

## Xylazine-ketamine immobilization and propofol anesthesia for surgical excision of sebaceous adenoma in a jaguar (*Panthera onca*)

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### Abstract

**Aim:** A captive male jaguar (*Panthera onca*) was anaesthetized for surgical excision of a tumor at the left belly fold under xylazine-ketamine immobilization and propofol anesthesia. The objective was to assess the dose of xylazine and ketamine required to abolish ear flick reflex for safe approach when the jaguar was under chemical immobilization and efficacy of propofol induced anesthesia.

**Materials and Methods:** A male jaguar (*P. onca*) aged 14 years and weighing approximately 90 kg was subjected to chemical immobilization using a combination of xylazine and ketamine using a blow pipe. The jaguar was approached after the absence of ear flick reflex and transported to zoo Operation Theater. Propofol was administered intravenously to induce and maintain anesthesia. The tumor was excised using thermocautery and subjected to histopathology.

**Results:** Ear flick reflex was stimulated at 5 and 10 min after immobilization and observed shaking of head and movement of fore limb following administration of xylazine and ketamine. Dose of xylazine and ketamine required for chemical immobilization, characterized by absence of ear flick reflex was 1.0 and 3.5 mg/kg body weight respectively, and was achieved in 13 min. The surgical plane of anesthesia was maintained for 11 min following administration of propofol at a dose of 2 mg/kg body weight intravenously. The jaguar recovered in 41 min following surgery. The excised tumor was confirmed as sebaceous adenoma on histopathological examination. The animal recovered uneventfully, and no recurrence of the tumor was noticed in 3 months follow-up period.

**Conclusion:** The total dose xylazine and ketamine required for chemical immobilization with absence of ear flick reflex was 1.0 and 3.5 mg/kg body weight respectively. Further, administration of propofol intravenously, at a dose of 2 mg/kg maintained anesthesia for 11 min. Histopathological examination of the excised tumor at the belly fold was confirmed as sebaceous adenoma.

**Keywords:** ear flick reflex, jaguar, ketamine, *Panthera onca*, propofol, sebaceous adenoma, xylazine.

### Introduction

The jaguar (*Panthera onca*) is a big cat, of *Panthera* species living in Americas [1]. The most common causes of morbidity in captive jaguars were found to be dental, gastrointestinal, integumentary and musculoskeletal diseases. Prevalence of these diseases vary with age [2] and management practices [3,4]. Neoplastic proliferations of benign and malignancy are one of the common causes of morbidity and mortality in wild felids including jaguars [5]. Sebaceous adenomas are common benign tumors found more often in all domestic animals with higher prevalence in middle to older age dogs and cats [6]. Sebaceous glands are microscopic structures found just beneath the skin surface. They secrete an oily substance called

sebum that is transported to the skin surface via microscopic ducts. Adenoma can arise from the gland or the duct and can develop anywhere on a feline body [7].

Number of chemical immobilization technique is followed in wild felines with their merits and demerits. To perform surgeries the jaguar is to be anaesthetized and maintained in the surgical plane, and the anaesthetic administered should have the property of good induction and rapid recovery. Xylazine-ketamine immobilization is commonly practiced in wild felines for immobilization [8,9] but only limited publications are available on anaesthetic induction and maintenance and the use of propofol for induction and maintenance of anesthesia in wild felines.

In the present study, the dose of xylazine and ketamine that required to induce immobilization characterized by absence of ear flick reflex, which was a reliable indicator of immobilization and further maintenance of anesthesia with propofol for surgical excision of adenoma in a jaguar was discussed.

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## Materials and Methods

### Ethical committee approval

Ethical committee approval was not required as the case reported in this article was a clinical case. Standard anesthetic and surgical procedure were performed.

### Immobilization and anesthesia

A captive male jaguar, aged 14-year-old and weighing approximately around 90 kg body weight was referred to the Department of Veterinary Surgery and Radiology, Madras Veterinary College from Arignar Anna Zoological Park, Chennai, Tamil Nadu, India for the surgical excision of a growth on the left belly fold.

The jaguar was moved to a squeeze cage 24 h prior to the procedure and feed and water were withheld for 24 and 6 h respectively. Xylazine and ketamine at the rate of 1.0 and 2.5 mg/kg body weight respectively was administered intramuscularly at the right thigh using a blow pipe. The ear flick reflex was induced using a stiff wooden stick sufficient to stretch the auricular muscles after 5 and 10 min of darting. As the depth of immobilization was not sufficient to approach, further ketamine at the dose of 1.0 mg/kg body weight was administered intramuscularly. The animal was approached when the ear flick reflex was absent (Figure-1). Atropine sulphate at the dose of 0.04 mg/kg body weight was administered intramuscularly. The jaguar was transported to the zoo operation theatre. To induce anesthesia propofol was administered at the rate of 2 mg/kg body weight intravenously through saphenous vein to effect. The rectal temperature, respiratory rate and heart rates were monitored after xylazine-ketamine immobilization, after administration of propofol and before release into the cage.

