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Vasectomy in Drill Monkeys (*Mandrillus leucophaeus)* - A Population Management Tool

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Abstract: Management intervention to avoid inbreeding in captive breeding programs is essential to maintain maximum genetic diversity. Vasectomy was enlisted in drill monkeys (*Mandrillus leucophaeus*) to achieve this purpose without altering the social dynamics of the groups. All the vasectomies were carried out at the Drill Rehabilitation and Breeding Centre, Cross River State, Nigeria. Vasectomy in drill monkeys and the post-operative results were documented. Twelve drill monkeys were vasectomised between 2001 and 2008; six of the males were vasectomised as alpha males, 3 were ex-alphas at vasectomy, while 3 were males from genetically well-represented lineages. Ten of the animals were wild born while 2 were captive bred. No changes in group dynamics or post-surgical complications were recorded. There was a reduction in drill births in groups where the alpha males were vasectomised.

Key words: Captive breeding · Drill monkey · *Mandrillus leucophaeus* · Population Management · *Vas deferens* and Vasectomy

INTRODUCTION

Drill monkeys (*Mandrillus leucophaeus*) are endangered, short tailed, heavy-bodied, forest-dwelling primates restricted to small areas of rain forest in Cross River State, Nigeria, south western Cameroon and Bioko Island of Equatorial Guinea [1]. Drill monkeys are of topmost priority for conservation action by International Union for Conservation of Nature [2]. The drill monkey (Drill) is listed under Schedule 1 of the Convention in International Trade in Endangered species of which all three nations are signatory.

The founder population of drills were recovered from illegal captivity after their nursing mothers were poached for bush meat. The drills are quarantined, screened and integrated rehabilitated into natural-sized social groups for captive breeding and future reintroduction into the wild. Captive populations are usually small with limited genetic variations. They may be therefore more susceptible to effects of inbreeding. There is the need to manage the population in captivity to prevent over-representation of some paternal lines and also reduce the risks of inbreeding. The current populations of four hundred drills, from about seventy reproductively active founders makes a strong case for some forms of population management.

Male drills are sexually mature at six years and fully mature by nine years weighing between 30 and 40 kg. The species exhibits extreme sexual dimorphism. Female drills become sexually mature with the advent of an ano-vulva swelling from about two and half years of age, but typically do not have their first pregnancy until four year of age. An adult/sub adult male may serve as dominant male and lead a group for more than four years by which time his daughters are sexually mature presenting a risk of inbreeding.

Contraceptive options available for use in wild primates include separation of the sexes where allowed; castration or vasectomy for males [3,4] and in females-intra uterine devices, tubal ligation, hysterectomies, hormonal implants and birth control pills[5,6]. Our targets were sexually active males as earlier defined and vasectomy was preferred because of the relative safety of operation and the expected resultant effects on the dominant male whose status within the group is not affected. This report aims to document the use and appropriateness of vasectomy as a means of population management in multi male, multi-female, non-human primate populations in a semi wild captive facility.

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MATERIALS AND METHODS

Target animals: Twelve, genetically well-represented male drills from the existing multi-male/multi-female captive breeding groups within the programme were vasectomised between 2001 and 2008. Chosen males were sexually-matured sires with a minimum of 10 offspring, or males whose first daughters were already cycling, or sexually active males with close, adult female relatives. These males have assumed or are likely to assume leadership of the group and possibly breed with female relatives. All vasectomised males were sexually active (they were observed copulating or attempting to copulate with females with ano-vulva swelling within the group) at the time of vasectomy.

Anaesthesia: Target males for vasectomy were trapped in holding satellites and starved of food overnight. Anaesthetics were administered remotely using Teleinject Blowpipes. Anaesthesia was achieved by using combination of Ketamine hydrochloride 100mg/ml (Narketan-10®, Vetoquinol UK) at 3-4mg/kg and medetomidine 10 mg/ml (Zalopine®, Orion USA) at 100µg/kg intramuscularly [7], for the four males vasectomised in 2001. Zolazepam/Tiletamine (Telazol®, Fort Dodge, USA) at 2 mg/kg and medetomidine at 300 µg/kg combination delivered through remote anaesthesia was used for vasectomy for the 8 males, post 2001 Isoflurane (Forane® Abbott Laboratories, Illinois USA) at 2-3 % and oxygen 2.5L/min combination was used to maintain anaesthesia via a face mask, as needed, in all cases.

