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Ultrasonographic Monitoring of a Spontaneous Abortion in an Owl Monkey (*Aotus nancymaae*)

A Michele Schuler,[1,*] Virginia L Parks,[1] Christian R Abee,[2] and Jonathan G Scammell[1]

This case report describes the ultrasonographic findings during an idiopathic spontaneous abortion in an owl monkey. The female owl monkey presented for a transabdominal ultrasonogram to evaluate her pregnancy. This evaluation is a routine monitoring procedure in our owl monkey breeding colony. Although the fetus and placenta appeared normal at the initial scan, no fetal heartbeat could be detected. We followed the abortion with serial ultrasonographic scans and documented complete involution of the uterus post-abortion.

Abbreviations: BPD, biparietal diameter; CBC, complete blood count

Transabdominal ultrasonography is commonly used for pregnancy monitoring in many species of nonhuman primates.[2,5,8,9,12] Pregnancy can be reliably diagnosed as early as 2.5 wk after conception in New World primates.[5] Fetal growth and development can be measured using determinations of biparietal diameter (BPD), abdominal circumference, and femur length. In addition, fetal viability can be confirmed by using fetal heart rate and placental evaluation.[3,4]

In our owl monkey breeding colony, abortions are relatively common. The typical presentation is one of a 'silent abortion,' where the female initially palpates as pregnant (or is diagnosed by ultrasonographic exam) and is later diagnosed as not pregnant without evidence of the passage of fetal tissue (which is presumed to have been either resorbed or consumed). We use transabdominal ultrasonography for pregnancy confirmation and evaluation. One of the first ultrasonographic signs of pregnancy that we observe in owl monkeys is a fluid-filled uterus and loss of the endometrial stripe. In later stages of pregnancy, we measure BPD and fetal heart rate. We also evaluate the placenta for calcifications, fluid pockets, and placement in the uterus. A healthy placenta is uniform in echogenicity and is located away from the cervix. We rarely note the presence of calcifications or bleeding (as indicated by pockets of fluid) during sonograms of pregnant owl monkeys in our breeding colony. Using transabdominal ultrasonography, we identified a female owl monkey whose fetus was lacking a heartbeat. This finding was unusual in that the placenta and fetus both appeared to be in good condition, and the mother appeared healthy. We followed this animal using transabdominal ultrasonography and documented our findings. The following case study describes the progression of a spontaneous abortion in this female owl monkey (Table 1).

Table 1. Daily observations in a pregnant owl monkey diagnosed with impending abortion

Day 1	Ultrasonographic exam: normal fetus and placenta but no detectable fetal heartbeat Physical exam: normal
Day 2	Physical exam: normal
Day 3	Ultrasonographic exam: amorphous fetal appearance, subchorionic hemorrhage Complete blood count: leukocytosis Physical exam: normal
Day 4	Ultrasonographic exam: no change
Day 5	Physical exam: no vaginal discharge and pregnant uterus on abdominal palpation
Day 6	Physical exam: vaginal discharge and small uterus on abdominal palpation
Day 7	Physical exam: small uterus on abdominal palpation
Day 8	Ultrasonographic exam: small uterus with endometrial stripe Complete blood count: normal

Case Report

A 7-y-old multiparus female owl monkey was pair-housed with her mate at the University of South Alabama Center for Neotropical Primate Research and Resources (Mobile, AL). Her reproductive history included 2 live births, a full-term stillbirth, and an early abortion. These reproductive statistics are not uncommon for owl monkeys in this breeding colony. As is common in owl monkeys, the causes of her stillbirth and prior abortion were undetermined.[11] She was fed a commercial diet (New World Monkey Chow, Purina, Richmond, IN) and seasonal produce. Peanuts and grapes were offered as environmental enrichment. All experimental protocols were approved by the Institutional Animal Care and Use Committee at the University of South Alabama and are in accordance with the Animal Welfare Act and the *Guide for the Care and Use of Laboratory Animals*.[7]

This female owl monkey presented for a routine abdominal sonogram to evaluate her pregnancy (day 1 in Table 1). This animal was part of the general breeding colony and was not assigned to an experimental project. Abdominal hair was clipped, and she was restrained in dorsal recumbency unanesthetized; abdominal ultrasonography is a painless procedure and does not require anesthesia. Ultrasonography gel (Aquasonic 100, Parker Laboratories, Orange NJ) was applied to the abdomen. The ovaries and uterus were visualized by placing a transducer (13L5, Siemens Acuson Aspen, Siemens, Malvern, PA) trans-

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[1]Center for Neotropical Primate Research and Resources, University of South Alabama, Mobile, AL; [2]Michale E Keeling Center for Comparative Medicine and Research, MD Anderson Cancer Center, Bastrop, TX.
[*]Corresponding author. Email: mschuler@usouthal.edu

