

CESAREAN SECTIONS IN MARMOSETS: WHITE-TUFTED MARMOSET (*Callithrix jacchus*)

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ABSTRACT

Callithrix jacchus is a small primate characteristic to the Brazilian Northeast. We considered relevant to report details on the anesthetic protocol and the surgical technique of cesarean sections applied in three cases of dystocia in *C. jacchus*. Animals were subjected to cesarean intervention because their small body size did not allow for less invasive obstetric maneuvers. The anesthetic protocol was shown to be efficient, safe and original in its equipment adaptations, by means of endotracheal intubation with a 14G catheter. The surgical procedure was relatively simple and did not offer a major challenge in the exposure of the uterus. The suture of the uterus, abdominal wall and skin did not present technical difficulties, however even the thinnest sutures used in dogs and cats may be considered too thick considering the marmosets' small body size.

Keywords: general anesthesia, obstetric intervention, small primate, new world primates, surgical technique

CESAREANA EM SAGUIS: SAGUI-DE-TUFOS-BRANCOS (*Callithrix jacchus*)

RESUMO

Callithrix jacchus é um pequeno primata característico do Nordeste brasileiro. Considerou-se importante a descrição do protocolo anestésico e da técnica cirúrgica da cesariana aplicada em três casos de distocia em *C. jacchus*. Os animais foram submetidos à intervenção cesariana, devido o pequeno tamanho dos seus corpos, o qual não permite manobras obstétricas menos invasivas. O protocolo anestésico mostrou-se eficiente, seguro e original em suas adaptações anestésicas por meio de intubação endotraqueal com um cateter 14G. O procedimento cirúrgico foi relativamente simples e a exposição do útero não foi um grande desafio. Não houveram grandes dificuldades quanto a técnica de sutura do útero, da parede abdominal e da pele, porém os mais finos fios de suturas utilizados em cães e gatos são muito grossos considerando o tamanho do pequeno corpo dos saguis.

Palavras-chave: anestesia geral, intervenção obstétrica, pequenos primatas, primatas do novo mundo, técnica cirúrgica

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CESÁREA EN TITÍES: TITÍES-DE-MECHONES-BLANCOS (*Callithrix jacchus*)

RESUMEN

Callithrix jacchus es un pequeño primata característico del Nordeste Brasileño. Se considera importante la descripción de un protocolo anestésico y de una técnica quirúrgica de la cesaría aplicada en tres casos de distocia en *C. jacchus*. Los animales fueron sometidos a una intervención por cesárea, debido al pequeño tamaño de sus cuerpos, lo cual, no permitía maniobras obstétricas menos invasivas. El protocolo anestésico se mostro eficiente, seguros y originales en sus adaptaciones anestésicas por medio de la intubación endotraqueal con un catéter 14G. El procedimiento quirúrgico fue relativamente sencillo y la exposición del útero no fue de gran desafío. No presentó dificultades en cuanto la técnica de sutura al útero, pared abdominal y piel, sin embargo, incluso las más finas suturas utilizadas en perros y gatos es muy gruesa considerando el tamaño del pequeño cuerpo de los titíes.

Palabras clave: anestesia general, intervención obstétrica, pequeños primatas, primatas del nuevo mundo, técnica quirúrgica

INTRODUCTION

Callithrix jacchus is a small primate characteristic to the Brazilian Northeast, inhabiting a variety of habitats ranging from coastal Atlantic forest to central caatinga areas (1). Primates in the Callitrichidae family have small body sizes. They are distinguished by their dense hair and ear tufts, which are white in *C. jacchus* (hence “white-tufted marmoset”), and the tail has alternating light and dark rings (2). All callitrichids are omnivorous, feeding on a variety of plant (exudates, seeds, flowers, fruits, nectar, among others) and animal items (arthropods, mollusks and small vertebrates) (3).

Callitrichids have the highest reproductive capacity among non-human primates (4). Females have a highly variable ovulation rate, ranging from one to four follicles per cycle, and as such marmoset litter sizes typically vary in captivity from singletons to quadruplets (5). There are published reports of obstetric problems in *C. jacchus*; in these cases a cesarean intervention is generally advised, however sometimes soft manual traction of the fetus and pharmacological stimulation of uterine contractions may prove useful. Obstetric assistance for primates is rather an exception, due to the low frequency with which these animals are brought to clinical visits and to the relatively uncommon necessity for obstetric interventions (6). We therefore considered it relevant to report details on the anesthetic protocol and the surgical technique of cesarean sections applied in three cases of dystocia in *C. jacchus*. These primates have a characteristic communal breeding strategy, in which the infants remain in the family group until adulthood, and one of the main roles of the non-breeding females is to cooperatively care of the offspring (3, 7).

