Effects of exercise on maternal and foetal heart rate in pregnant mares

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Abstract

Pregnant mares are often removed from work during gestation. However, little is known about the effects of exercise on the pregnant mare and her foetus. In the present study, maternal and foetal heart rates were monitored by electrocardiography before and after exercise in four equine pregnancies (days 250–285). Exercise consisted of lunging mares in 20 m circles for 5, 10 and 20 min. Following exercise, significant increases in maternal heart rate were detected ($P < 0.0001$) but not in foetal heart rate ($P = 0.4331$). All mares gave birth to normal foals uneventfully. While these findings suggest that moderate exercise of the pregnant mare does not appear to be harmful to the equine foetus, data are insufficient to draw conclusions. A larger, more controlled study is necessary.

Keywords: equine; foetus; exercise; electrocardiography; pregnancy

Introduction

It is common for pregnant mares to be removed from work during gestation. Because the gestation length of the mare is greater than 11 months, suspending physical activities such as riding, training, showing or draft work during pregnancy can lead to significant loss of revenue. In contrast, allowing moderate exercise may allow horse owners to augment the economic return of pregnant animals. Furthermore, it is generally accepted in humans that moderate exercise can benefit the mother and foetus. However, in pregnant horses, there is a shortage of experimental data addressing the beneficial effects of exercise.

Clinical recommendations in humans encourage pregnant women to maintain a moderate exercise programme. Benefits include improved maternal cardiovascular function, easier delivery and possibly improved neural development of the neonate. During exercise, a transient rise in foetal heart rate may be observed, which may decrease or increase as pregnancy advances, depending on such factors as type, duration and intensity of the exercise. Although exercise-induced foetal tachycardia may represent sympathetic response to slightly decreased foetal PO2, this does not appear to indicate foetal distress.

However, foetal tachycardia may indicate foetal distress in the face of certain pathologic conditions in both horses and women. Elevated foetal heart rate may be seen in equine foetuses preceding abortion, while foetal heart rate may be decreased in the hour preceding abortion. In women, elevated foetal heart rates may be seen in conditions such as chorioamnionitis, maternal fever and meconium aspiration.

In this study, the effects of exercise on the equine foetus were investigated, using foetal heart rate as an indicator of foetal stress. The hypothesis that moderate maternal exercise would cause elevation in foetal heart rate was tested. These data would provide an improved scientific basis for recommendations to mare owners concerning exercise of pregnant animals.

Materials and methods

Horses

Three mares were used in this study, two Standardbreds (horses 1 and 2) and a Thoroughbred (horse 3). All were between 10 and 15 years of age. Horses 1 and 2 were in foal to Standardbred stallions, horse 3 to a Lipizzaner stallion. During the study, mares were housed in paddocks.
with shelter and free-choice water, and fed a normal diet of grass hay supplemented with grain, salt, trace minerals and vitamins. All procedures were approved by the University of Maine Institutional Animal Care and Use Committee.

**Experimental design**

Data were collected between days 250 and 285 of four pregnancies: two from successive pregnancies of horse 1 (pregnancies 1A and 1B), and one each from horse 2 (pregnancy 2) and horse 3 (pregnancy 3). For data collection, mares were lunged in a 20 m circle at the trot. Each mare received nine lunging sessions, each session on a different day, with 1–3 days between lunging sessions. For the first three sessions, mares were lunged for 5 min, for the second three sessions mares were lunged for 10 min, and for the third three sessions mares were lunged for 20 min. Direction was reversed halfway through each lunging session. Maternal and foetal heart rates were assessed by electrocardiography (ECG) prior to and immediately (< 2 min) after each lunging session.

