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SPECIAL DELIVERY
Monitoring and prompt treatment helped the medical team manage a mare that began hemorrhaging into her abdomen soon after parturition.

CASE REPORT: EQUINE MEDICINE

Periparturient Hemorrhage in a Mare

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Periparturient hemorrhage (PPH) is a potentially fatal complication of foaling. The bleeding is most often associated with rupture of the uterine artery and can lead to either a hematoma on the broad ligament or hemoabdomen. One referral hospital reported that among all hemoabdomen cases reported between 1989 and 2004, 13.4% were caused by a ruptured uterine artery.[1]

Clinical signs of PPH are variable and can range from mild discomfort and lethargy to more obvious signs of colic (e.g., rolling, pawing, flank watching). Patients may also be in cardiovascular shock. Treatment options are typically limited to supportive care (e.g., administration of crystalloid and colloid fluids and hemostatic agents).

Studies show that PPH accounts for up to 40% of deaths in periparturient mares.[2] An indicator of poor prognosis is high respiratory rate.[1] Outcomes can be improved by early treatment and proximity to care. One retrospective study showed that when PPH was diagnosed early in mares that were near a referral hospital, survival rate was 84%.[2]

This case report of a mare that began hemorrhaging into her abdomen soon after parturition illustrates how preliminary laboratory work, careful observations, and prompt treatment allowed for the best possible outcome.

SIGNALMENT AND HISTORY

On day 333 of gestation (average equine gestation is 320 to 380 days), a 17-year-old, multiparous thoroughbred broodmare was presented to Rhinebeck Equine as a high-risk foaling mare. Historically, the mare had foaled at the end of her gestation period, but in recent years she had exhibited postfoaling signs consistent with shock. Because the mare and her foal were considered to be of high value, the decision was made to have her deliver this foal at our hospital, which was staffed 24/7 and had a theriogenologist, internist, and surgeon on call. The client gave consent for the mare to have a cesarean section if foaling conditions warranted the procedure.

PRESENTATION

Physical examination at the time of presentation indicated no abnormalities. Transabdominal ultrasonography revealed a viable fetus in an anterior position. The initial pH of the mare's milk was 7.51 (milk pH <6.5 indicates parturition within approximately 72 hours). A foalert transmitter (**foalert.com**) was sutured into her vulva, and she was routinely turned out and underwent daily physical examination and

mammary secretion monitoring. A blood sample for neonatal isoerythrolysis screening and samples from 3 local blood donor horses for potential crossmatching were sent to a referral laboratory. The neonatal isoerythrolysis results were negative, and 1 donor was identified as an acceptable crossmatch.

LABOR AND DELIVERY

On day 341 of gestation, the mare began exhibiting signs of stage I labor (abdominal discomfort and restlessness resulting from uterine contractions). Wax developed on her teats early in the morning, and by 7 AM, she was circling and pacing the stall. Her morning physical examination results were unremarkable, except for her agitated attitude and mild tachycardia of 52 beats/min (reference range 28 to 44 beats/min). Her tail was wrapped and she was monitored quietly from outside the stall.

At 8 AM, she entered stage II labor (from rupture of the chorioallantois to expulsion of the fetus). The foal was in the correct anatomic position for delivery and was born at 8:20 AM via assisted vaginal delivery. The foal was a clinically healthy colt, and the mare's progression through stage III (expulsion of fetal membranes) was unremarkable.

FIGURE 1. Mare and foal resting soon after delivery.

A blood sample collected from the mare immediately after foaling indicated a packed cell volume (PCV) of 47% (reference range 27% to 43%) and total protein concentration of 7.6 g/dL (reference range 4.6 to 6.9 g/dL). After routine cleaning of the stall and attention to the foal, the mare and foal were left to rest quietly while being monitored from outside the stall (**FIGURE 1**).

After 30 minutes, we entered the stall to administer routine neuroprotective fluids to the foal. While completing this task, we noticed that the mare was getting up and down, flank watching, and exhibiting the Flehmen response—all signs consistent with colic, which can indicate peripartum complications. We immediately notified the theriogenologist.