CASE REPORT

The cases here in reported occurred from July 2010 to December 2011 at the *C. jacchus* captive colony maintained at the Medicine Center and Research on Wild Animal, Faculty of Veterinary Medicine and Animal Science, UNESP, Botucatu, SP, Brazil (22°53'09"S, 48°26'42"W; mean annual temperature = 22°C). All procedures were approved by the Ethics Committee (N° 126/2010).

Marmosets were housed in 60 x 120 x 60 cm cages, under natural conditions of temperature, humidity and light. Two meals were offered daily: in the morning, fruits,

vegetables and eggs; in the afternoon, a mixture of commercial food (Alcon Club Monkey Cookies®, Alcon Pet), nutritional supplements (Sustagen®, Mead Johnson & Company), banana and honey. Mealworms (*Tenebrio molitor*) were also offered weekly.

To avoid aggressive behaviors, couples were introduced through a slow adaptation process over 11 months, in which they were placed in neighbouring cages but separated by a metal sheet with a thin crevice. Following this gradual olfactory, auditory and visual approximation, mutual aggressive behaviour was monitored and behaviourally compatible pairs were paired. Animals were paired in July 2011 and copulated, thus parturition was expected to occur in December of the same year; video cameras were placed inside the cages to monitor behaviour and allow for early obstetric interventions. Parturient females were brought to the ambulatory, of which three had signs of dystocia:

- Female 1: Abdominal contractions started at 10:30 h, 26/11/2011. Manual traction was successful for the first fetus, and it was decided to wait until the following morning for the natural expulsion of the second fetus, which did not occur and therefore a cesarean section was performed.
- Female 2: Abdominal contractions started at 07:00 h, 13/12/2011. After three hours with no fetuses having been delivered, fetal death was detected and cesarean section was performed at 11:00 h.
- Female 3: Apathy and anorexia were noted on the morning of 21/12/2011, although normal appetite had been observed until the previous day. Obstetric exams detected uterine atony, and cesarean section was conducted on the afternoon of the same day.

Anesthetic protocol and surgical technique

Physical examination and ultrasonography (Chinson 8100VET with 8 Hz probe) revealed fetal relative oversize and fetal death in the three females, thus animals were clipped and prepared for surgery. Animals were placed in an induction chamber (Figure 1A), and anesthesia was induced with 4% isoflurane in 100% oxygen. Following muscular relaxation and decubitus, animals were removed from the chamber and anesthesia was further induced with isoflurane through a facial mask. Once palpebral, interdigital and laryngotracheal reflexes were lost, endotracheal intubation was performed with a 14G catheter; 2% lidocaine (solution 2%) was topically applied to the larynx to facilitate intubation.

Due to the small size of animals, an adapted circuit was confectioned to allow assisted ventilation and to avoid CO₂ re-inhalation. Ventilation was adjusted according to end-tidal CO₂ values obtained by capnograph. If ET-CO₂ values rise above physiological values (35-45 mmHg), assisted ventilation was initiated manually. Anesthesia was maintained with isoflurane (0.5 to 2.5%) in 100% oxygen, and additional trans-operative analgesia was provided through morphine or methadone 0.1 mg/kg IM. Fluid therapy (Lactated Ringer's solution) was administered with a syringe infusion pump (Syringe infusion pump ST 680, Samtronic, São Paulo, Brazil) (5 mL/kg/h), and vital parameters were maintained in physiological ranges for the specie and monitored through Doppler vascular (Parks Medical, Oregon, USA), electrocardiography and capnography (Digicare LifeWindow, Florida, USA). Normothermia was maintained through hot air insufflators during the entire procedure.