### Tumor excision

Surgical site on the left belly fold merging at the level of stifle joint was prepared aseptically using surgical spirit, povidone iodine and the tumor was excised using thermocautery. Subcutaneous tissue and skin were closed as per standard technique. Skin incision was sealed with methyl methacrylate skin glue. Injection ceftriaxone and meloxicam were administered intravenously at the rate of 20 mg/kg and



**Figure-1:** Immobilized jaguar (*Panthera onca*) with xylazine (1.0 mg/kg body weight [B.W]) and ketamine (3.5 mg/kg B.W).

0.2 mg/kg body weight respectively. The animal was shifted to cage. No intra or post-anaesthetic complication was noticed, and animal recovered uneventfully. No recurrence of the tumor was noticed till 3 months follow-up.

### Histopathology

Cross section of the tumor revealed absence of ulceration and abscess. The excised tissue was preserved in 10% formal saline and subjected to histopathological examination. The tissue was prepared as per standard procedure [10]; the sections were stained with hematoxylin and eosin [11] and examined under light microscope.

## Results

### Immobilization and anesthesia

The jaguar after the first dart with xylazine and ketamine combination became ataxic with in-coordination of the hind quarters by 3 min and recumbent by 5 min. The ear flick reflex was stimulated, and the animal reacted by lifting the head and neck and fore limb. Again the reflex was stimulated after 10 min of darting and the reflex was sluggish with nodding of the head. Further administration of incremental dose of ketamine at the rate of 1.0 mg/kg body weight totally abolished the ear flick reflex in 3 min; sufficient to approach the animal. A total dose of 1.0 mg and 3.5 mg/kg body weight of xylazine and ketamine respectively induced deep immobilization sufficiently safe for the operating personnel to approach the jaguar. Administration of propofol at the rate of 2 mg/kg intravenously induced and maintained the anesthesia for 11 min and animal recovered after 41 min. The rectal temperature in celsius was 38.8, 37.4 and 38.6, heart rate per minute was 86, 80 and 102 and respiratory rate per minute was 16, 14 and 20 after xylazine-ketamine immobilization, after administration of propofol and before release into the cage respectively.

### Tumor excision

Examination of the tumor revealed macroscopically single subcutaneous mass measuring around 5 cm diameters, pedunculated, well demarcated, freely movable and non-adherent to adjacent tissue with absence of ulceration and discharge (Figure-2). Thermocautery was found to be efficient in tumor excision without bleeding (Figure-3). Skin closure with methyl methacrylate skin glue was effective as evident by no post-operative bleeding, wound dehiscence and infection.

### Histopathology

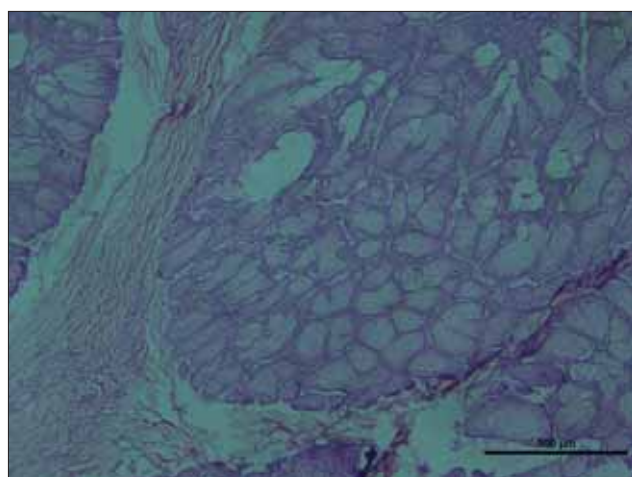
Histopathology of the tumor mass was characterized by multilobulated tumor, sharply demarcated from the surrounding tissue. Two types of cells were present in the lobules. Large mature sebaceous cells (sebocytes) at the centre and undifferentiated basaloid cells at the periphery were noticed (Figure-4).



**Figure-2:** Exposed tumor mass at the left belly fold.



**Figure-3:** Surgical excision of the tumor using thermocautery.



**Figure-4:** Large mature sebaceous cells (sebocytes) at the center and undifferentiated basaloid cells at the periphery characteristic of sebaceous adenoma (500  $\mu$ m).

## Discussion

### Immobilization and anesthesia

Chemical immobilization is the safe method of capturing and immobilization of wild felids as chemical immobilization induce less stress, less morbidity and mortality due to trauma induced by dashing against the cages and vigorous struggling [12,13]. Various anaesthetics and ancillary drugs were used for

induction of chemical immobilization of wild captive and free ranging big cats. Xylazine is preferred as an integral agent of immobilization due to its potential sedative and analgesic action with less complication [14]. The demerits of xylazine were salivation, vomition, arterio-ventricular block, paralytic ileus on repeated administration and arousal to auditory, visual and external stimuli [15,16]. Xylazine when administered along with ketamine prolonged the plasma half-life of ketamine and administration of incremental dose of ketamine at the rate of 1 mg/kg abolished the ear tactile reflex in 3 min and diminished the hyper-tonicity and tremors of skeletal muscles induced by ketamine [17]. Whereas ketamine moderated the bradycardic effect of xylazine by cardiotoxic action mediated through sympathetic stimulation and vagolytic action [18]; thus xylazine and ketamine acted as a useful and safe combination for chemical immobilization of jaguar at the total dose of 1.0 and 3.5 mg/kg body weight intramuscularly [1,7,19]. Atropine sulphate at the dose of 0.04 mg/kg body weight contributed benefits due to its antimuscarinic effect [20].