DIAGNOSTIC WORKUP

The theriogenologist first performed abdominal ultrasonography, which showed a small amount of free hyperechoic fluid, and then ordered placement of a 14-gauge catheter in the right jugular vein while he performed a vaginal examination. The mare's mucous membranes were pale pink and tacky, and capillary refill time was prolonged. We were unable to measure her temperature and heart rate at that time due to the other ongoing procedures. Her respiratory rate was subjectively normal, although we could not measure the exact rate. The internist, who was also consulted, performed a rectal examination and repeated the abdominal ultrasonography. Findings included pneumouterus, a mild amount of blood in the rectum, and a large amount of swirling heterogenous fluid in the abdomen (**FIGURE 2**). The heterogenous fluid was

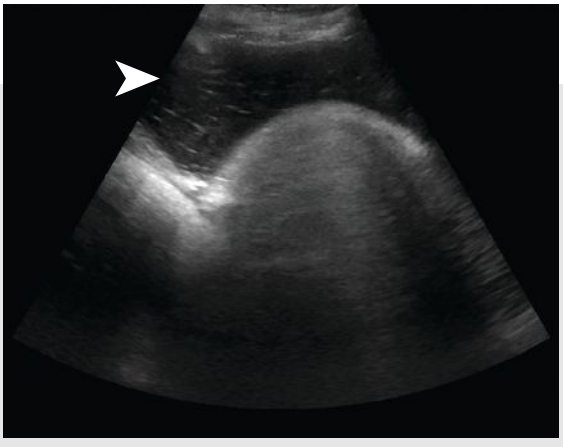

FIGURE 2. Ultrasonogram taken about an hour after delivery, showing a large amount of abdominal fluid **(arrowhead)**.

consistent with hemoabdomen secondary to uterine artery rupture. A blood sample indicated a lactate concentration of 1.7 mmol/L (reference range 0.5 to 1.78 mmol/L), PCV of 40%, and total protein of 6.8 g/dL. Abdominocentesis retrieved frank blood, confirming that the mare was bleeding into her abdomen.

TREATMENT

When the mare became ataxic, presumably due to hypoxia secondary to blood loss, she was sedated with 100 mg of xylazine IV, 5 mg of butorphanol IV, and 1 mg of butorphanol IM, followed by 100 mg of ketamine IM. An ambulatory team was sent to collect 6 L of blood from the crossmatched blood donor, while a 10-L bolus of lactated Ringers solution (LRS) was administered to the mare via the IV catheter, after which the fluid rate was decreased to 2 to 3 L/hr. To encourage hemostasis, she was also given a loading dose of aminocaproic acid (40 mg/kg) IV over 30 minutes and 4 g of Yunnan Baiyao powder mixed with 30 mL water PO. Out of concern for safety of the foal, the pair was separated by a stall partition.

To address the mare's increasing ataxia and instability, we administered lidocaine (0.05 mg/kg/min) and ketamine (10 µg/kg/min) IV at a constant rate infusion (CRI), oxygen therapy through a nasal canula at a rate of 10 L/min, and 1 L of blood IV at a rate of approximately 1 L/hr. She was monitored continuously for reactions, although a full physical examination could not be performed due to the risk her ataxia posed to staff. To enable faster administration of blood, a 12-gauge catheter with a large-bore extension set was placed in her left jugular vein and the blood transfusion line was transferred to this catheter. The catheter in the right jugular vein was used for LRS administration. The mare remained stuporous and ataxic due to her hypoxic state. When standing still, her limbs were splayed out in a wide stance with her head hung low.

During the administration of the third liter of blood, muscle fasciculations were noted, indicating a mild reaction to the transfusion. Her heart rate remained at 52 beats/min, she remained eupneic at 16 breaths/min (reference range 12 to 20 breaths/min), but she became hypothermic with a temperature of 95.2˚F (reference range 99.5˚F to 101.5˚F). A blanket was placed on the mare, and 250 mg of diphenhydramine IM and 625 mg of methylprednisolone sodium succinate IV were administered to reduce the risk for further transfusion reactions.

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By the time the mare had received the fifth and sixth liters of blood, she appeared much brighter and began nibbling at some hay. She became steady on her feet with her limbs placed squarely beneath her; the muscle fasciculations stopped. A full physical examination was possible and indicated that she was normothermic. Her heart and respiratory rates remained the same at 52 beats/min and 16 breaths/min, respectively. Her mucous membrane color was a brighter, more normal, pink, and the membranes were moist. Capillary refill time returned to 2 seconds. The oxygen delivery rate was reduced to 5 L/min and treatment with IV antimicrobials was initiated.