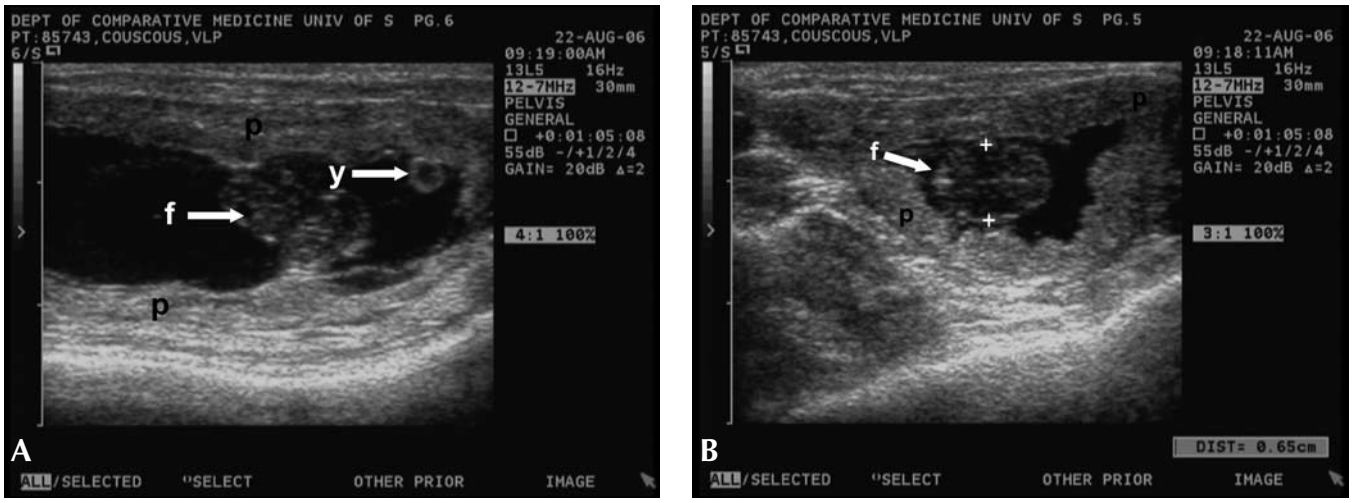

Figure 1. An ultrasonographic image of the uterus of a female pregnant owl monkey taken at the initial examination. (A) The yolk sac (y), fetus (f), and placenta (p) all have normal morphology. (B) The BPD (measured between the 2 + marks) was 6.5 mm. The fetus (f) and placenta (p) have normal morphology.

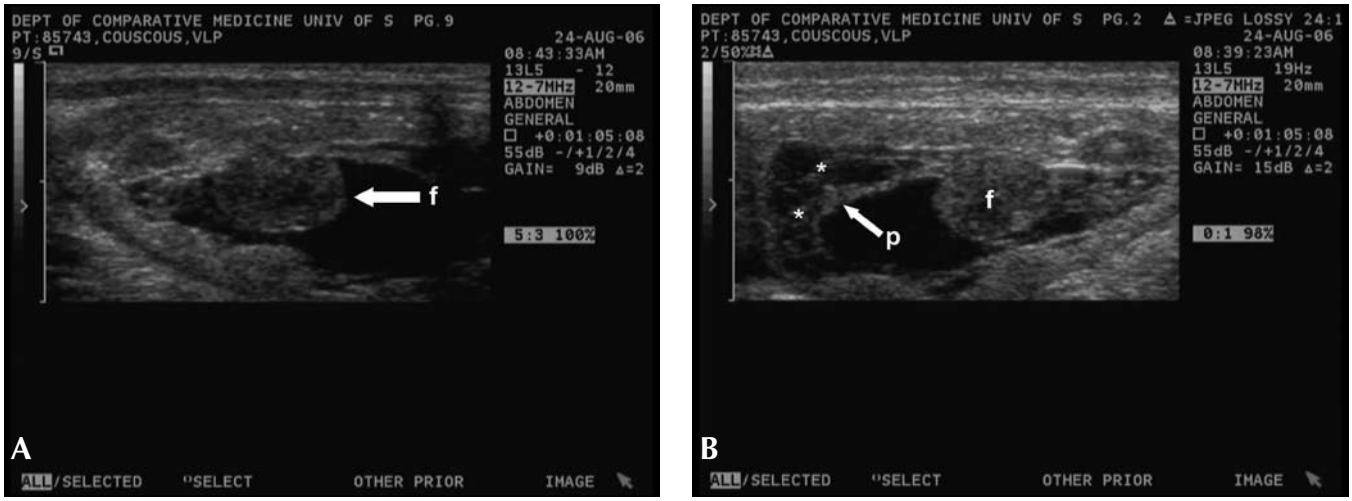

Figure 2. An ultrasonographic image showing the fetus after fetal demise. This scan was performed 48 h after the initial scan (shown in Figure 1). (A) The fetus (f) has an amorphous appearance. (B) The placenta (p) has multiple hypoechoic areas and is pulling away from the myometrium. The * indicates 'thready' membranes and a 'spider-web appearance' of the placenta. These features are indicative of deterioration and detachment. f, fetus.

versely on the lower abdomen. A depth of 20 to 30 mm and a frequency of 12 to 17 MHz were used. A yolk sac was clearly visible, and the placenta was free of calcifications or pockets of fluid (Figure 1 A). The fetus had normal morphology, and the BPD was 6.5 mm (Figure 1 B). However, a fetal heartbeat could not be located. The mother was bright, alert, and responsive during the ultrasonographic exam and exhibited no abnormal clinical features on physical exam.