Procedure: Following confirmed immobilisation, the drills were moved from holding cages adjoining the enclosures into an already prepared surgery (thatched roof surgical shed for vasectomies carried out in the forested field site and a proper veterinary surgery for the urban facility in Calabar).

The drills were placed in a supine position with hind feet extended and secured to ensure an undisturbed access to surgical site and prevent the animals from sliding off the surgical table during surgery. The pelvic/upper scrotal area was aseptically prepared with chlorhexidine gluconate (Hibiscrub®, Boots, UK) antiseptic solution and draped. A quick but precise physical examination was done prior to surgery [7] and vitals were monitored throughout surgery and recovery. The spermatic cord is palpable externally at the skin area above the spermatic cord in drills, cranial to the neck of the scrotum. A 2.5 - 3.0 cm cranio-caudal incision was made on the skin above the spermatic cord [3, 4]. The spermatic cord was easily accessible in most cases except in some males with heavy fat deposits. The cord was elevated using a pair of curved forceps. The right spermatic cord is freed by blunt dissection and exteriorised and mildly manipulated. The *tunica vaginalis* was incised and the contents were bluntly dissected out. The *vas deferens* was identified as a cord like, non-pulsating structure and separated by blunt dissection. The *vas deferens* was clamped slightly with forceps to avoid slipping back into the dissected *tunica vaginalis*. The *vas deferens* was clamped at the two ends and then ligated at both two parts to avoid it slipping back and to avoid retubulisation. About 4 cm of the vas in between the clamped ends was cut off and stored in formal saline for histology. The *tunica vaginalis* was not closed. The skin incision was closed with simple interrupted intradermal buried stiches with 3/0 absorbable vicryl sutures. The complete procedure as done on the right side was repeated on the left side

Post Operative Care: Long-acting Amoxicillin® (Amoxicillin trihydrate, Beecham, UK) as post-surgery antibiotic cover at dose rate of 15mg/kg; Finadyne® (Flunixin Meglumine, MSD Animal Health, UK) at 1.0 mg/kg as analgesic and a single injection of 40 IU anti-tetanus toxoid (Dano Biologicals, India) was administered as a booster. The surgical site was sprayed with Aluspray® (Vetoquinol, UK). In cases where anaesthetic reversal was used, Antisedan® (Atipamezole, Pfizer Animal Health) at 3-5 times the initial Medetomidine dose depending on how long the total anaesthesia have lasted was administered. The time to complete bilateral vasectomy was 50 ± 20 mins. The extended periods could be attributed to the initial vasectomies and drills with excess adipose tissue around the surgical site (note that fat deposition around the scrotal region in dominant males is typical in *Mandrillus*). The animals were rested overnight in a clean holding satellite for post-operative monitoring based on standard operating procedure manual [7].

RESULTS

The dominant status of the six males who were alpha males at the time of vasectomy did not change; the remaining six were not reigning alphas but their ranking/statuses were not affected post vasectomy.

Bilateral vasectomies were confirmed in the 12 vasectomies. All the tissue sections have the typical appearance of the vas deferens on histological examination. Tall columnar epithelial cells with a central lumen which contain sperm were seen.

The sexual drive of vasectomised males was neither compromised nor reduced post vasectomy, as the vasectomised males were observed mating or attempting to mate with females (Non-alpha males will normally be chased away from mating if mating is attempted within the observational range of the alpha male)

Semen analysis was not performed on vasectomised subjects because they were not trained or programmed for handling to such a degree without anaesthesia and re-trapping post release was almost impossible; although a six week delay post vasectomy was prescribed if attainable.

No post-operative complications were encountered; neither the age nor the weight at vasectomy affected the outcome of the vasectomies. No outwards physical impairment was noticed in any vasectomised drill. No infections occurred at the surgical site.

DISCUSSION

Vasectomy has proven to be a useful population management option in non-human primate species like chimpanzees, baboons and gibbons in captivity [3-5]. Vasectomy as a male contraceptive option is recommended by African primate sanctuaries involved in chimpanzee rehabilitation as it leaves the testes, which is an indication of masculinity [8]. The presence of intact scrotum may thus be relevant for aesthetic purposes as observations have been made of male drills touching their scrotum and infant drills, who are intimate with adult males touching the scrotum, probably out of curiosity.