After the blood transfusions, the mare continued to receive LRS with a 2.5% calcium, magnesium, phosphorus, and potassium (CMPK) supplement IV at a rate of 2 to 3 L/hr. Her oxygen delivery remained at 5 L/min and her CRI of lidocaine/ketamine remained at 81 mL/hr. She received another dose of aminocaproic acid (at the maintenance dose of 20 mg/kg) and another dose of Yunnan Baiyao powder.

Two hours after administration of the last liter of blood, it was noted that the IV fluids had stopped flowing and that her fluid and oxygen lines had become entangled. After the lines were untangled and fluid flow resumed, the mare inadvertently received a large bolus of lidocaine/ketamine because although the LRS was not flowing, the pump administering the lidocaine/ketamine had not stopped and, therefore, lidocaine/ketamine had built up in the chamber of the fluid coil set. The mare experienced a severe lidocaine reaction in the form of acute, severe ataxia and muscle fasciculations, and the lidocaine/ketamine CRI was discontinued immediately. After giving her time to recover from the reaction, it was decided to administer 2 more liters of blood from a donor that was not crossmatched to the mare. This decision was made

because it was clinically unclear whether her acute ataxia was solely from the lidocaine reaction or from hypoxia. There was also a risk that a clot had dislodged during the lidocaine reaction and hemorrhaging had resumed. The mare was observed closely while receiving the blood, and no transfusion reactions were observed.

Throughout the day, serial PCVs and lactate concentrations were measured (**FIGURE 3**). At 8 PM, the PCV rose from 23% to 40%, probably resulting from splenic contraction after the lidocaine reaction, and the lactate concentration increased to 9 mmol/L. After this spike, the PCV dropped again but slowly began to level out and stabilize. By 4 AM, the lactate concentration had normalized to 0.8 mmol/L. At this time, serial lactate measurements were discontinued, but PCV monitoring continued throughout the duration of hospitalization.

The mare's condition remained stable throughout the night, her oxygen delivery was discontinued, and she began showing interest in her foal over the divider in the stall. The next morning, she was reunited with her foal. Because of concern about decreased milk production, domperidone was administered at 550 mg PO q24h. PCV remained stable, and maintenance doses of aminocaproic acid and Yunnan Baiyao were continued every 6 hours. At 24 hours after delivery, the 12-gauge catheter was removed from her left jugular vein; however, the catheter in her right jugular vein remained, and IV fluids were continued at a maintenance rate.

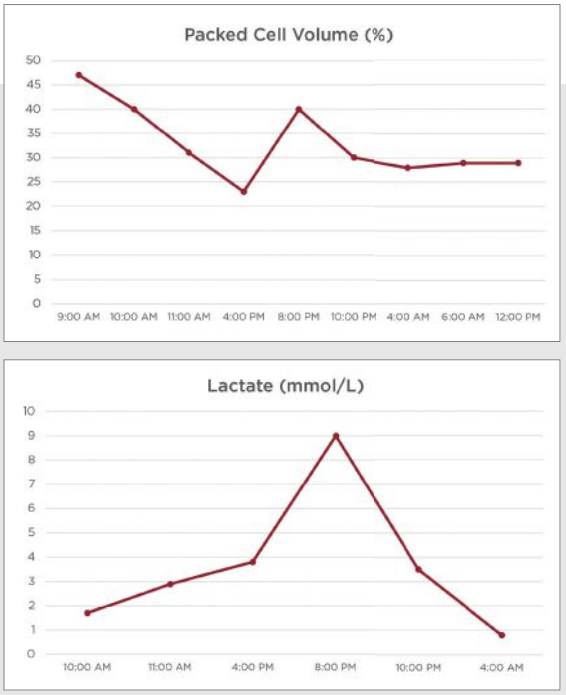

FIGURE 3. Packed cell volume and lactate trends in the mare after delivery.

OUTCOME

Seventy-two hours after foaling, abdominal ultrasonography indicated a large amount of free fluid within the abdomen, but the amount was significantly less than that previously detected (**FIGURE 4**). A repeated rectal examination detected a large hematoma, most likely associated with the broad ligament.

