aid in detecting pregnancy, especially when there are large litter sizes. The surgical methods used in the tenrec cases were similar to the routine OVH method described previously in another small species, vampire bats (*Desmodus rotundus*).[8] Because of the small size of these animals, hemoclips and ophthalmic microsurgical instruments were vital to the success of the surgeries. Additionally, the use of magnification, such as operating loupes, may be beneficial.

Tenrecs have hemochorial placentation, which is the same classification as vampire bats, primates, humans, rabbits, hedgehogs, and many rodents.[4,5] The small species with the most well studied obstetric complications and their management are laboratory mice, rats, and guinea pigs, which are often bred in high numbers with significant inbreeding and genetic manipulation.[17,18] A review of mortality in another Afrotheria species, the elephant shrews (Macroscelididae), found dystocia to be the cause of death in 4.2% of the study population.[7] A study on obstetric problems in black-tufted marmosets (*Callithrix penicillata*) in Europe documented several cases of dystocia- and pregnancy-related toxemia.[19] A morbidity study in pet degus (*Octodon degus*), found that 9.3% of cases observed had reproductive diseases, including pyometra, hemometra, and dystocia.[13] A single case is reported of diagnosis and surgical management, cesarean section, and OVH of a dystocia secondary to a perianal fetal hernia in an African hedgehog (*Atelerix algirus*).[21]

Retention of the placenta for 8–48 hr postpartum, depending on the species, is defined as RFM.[2] Risk factors for RFM in other species, such as humans, cattle, and horses, are proposed to include induced parturition, immunosuppression, dystocia, abortion, hypocalcemia, prolonged or shortened gestation, uterine inertia, uterine lesions, advanced age of the dam, and previous cesarean section or RFM.[1,2] An animal with RFM may be predisposed to developing endometritis, metritis, ketosis, and mastitis, as well as decreased fertility for future breeding.[2] A review of retained placentas in a nonhuman primate breeding colony revealed an incidence of 0.97–3.27% in all births, depending on the species.[1] The study found that, within this group of animals, risk factors included stillbirth/abortion and having had one or more cesarean sections.[1] One report exists on successful resolution of RFM by OVH of a placenta that was retained for 5 days, despite aggressive medical management, in a 600-g golden lion tamarin (*Leontopithecus rosalia*).[3]

Tenrecs may be able to mask the clinical signs of RFM-induced pyometra for extended periods compared with other species. Case 3 had RFM for 6 wk before decompensation in condition and subsequent OVH. Treatment with systemic antibiotics in cattle have been shown to be beneficial for cases in which the placenta has been retained for a prolonged period of time.[2] Case 3 was treated twice with antibiotic therapy, which may have helped this animal mask clinical signs of pyometra and RFM. In Cases 2, 3, and 4, the bacteria associated with the RFM or metritis was *M. morganii,* which in humans has been shown to be associated with the urinary tract as the portal of entry.[16]

Case 4 exhibited clinical signs of both intermittent hemorrhagic and later purulent cloacal discharge but remained clinically normal otherwise. The authors suspect that Case 4 developed metritis at 11 wk postpartum on the basis of cytology, with intracellular bacteria, positive culture, and clinical signs of mucopurulent cloacal discharge. The treatment with antibiotics may have resolved metritis before surgery and histopathology. This tenrec also had persistent intermittent mild hemorrhagic uterine discharge, which is consistent with a differential diagnosis of SIPS, and abnormal repair of endometrial placental sites.[20] In domestic canines, SIPS occurs most commonly in young primiparous dogs that present with prolonged intermittent hemorrhagic vaginal discharge postpartum.[22] Conservative medical treatment in other species and humans is typically initiated first because SIPS often resolves without intervention. Treatment for more severe or persistent cases can include

OVH or blood transfusions for treatment of anemia.[20]

Because all tenrecs were from the same institution, it is possible that an environmental, nutritional, or genetic factor could account for the high rate of complications, although not all tenrecs were related. Case 4 was an offspring from Case 3. Case 1 was not related to any of the other cases, and Cases 1 and 2 were not bred until the age of 11 yr when they were considered geriatric, which could have theoretically predisposed them to complications.

CONCLUSIONS

This article reports a diverse range of obstetric and postpartum complications that have occurred in a colony of tenrecs at a single institution (Table 1). Diagnosis, treatment, and management of these complications presented many challenges because of their small size. Despite these challenges, an accurate diagnosis and treatment was often possible and vital to a successful outcome. Surgical intervention, both OVH and cesarean section, were accomplished with the aid of microopthalmic surgical instruments, surgical magnifying loupes, and hemoclips. Dystocia or RFM should be suspected in tenrecs that have a history of breeding and present with vaginal discharge and lethargy. Tenrecs may be able to mask signs of systemic disease due to RFM longer than other species, but they eventually develop complications such as pyometra. The high incidence of complications observed in this institution's breeding colony might not be representative of all populations of tenrecs. Hand-rearing of tenrec neonates can be successful but does require extensive staff training and time commitment.

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