Case Report

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Surgical management of severe tail injury by partial caudectomy in a long-tailed macaque (*Macaca fascicularis*)

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ABSTRACT

A male long-tailed macaque (*Macaca fascicularis*) was found to have a severe tail injury during a clinical examination prior to vasectomy at the Sacred Monkey Forest Sanctuary in Ubud, Bali, Indonesia. The injury involved an open wound with areas of necrosis and fracture. Based on the tail condition, the animal was treated with a partial caudectomy. Prophylactic treatment prior to surgery with antibiotic and anti-inflammatory was carried out using amoxicillin and ketorolac tromethamine, respectively. Anesthesia was maintained using propofol. Postoperatively, the anesthesia reversal agent atipamezole was administered. After the macaque exhibited clear signs of recovery from anesthesia, it was transported in a cage back to the capture site and released into its original social group. To the best of our knowledge, this is the first documented case report describing partial caudectomy in macaques.

Introduction

The tail is an extension of the vertebral column and serves a variety of complex functions in animals. In companion animals such as dogs and cats, the tail plays a key role in communication and balance. For example, the position and movement of a dog's tail can indicate its emotional state (Fesseha, 2020). Similarly, in macaques, the tail serves comparable functions, aiding in social communication, balance, and locomotion. The structural adaptations in the vertebrae support increased flexibility and range of motion, which are essential for their arboreal lifestyle (Russo, 2015; Tojima, 2021).

Caudectomy, or tail amputation, is a surgical procedure indicated for traumatic injuries, infections, neoplasia, and perianal fistula cases (Fossum, 2019). Depending on the location and extent of the lesion, caudectomy can be classified into two types: complete caudectomy (removal of the entire tail) and partial caudectomy (removal of a portion of the tail) (Coleman and Gall, 2024). In companion animals such as dogs and cats, tail injuries are the most common reason for partial caudectomy, accounting for approximately 72.7% of cases (Simons *et al*., 2014). Besides injuries, caudectomy in dogs is also indicated in cases of repeated self-trauma. Cosmetic caudectomy, or tail docking, is also performed in dogs for aesthetic reasons, although it remains controversial among animal welfare advocates and veterinarians worldwide (Eyarefe and Oguntoye, 2016). In livestock such as cattle, pigs, and sheep, caudectomy is typically carried out to improve hygiene and lower the risk of mastitis in dairy cattle, prevent tail biting in pigs, and reduce fly strike in sheep (Sutherland and Tucker, 2011; Sandercock *et al*., 2016).

We believe that tail injuries also commonly occur in wild animals, such as long-tailed macaques, which may require surgical intervention. During 2015-2018 period, tail injuries were reported in 4.03% (9/223) of cases at the Sacred Monkey Forest Sanctuary in Ubud, Bali, Indonesia, two of which resulted in mortality (Loudon *et al*., 2024). However, to date, there have been no direct documented reports of partial caudectomy in wild animals, particularly long-tailed macaques. This present case report aims to describe the preoperative, surgical procedure, and postoperative management of a long-tailed macaque with severe tail injury.

Case description

Signalments and history

The case animal was an adult male long-tailed macaques (*Macaca fascicularis*) scheduled for vasectomy as part of the annual sterilization program conducted in our veterinary clinics at the Sacred Monkey Forest Sanctuary in Ubud, Bali, Indonesia (8°31'09.3"S, 115°15'38.2"E). The capture procedure was approved by the Natural Resources Conservation Agency (*Balai Sumberdaya Konservasi Sumber Daya Alam*) of Bali Province, Indonesia (Approval No. 294/BKSDA.BI-1/PLK/7/2022) and followed ethical guidelines outlined by Jolly *et al.* (2011). The macaque was captured using a cage equipped with manually operated, remote-controlled trap doors. The capture process used food-baiting strategy. Following capture, anesthesia was induced via intramuscular injection of ketamine at 5 mg/kg body weight (BW) (Keta-A-100®, Agrovet SA, Peru) and xylazine at 1.33 mg/kg BW (Xyla®, Interchemie, Holland). Doses were determined based on a visual assessment of the age class. Based on previous data, the adult male was estimated to weigh approximately 7 kg.