On day 3, we repeated the ultrasonographic scan and obtained a blood sample for a complete blood count (CBC). Again, no fetal heartbeat could be located, and the fetus had lost distinct characteristics (such as definition of limbs) and had taken on an amorphous appearance (Figure 2 A). The placenta appeared to have a spider-web-like appearance and areas of decreased echogenicity (Figure 2 B). Both of these characteristics are consistent with placental degradation and separation and subchorionic hemorrhage. The CBC indicated leukocytosis (primarily a neutrophilia) and toxic neutrophils (Table 2). Results of the CBC were consistent with infection. Physical exam revealed no abnormal findings and no vaginal discharge. In addition, there were no signs of abdominal discomfort. A subcutaneous injection of cephtriaxone sodium (75 mg; Rocephin, Roche, Nutley, NJ) was administered and was followed with twice-daily oral trimethoprim and sulfamethoxazole (2.4 mg and 12 mg, respectively). On day 4, a repeat sonogram revealed no change in condition. At this point, the animal was bright, alert, and responsive and did not appear to be in any distress. We elected to wait for her to have a spontaneous abortion, considering her good condition. We continued to palpate her abdomen daily and to watch for any vaginal discharge and maintained the twice-daily oral antibiotic regimen.

On day 6, vaginal bleeding was noted, and the uterus palpated small and flaccid. Complete uterine involution was confirmed by abdominal palpation the following day (day 7). We performed a final abdominal sonogram on day 8 and noted a small uterus with a clear endometrial stripe (Figure 3). A repeat CBC on this same day confirmed that the leukocytosis had resolved (Table 2).

Discussion

This report documents the natural progression of a spontaneous abortion in an owl monkey after fetal demise. The cause for

Table 2. Leukograms before and after abortion in a female owl monkey

	Before	After
White blood cells	17.99 m/mm^3	8.74 m/mm^3
Lymphocytes	15.8%	28.7%
Monocytes	3.2%	2.1%
Granulocytes	81.0%	69.2%
Segmented neutrophils	81%	74%
Hematocrit	46.8%	43.9%
Hemoglobin	14 g/dl	13 g/dl
Nucleated red blood cells per 100 white blood cells	2	2
Toxic neutrophils	present	absent

the fetal demise is unknown and could have resulted from a variety of factors. A relatively common reason for spontaneous abortion in captive primates is ascending infection and concurrent placentitis.[1,10,11] *Yersinia pseudotuberculosis* and *Shigella flexneri* have been implicated as probable causes for abortions in *Macaca fascicularis*.[10] *Campylobacter fetus* has been described as a cause of spontaneous abortion in rhesus monkeys.[1] In one case of abortion resulting from infection with *Campylobacter fetus*, ultrasonography revealed "numerous small hyperechoic areas" and "hyperechoic uterine sections bordered by hypoechoic areas" in the placenta.[1] In the female owl monkey we present, the placenta appeared normal at the initial ultrasonographic evaluation despite an abnormal leukogram. No signs of placentitis were noted. These findings suggest that ascending infection was not the primary cause of the monkey's abortion.

Abnormalities of placental location and placental abruption also can result in fetal demise.[6] In our first ultrasonographic evaluation of this owl monkey, the placenta was high in the uterus and far from the cervix. In addition, it was uniformly echogenic and lacked areas of hypogenicity—both findings suggest tight adherence to the myometrium.

We suspect the spontaneous abortion in this case was due to an idiopathic lack of normal development of the fetus. Although we were able to obtain a BPD measurement and although the fetus appeared morphologically normal during the initial scan, we hypothesize that there was some perturbation in development. After evaluation of the mother's overall clinical state and considering the potential risks associated with surgical intervention, we decided to allow the animal to abort spontaneously. As a result, we were unable to collect tissue from the fetus. Like most of those in humans and other animals, we consider the spontaneous abortion in this owl monkey to be idiopathic. The abnormal leukogram we observed was most likely secondary to fetal demise. Regardless, we were able to document in detail the progression from normal placenta and fetal morphology to complete involution of the uterus.

Figure 3. An ultrasonographic image of the uterus of a female owl monkey showing a small, involuted uterus (u) postabortion and the presence of an endometrial stripe (es). This scan was performed 48 h after spontaneous abortion was confirmed by abdominal palpation.

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