Following antiseptic procedures (Povidone-iodine + alcohol) (Figure 1B), laparotomy was performed through the incision of the skin, musculature and peritoneum along the linea alba; special care must be taken during the incision of the abdominal wall to avoid the accidental perforation of the bladder, as it will often be full and juxtaposed to the gravid

uterus. The uterus was exposed and incised transversally to allow the removal of the dead fetuses and their respective placentae (Figure 1C). The uterus was sutured with catgut 3-0 in a monolayer Schimieden pattern; the peritoneum and abdominal musculature were sutured with vicryl 2-0 in a simple running pattern; the subcutaneous tissue was approached using vicryl 2-0 in a Cushing pattern, and the skin was closed using mononylon 3-0 in a running suture (Figure 1D). Anesthetic administration was discontinued at the end of the surgical procedure, the endotracheal catheter was removed upon regaining of protective reflexes, and anesthetic recovery was smooth and uneventful in all cases. Meloxicam 0.1mg/kg IM was administered to produce post-operative analgesia only immediately after the cesarean. Tramadol chloridate 1mg/Kg PO TID was used for five days in the post-operative. Antimicrobial therapy was administered by a single dose of benzathine penicillin 20 UI/kg IM, and cephalexin 20 mg/kg PO BID for 5 days (yogurt was used to improve palatability).



Figure-1A. Anesthetic induction Box. B. Endotracheal intubation and abdominal antisepsis. C. Removal of the fetus and placenta. D. Skin simple interrupted and anesthetic recovery.

One of the females (female number 3) died fifteen days after surgery. At the tenth day, evisceration occurred after the removal of the suture from the cesarean intervention, and a new surgical procedure was necessary to seal the abdominal wall; the same anesthetic protocol was used. On the following days, the female presented vomit, anorexia and prostration, while also arching her back and not defecating. Death occurred five days later, and necropsy revealed the digestive tract was filled with food; this reaction may have been caused by the administration of tramadol, a medication offered continuously for five days in the post-operative and that may have caused constipation. The maternal and fetal detail in the studied cases (table 1) are showed below.

Table 1. Maternal and fetal details

Female	Number of fetuses	Maternal mass	Fetus mass	Fetus gender	Fetus body length	Fetus tail length	Fetus skull diameter
1	2	264 g	34.4 g	F	15 cm	10 cm	9 cm
			36.1 g	M	15 cm	10 cm	9 cm
2	2	338 g	34.0 g	F	13 cm	9 cm	9.5 cm
			32.0 g	M	11 cm	10 cm	9 cm
3	2	270 g	28 g	F	11 cm	9 cm	7 cm
			28 g	F	11 cm	8 cm	10 cm

DISCUSSION AND CONCLUSION

Varela, Guilló and Buxó (2) performed a cesarean section in a 1.5 year-old female, weighting 456 g. After 150 days of pregnancy, physical examination revealed the death of the fetuses and radiography indicated fetal absolute oversize. In agreement the cases here presented may be considered exceptions considering both the low frequency with which non-human primates are brought to exotic pet clinics and the relative infrequency with which obstetric interventions are necessary in these species.

Cesarean sections in marmosets are technically simple procedures; the surgical technique described by Varela, Guilló and Buxó (2) was used in the studied cases, however with different sutures. Because the placenta of the callitrichids is hemochorial monodiscoid, the incision to the uterine wall was transversal to avoid risks of hemorrhage. The anesthetic protocol was highly efficient and safe, and it was novel in the anesthetic induction, the intubation technique using an adapted 14G catheter as an endotracheal tube, and the drugs and monitoring procedures, guaranteeing control and patient safety throughout the procedure, unlike the stated by Varela, Guilló and Buxó (2) and Hobson and Hobbs (8).

Although Hobson and Hobbs (8) did not inform the body mass of the *C. jacchus* female they operated, it is possible to affirm that pregnancy duration and fetal mass did not differ considerably from our findings, which were also similar to those of Hobson and Hobbs (8), Varella et al. (2) and Carretero, Guimarães and Sá (9), which differed only in fetal body length.

Animals were subjected to cesarean intervention because their small body size did not allow for less invasive obstetric maneuvers. The anesthetic protocol was shown to be efficient, safe and original in its equipment adaptations.

The surgical procedure is relatively simple and does not offer a major challenge in the exposure of the uterus. The suture of the uterus, abdominal wall and skin did not present technical difficulties, however even the thinnest sutures used in dogs and cats may be considered too thick considering the marmosets' small body size. Smaller and more delicate surgical instruments should be available for use exclusively in this animal species; ophthalmic surgery instruments are more delicate and may be used in these cases.

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