Clinical examination

Clinical examination revealed a multiple open wounds, areas of necrosis, and fractures in the tail (Fig. 1). Despite the injury, the macaque's rectal temperature, respiration rate, and heart rate were within normal limits. Based on clinical findings, the macaque diagnosed with severe tail injury, and partial caudectomy was considered as the appropriate course

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of treatment. Given the overall stable condition and the absence of systemic complications, the prognosis was considered good (*fausta*).

Fig 1. Clinical presentation of the long-tailed macaque tail, showing (a) fractures, (b) multiple wounds, and necrotic tissues.

Treatment

Prior to surgery, a general physical examination and preoperative preparation were performed. This included assessing the animal's overall condition and removing feed material from the oral cavity and cheek pouches to minimize the risk of aspiration pneumonia. An intravenous catheter was placed in the cephalic vein with 0.9% NaCl as fluid therapy was maintained during surgery. Prophylactic treatment included an intramuscular injection of amoxicillin (Betamox LA®, Norbrook, United Kingdom) at 15 mg/kg BW, ketorolac tromethamine (Ketorolac, Dexa Medica, Indonesia) at 2.5 mg/kg BW, and the application of eye lubricant tetrahydrozoline hydrochloride 0.05% (Visine®, Johnson & Johnson, USA) to prevent corneal desiccation during surgery. The patient was positioned in lateral recumbency, and the surgical area on the tail was aseptically prepared by clipping the hair, then wiping it with antiseptic solution and povidone iodine. Throughout the procedure, vital signs including respiratory rate, heart rate, and rectal temperature were continuously monitored. Anesthesia was maintained using intravenous propofol at a dose of 1 mg/kg BW (Recofol®, Dexa Medica, Indonesia). As the food-baiting method was used for the capture strategy, the animal was not fasted before anesthesia.

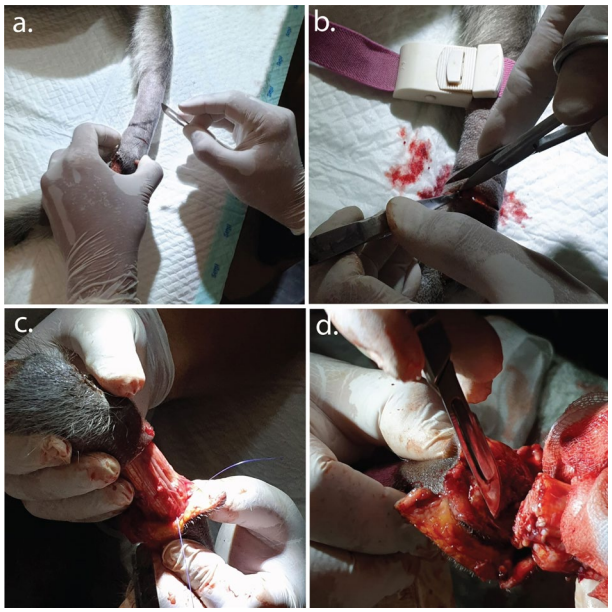

Fig 2. Partial caudectomy procedure in a long-tailed macaque with severe tail injury. (a) The surgical area was aseptically prepared, and a 'V'-shaped incision was marked. (b) A tourniquet was applied proximal to the transection site, followed by a skin incision. (c) The medial and lateral caudal arteries and veins were identified and ligated. (d) Soft tissue was incised slightly distal to the intervertebral space, and disarticulation was performed using a scalpel blade.