Stimulation of ear sufficient to stretch the auricularis muscles of the ear with a wooden stick to assess the depth of anesthesia in wild felids for safe approach was practiced and the wild felines were approached only after the absence of ear flick reflex [21]. The dorsal cochlear nucleus (DCN) in felines is the second-order auditory structure that also receive non-stimuli auditory including somato-sensory inputs from dorsal column and spinal trigeminal nuclei. When cervical nerves 1-8 (C1-8), dorsal and ventral branches of C2, branches of trigeminal nerve and hind limb nerves are stimulated separately; the largest evoked potentials in the DCN is produced by stimulation of the branches of dorsal branches of C2, that innervate the pinna, the back of the head, the rostral dorsal part of the neck and the fore limbs. Stimuli that activate pinna muscle receptors, such as stretch or vibration of the muscles connected to pinna are effective in driving DCN units. The fibres of C2 also share its fibres with C3 and trigeminal. Stimulation of pinna and eye movements to visual targets contribute too early "orientation response" in felines, and it is mediated through DCN output projections [22]. If the ear flick reflex is absent it could be assumed that the felines were sufficiently immobilized, input stimuli to DCN was abolished and thus render the animal completely unresponsive to external stimuli that could arise the felines [23]. The dose of and xylazine and ketamine used in the study was similar to the earlier reports [1,9]. Xylazine with ketamine was used as immobilizing agent in lions [24-25], tigers [26] and cheetah [27].

All the immobilized animals are not anaesthetized, but all the anaesthetized animals are immobilized. To perform surgeries, the animal is to be induced and maintained in the surgical plane of anesthesia. Propofol is an alkyl phenol intravenous agent, which can induce anesthesia in one-arm-brain

circulation, and the induction time is <5 min in domestic animals. It is rapidly metabolized in the body tissue, and recovery is due to rapid detoxification and elimination unlike other agents which depends on the liver [28]. The respiratory rate was within the clinical limits in the study. It possesses the structural formula like alpha tocopherol and act as antioxidant [29]. Due to the rapid recovery and antioxidant effect, propofol is used in critical ill and geriatric patients [30]. Propofol was used as anaesthetic in lion for induction and maintenance agent [21]. The duration of anesthesia and recovery following propofol anesthesia in the jaguar was 11 min, which was sufficient to excise the tumor and recovery in terms of time for standing was 41 min from the time of administration of propofol. The short and uneventful recovery is a desirable property in wild life anesthesia [13].

#### Tumor excision

Tumor excision was performed with thermocautery due to the benefits of simple, fast, better and haemostasis and more aseptic than cutting and ligation [31-32] and methyl methacrylate helped in faster healing without wound infection and dehiscence. No reoccurrence was noticed during the 3 months follow-up period.

#### Histopathology

Macroscopically the tumor was a single subcutaneous mass measuring around 5 cm diameters, pedunculated, well demarcated, freely movable and non-adherent to adjacent tissue with absence of ulceration and discharge. Microscopically the tumor mass was characterized by multilobulated tumor, sharply demarcated from the surrounding tissue. Two types of cells were present in the lobules. Microscopically large mature sebaceous cells (sebocytes) at the centre and undifferentiated basaloid cells at the periphery and similar microscopic finding were documented in dogs [33]. Incidence of cutaneous adenocarcinoma of sebaceous gland was reported in jaguars and was attributed to age and husbandry practices in captivity [34]. The neoplasms reported in jaguars were thyroid adenoma and adenocortical adenoma, ovarian cystadenocarcinoma, haemangio-endothelioma, glucagonoma, squamous cell carcinoma of the tail, visceral mast cell tumor, and mammary tumor [5].

#### Conclusion

Xylazine and ketamine induced the immobilization in 13 min, characterized by absence of ear flick reflex at a dose of 1.0 mg/kg and 3.5 mg/kg body weight respectively in a jaguar. Further induction of anesthesia with propofol at a rate of 2 mg/kg body intravenously maintained the anesthesia for 11 min, sufficient to remove a tumor with recovery time of 45 min. Histopathological examination of tumor revealed sebaceous adenoma.

#### Authors' Contributions

MB and BJW performed the surgery, RT, RSG and AA managed the immobilization and anesthesia. TAK and SV were involved in the pre and post-operative care and management. All the authors participated in draft and revision of manuscript. All authors read and approved the final manuscript.

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#### Competing Interests

The authors declare that they have no competing interests.

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