The mare continued to improve clinically, and the pair was discharged to the care of the clients at 7 days after foaling. Discharge instructions to the clients included administration of the broad spectrum antimicrobial sulfadiazine/trimethoprim and recommendations for frequent rectal ultrasonography to monitor the size of

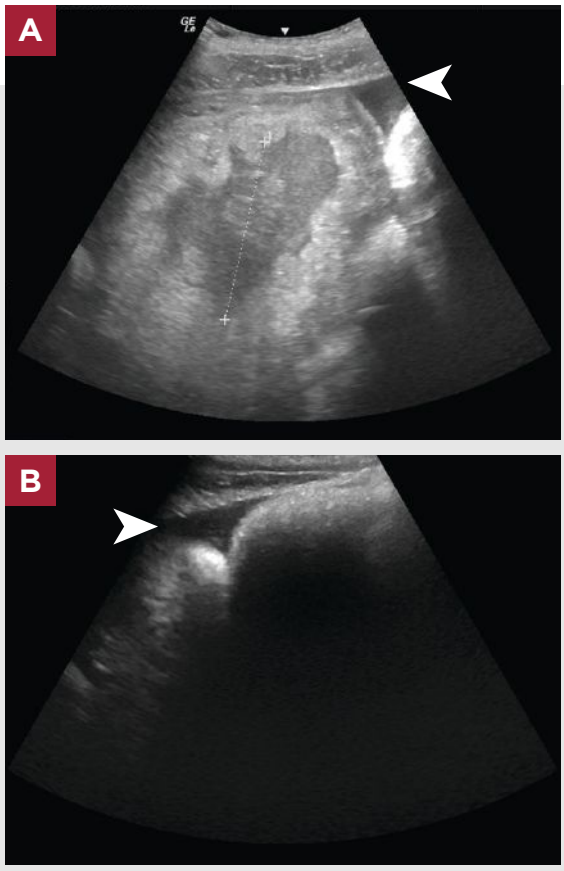

FIGURE 4. Ultrasonograms taken 72 hours after delivery showing abdominal fluid, but less than was present at 30 minutes after delivery **(arrowheads)**.

the hematoma. It was recommended that although the hematoma and the free abdominal fluid would eventually be absorbed, the mare should remain on stall rest or in a small turnout pen to prevent intense activity that could disrupt the hematoma and cause hemorrhaging again.

Because of the severity of the postpartum complications, it was recommended that this mare not be rebred during the same year because breeding could disrupt the hematoma. It was also recommended that, should the clients choose to breed the mare again, foaling should take place in an equine hospital setting with the option for elective cesarean delivery because the mare would be prone to uterine artery rupture. Regulations of the thoroughbred racing industry eliminate the option of embryo transfer. Ultimately, the clients decided to retire the mare from breeding.

CONCLUSION

This mare had a classic case of a hemoabdomen secondary to a ruptured uterine artery. In the absence of client financial constraints, we were able to offer complete supportive care, including analgesics, sedatives, crystalloid fluids, multiple whole blood transfusions, oxygen therapy, and hemostatic agents such as aminocaproic acid and Yunnan Baiyao. Studies of Yunnan Baiyao have not shown any effect on hemostasis,[3,4] but this Chinese herbal blend is a homeopathic option that does not harm the patient, and anecdotal evidence suggests increased blood coagulation.

Good planning set this mare up for the best possible outcome after a potentially fatal foaling complication. Good decisions included that of the farm manager to have foaling take place in a hospital setting, preliminarily crossmatching blood samples to locate a potential blood donor, and continual observation by veterinary nurses who recognized the peripartum complications as soon as clinical signs were exhibited. TVN

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Janine earned a Bachelor of Technology degree in equine science from SUNY Morrisville and intends to complete the AVMA-accredited Penn Foster Veterinary Technician program in December 2021. Janine has worked at Rhinebeck Equine since 2015 as the assistant to the internal medicine team, working closely with the board-certified internists. She has developed a passion for internal medicine and contemplates pursuing a VTS in large animal internal medicine. Janine lives in New York's Hudson Valley region, where she enjoys hiking with her English pointer, Ace.