A "V"-shaped or "fishmouth with an overbite"-shaped incision line was marked on the skin (Fig. 2a). The "V"-shaped lines were drawn on the dorsal and ventral aspects of the tail, approximately one vertebral body length distally from the desired amputation site. To identify the intervertebral space, a hypodermic needle was used. A tourniquet was applied proximal to the transection site, and a skin incision was made using a No. 10 scalpel blade (Fig. 2b). The medial and lateral caudal arteries and veins cranial to the transection site were identified and ligated using monofilament absorbable 3-0 poliglecaprone 25 suture (Monocryl®, Ethicon Inc., USA) (Fig. 2). The soft tissue was incised slightly distal to the intervertebral space, and the tail was disarticulated distally using a No. 10 scalpel blade (Fig. 2d). Prior to skin closure, the tourniquet was released to assess for hemostasis, and the tissue was flushed with saline solution. The subcutaneous tissue and muscle layers were closed using simple interrupted pattern with poliglecaprone 25. The skin flaps were trimmed appropriately to ensure closure without tension and sutured using the same suture material and pattern (Fig. 3). Postoperatively, the macaque was administered atipamezole (Antimedin®, Dog Bang Co., Korea) intramuscularly, at a volume equivalent to the xylazine dose. The macaque was then placed in lateral recumbency in an individual recovery cage. During recovery, the animal was monitored for signs of pain. Once the macaque exhibited clear signs of anesthesia recovery, such as firm grasping, climbing reflex, and visual fixation, it was transported in a cage back to the capture site and released into its original social group.

Fig 3. Skin closure using a simple interrupted suture pattern.

Discussion

Among macaques, wounds are the most common type of injury, followed by fractures, amputations, and snares/pellets (Kumar and Sankhyan, 2021). These injuries can result from various causes, including fights, falls from heights, and interactions with man-made objects. Kumar and Sankhyan (2021) reported that leg fractures are among the most frequent musculoskeletal injuries in rhesus macaques (*Macaca mulatta*) in northern India. These fractures often result from falls or inter-individual conflict.

At the Sacred Monkey Forest Sanctuary in Ubud, Indonesia, injuries have been documented across nearly all anatomical regions in long-tailed macaques, with the body, particularly the sides and ventrum, being the commonly reported sites. Non-fighting injuries were more frequent than fighting injuries (Loudon *et al*., 2024). In the present case, it is suspected that the tail injury in the animal may have resulted from a fall or a fight with other macaques. Additionally, given the sanctuary's semi-wild urban setting, traffic-related trauma is also a possible contributing factor. Based on sex, male long-tailed macaques are reported to sustain injuries more frequently than females (Loudon *et al*., 2024). A similar report was also reported by Kumar and Sankhyan (2021), who stated that rhesus macaques experienced musculoskeletal injuries more frequently in males. This is likely due to their more aggressive behavior and greater involvement in conflicts.

In the present case, the incision was made approximately one coccygeal vertebrae distal to the intervertebral amputation site to allow a tension-free closure. Poliglecaprone 25, an absorbable monofilament suture material, was selected for the skin closure due to its low tissue reactivity and ability to produce aesthetically favorable results with minimal scarring (Yang-Howard and Lavalle, 2013). Additionally, absorbable sutures were preferred because the macaque would be released back into its group post-surgery. Unlike non-absorbable sutures, which would require follow-up for removal, absorbable sutures eliminate the need for suture removal, making them more suitable for this case.

In dogs and cats, partial caudectomy is considered well tolerated, with no reported loss of function. The pet owner did not observe any behavioral changes following the procedure (Simons *et al*., 2014). However, there is limited knowledge regarding the effect of partial caudectomy on the macaque behavior. Further studies are needed to evaluate the short and long-term behavioral and physiological effects of this procedure in macaques, especially in free-ranging populations. Given the presence of fractures, necrosis, and open wounds on the tail in this case, partial caudectomy was considered the most appropriate course of action to prevent further infection and potential complications such as nerve damage, sepsis, or even death. To the best of our knowledge, this is the first report to describe partial caudectomy in long-tailed macaques.

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Conflict of interest

The authors have no conflict of interest to declare.

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