**Electrocardiography**

Four sites were prepared to receive electrodes, two on each side of the mare’s rump, one approximately an inch cranial to the umbilicus and one at the most ventral point of the abdomen. Sites were clipped and shaved, and electrodes with adherent pads were placed at each site (Vermont Medical, Bellows, VT, USA). Each electrode contained a small metal button to which the electrocardiograph leads could be conveniently connected and disconnected. In most cases, electrodes remained attached to the mare for the entire study period (about 2 weeks), and did not appear to cause any irritation or discomfort. The left arm, right arm, left leg and right leg leads were attached cranial to the umbilicus, ventral abdomen, left rump and right rump, respectively. Traces were run at a tape speed of 25 mm/s and at sensitivities of 10 mm/mv, 20 mm/mv and 40 mm/mv, depending on which provided the clearest signal. Average interval between foetal and maternal QRS complexes (x) was determined by measuring a minimum of 3 R–R intervals using calipers. Pulse rate (beats per min) was calculated using the expression (25/x) × 60.

**Statistical analysis**

Maternal and foetal heart rates before and after lunging were compared by ANOVA, using the general linear models procedure of SAS (Statistical Analysis Software, SAS Institute, Cary, NC, USA). Means were compared by Scheffe’s method with significance set at P < 0.05.

**Results**

Representative ECG traces are shown from a mare before (Fig. 1) and less than 2 min after exercise (B). Fetal and maternal QRS complexes indicated by ‘F’ and ‘M’, respectively. 

![Fig. 1 Representative electrocardiograms of a mare before (A) and less than 2 min after exercise (B). Fetal and maternal QRS complexes indicated by 'F' and 'M', respectively](image)

![Fig. 2 Effect of exercise for 5, 10 and 20 min on maternal pulse rate. Post-exercise pulse rates were taken less than 2 min after exercise. Data from four pregnancies are shown (1A, 1B, 2, 3). Data points at 5, 10 and 20 min represent averages of three lunging sessions for each mare. Data points at 0 min represent an average of nine values recorded pre-exercise](image)
Effects of exercise in pregnant mares

![Graph](image)

**Fig. 3** Effect on foetal pulse rate of maternal exercise shown in Fig. 2. Post-exercise pulse rates were taken less than 2 min after exercise. Fetal data from four pregnancies are shown (1A, 1B, 2, 3). Data points at 5, 10 and 20 min represent averages of three lungeing sessions for each mare. Data points at 0 min represent an average of nine values recorded pre-exercise.

Heart rate (P = 0.4331; Fig. 3). While two foetuses showed increased heart rate between 5 and 10 min (pregnancies 2 and 3), this appeared to be offset by decreased heart rate in the other two foetuses over the same time period (pregnancies 1A and 1B). While the degree of effort expended was not assessed objectively, the approximate doubling of heart rate, the nature of the exercise and our subjective impressions of mare effort indicated light-to-moderate work.

All mares in the study subsequently foaled normally, giving birth to healthy offspring.

**Discussion**

These data suggest that exercise in these four pregnancies did not induce foetal stress. However, data from too few horses are presented for any conclusions to be drawn. If confirmed by subsequent studies, these findings would support recommendations that mares can be exercised moderately up to days 250–285 of gestation without adverse effects.

The potential health benefits of exercising mares are many. The improved cardiovascular function will be valuable to the mare during the rigours of labour. Stage 2 of labour lasts about 20–30 min in the mare and is characterized by intense abdominal straining, anxious pacing and usually lying down, then rising several times, inducing significant cardiovascular stress. Similarly, strengthened abdominal muscles may promote faster delivery of the foal. In addition, abdominal herniations may be partially prevented by strengthening of relevant muscles during exercise. Finally, increased interaction with the pregnant mare in a controlled exercise programme may allow increased opportunities for observation and improved monitoring of the progress of the pregnancy. Mares that receive regular human contact during pregnancy will probably adjust better to the increased human activity surrounding foaling.

However, this study has significant limitations. First, data from only four pregnancies are presented and cannot be extrapolated to the entire horse population. Secondly, lungeing mares does not provide a highly repeatable stress test because mares trot at different speeds, despite the best efforts of the handler. Finally, it was not possible to monitor foetal heart rate during exercise in this study. The potential thus exists for a foetal response during the lungeing session that was not detected post-exercise. These limitations might be partially correctable by extending the study to a larger group of horses in a more controlled environment, such as a graded exercise stress test on a high-speed equine treadmill. Nevertheless, if confirmed, the apparent ability of the mare to shield her foetus from the stresses of exercise may be another example of evolved athleticism in the horse.

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**References**