Vasectomy was used in the drill monkeys as a population management tool to reduce inbreeding risks and is expected to optimize variety in the origins of captive bred drills by brightening the chances of other males to sire offspring. Vasectomies were carried out based on a combination of factors namely age, number of offspring, age of first daughters and in the case of captive bred sires from well-represented lineages. The vasectomised males were well-represented in the captive population. The vasectomised alpha males have sired a minimum of 10 offspring. The mean age of male drills at vasectomy was 13 years (range 9-15 years) while the mean number of offspring was 13.35 babies (range 10-15).

There is need to strive for maximum diversity in the genetic pool of any managed population, thus the importance of preventing any particular lineage from becoming ‘overblown’ and creating an imbalance in the population should be stressed. In the lifetime of a female drill monkey, there is a high likelihood of bearing offspring from more than one male. This widens the genetic spread.

The *vas deferens* has been exploited for male contraception without undue side effects. The potential of vasectomy as a tool to control births in drills is dependent on the length of time the vasectomised male remains dominant. A reduction in the birth rates in groups where the vasectomised male is the current alpha male was recorded.

Vasectomy did not prevent other sexually-mature males from attempting or mating with females in the group. The group status or ranking of the vasectomised males was not distorted apart from a stoppage of procreation. It has no effect on sexual drive or ejaculation and does not cause impotency.

Although the vasectomies were not carried out with the intentions or expectations of reversals in future, vasectomy reversals can be achieved surgically through the restoration of continuity of the vas deferens [5,9], though this cannot be guaranteed. This is not likely to be desirable in the long term management of breeding for drill monkeys in captivity.

Vasectomised males were returned back within twenty-four hours of operations on confirmation of non-observation of complications back into the main group. This was to avoid loss of hierarchy, alteration of group dynamics or unnecessary vacuum in leadership, which could arise from extended period of separation from the group. In humans about 15-20 ejaculations are usually required after operation before sterility is achieved and man is considered sterile after two sperm-free ejaculates [10]. Although we noticed a drop in pregnancy rates in females in drill groups post vasectomy, we cannot suggest a guess on the time taken or number of ejaculations before sterility was achieved. Post-vasectomy laboratory semen evaluation was not performed due to the semi-wild condition of the drills. There was no previous training to collect semen without anaesthesia and decision not to interfere with the group dynamics. Azoospermia and motility assessment of sperm in ejaculates [11] as good indicators of successful vasectomy are scientifically proven indices. The tissues were however histologically confirmed as true *vas deferens*.

Laboratories are often faced with the challenge of promoting psychological wellbeing through socialization without allowing pregnancies to occur. Vasectomy has functioned in laboratories as a clinical management tool and allowed pairing and housing primates that might otherwise have remained individually housed. Pair housing following vasectomy has also been implemented for adult male macaques that engaged in self-injurious behaviour (SIB). The incidence of SIB was significantly

decreased or eliminated following these interventions [12] The Colobus Trust and Kenya Wildlife Service carried out vasectomies at Diani beach, Kenya to reduce the very high growth rate of the wild baboon population. Male contraception is considered easier and more definitive than female contraception as the method of prevention caters for 100% of sperm cells produced. It is important to carry out vasectomy on the two sides for the effect to be assured however, the anastomoses of the *vas* on one side alone could also lead to contraceptive failure.

Vasectomy was once considered the only effective technique available for male contraception [13], however use of immuno-contraception targeted at blocking epididymal antigen responsible for sperm maturation which renders the sperm incapable of reaching the egg is promising [9].

Vasectomy is a viable surgical intervention with no undesirable behavioural effects in the primate groups. It is recommended to promote social housing/ grouping of non-human primates without necessarily increasing their population and to manage a breeding population. Vasectomy will continue to be of use in primate facilities faced with population and social grouping problems. In areas without access to laboratory facilities to confirm azoospermia, histology of the cut vas deferens will suffice. For the purpose of male-targeted population control in non-human primate populations which does not interfere with the male hierarchy and social dynamics, vasectomy of the dominant male in the group remains one of the most viable options.

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