

Long Term ECG Recording with Holter Monitoring in Clinically Healthy Horses

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Raekallio, M.: Long term ECG recording with Holter monitoring in clinically healthy horses. Acta vet. scand. 1992, 33, 71-75. – The electrocardiogram of 9 horses was continuously recorded for 24 h with Holter monitoring to examine the variations in heart rate and rhythm during daily routine procedures and at night. Three horses had transient sinus bradycardia, and 3 had periods of sinus tachycardia. Heart blocks were detected in 3 horses, and all horses had periods of sinus arrhythmia. These changes in the heart rate and rhythm were apparently caused by variations in autonomic nervous system tone and they are probably “normal” findings in resting, undisturbed horses. Ventricular premature depolarisations were not observed in any horse, but some single supraventricular premature contractions were detected. There was preliminary evidence that in order to register the real resting heart rate and rhythm of a horse the ECG should be recorded over a long period, and also at night and without the presence of the investigator.

tachycardia; bradycardia; sinus arrhythmia; heart block.

Introduction

Measuring the heart rate of a horse by cardiac auscultation or by standard ECG usually causes some sympathetic stimulation, which may influence the heart rate and confuse the determination of the “normal” resting sinus rate. The standard ECG records only a brief period of cardiac rhythm, and it often fails to reveal many dynamic and transient phenomena. A long-term ECG Holter monitoring with a portable 24 h tape recorder, coupled with a playback analysis of the data, has been used in the examination of human patients (*Brodsky et al. 1977, Kennedy & Caralis 1977, Viitasalo et al. 1982, Romano et al. 1988*) and dogs (*Tilley 1985, Miller & Tilley 1988*). Direct storage of ECG data on a mini tape, giving 15 min of playing time, by recording device carried on the horse, has been reported (*Brownlie 1987, Gatti &*

Holmes 1990), but no reports concerning the examination of the heart rate and rhythm with a long-term tape recording in horses have been found in the available literature. The purpose of the present study was to examine the heart rate and rhythm in horses at rest and also during sleep without the presence of the investigator.

Materials and methods

Nine mature horses of various breeds and sexes, 4 to 11 years of age and weighing 360 to 572 kg, were used in this study. The horses were no longer used for athletic purposes due to orthopedic problems, but they were exercised daily in the paddock. The horses had no clinical signs of cardiac disease. Five of the horses had a permanent catheter in the left carotic artery.

ECG was recorded continuously for 24 h with Holter monitoring using a 2-channel electro-cardiographic tape recorder (Model 453, Avionics, California, USA). The leads were 50 cm long, and they were taped to the hair. The electrodes were fixed with alligator clamps on stainless steel sutures that were placed through the skin at 2 ribs on each sides, and the ground lead at the edge of the scapula. Mepivacaine (Carbocain^R, Astra, Södertälje, Sweden) was used as local anesthetic for the operation. The tape recorder was fixed at the withers with a girth that had an arch over the withers. The leads and the recorder were covered with a blanket to prevent the horse from tearing them off. The electrodes were placed and the recordings started in a restraining stock, from which the horses were moved into their loose boxes. The daily routine procedures (feeding, exercise in paddock etc.) were written down during the recording.

Tapes were first printed at low speed with a tape analyser (Cardioexpress CX 100/A, Avionics), and analyzed visually, after which at least 6 min in every h were printed at medium speed. Heart rate and the frequency of heart blocks and premature depolarisations were counted. Since sinoatrial (SA) heart block and sinus arrest cannot be distinguished with ECG, SA block was diagnosed, if the PP-interval was at least twice the sinus interval of the preceding or subsequent beats (Fregin 1982). An irregular sinus rhythm with adjacent cycle lengths varying by 10 per cent or more was defined as sinus arrhythmia (Brodsky *et al.* 1977).

Results

The quality of 54% to 86% (mean 69%) of the whole curves of 8 horses was sufficiently good to permit the heart rate to be counted and the heart rhythm evaluated visually. One

horse had torn off the leads 15.5 h after the beginning of the recording, but 75% of the recorded ECG was of an acceptable quality. The ECG tapes could not be analyzed automatically. There was excessive noise, and the ECG could not be analyzed even visually, when the horses were exercising in the paddock.

The maximal heart rates detected varied from 27 to 88 beats per min (mean 58.8) and the minimal rates from 15 to 32 beats per min (mean 26.0). The lowest frequencies had a tendency to appear in the early morning h (Fig. 1). In the ECG of 6 horses, no 2nd degree atrioventricular or sinoatrial heart blocks were found, 1 horse had a few single blocks and 2 horses had several (0 to 16) heart blocks per min. The slowing of the heart rate had a tendency to be caused both by decrease of the sinus rate and by the presence of more such impulses, which were not conducted. The minimum sinus rate recorded was 23 per min. All horses had periods of sinus arrhythmia. Ventricular premature depolarisations were not detected in any horse, but 1 horse had one, and another 2 single supraventricular premature contractions.

Discussion

The quality of the equine ECG recorded with Holter monitoring was on the whole adequate for visual evaluation of the heart rate and rhythm, in spite of the high number of artifacts in the recordings. Many of the artifacts were likely caused by muscular activity, but also poor electrode attachment is known to induce noise (Gatti & Holmes 1990). The R or S wave could have been larger and the muscular activity would probably have caused less noise, if the siting of electrodes reported for ECG recording during exercise (Gatti & Holmes 1990) had been

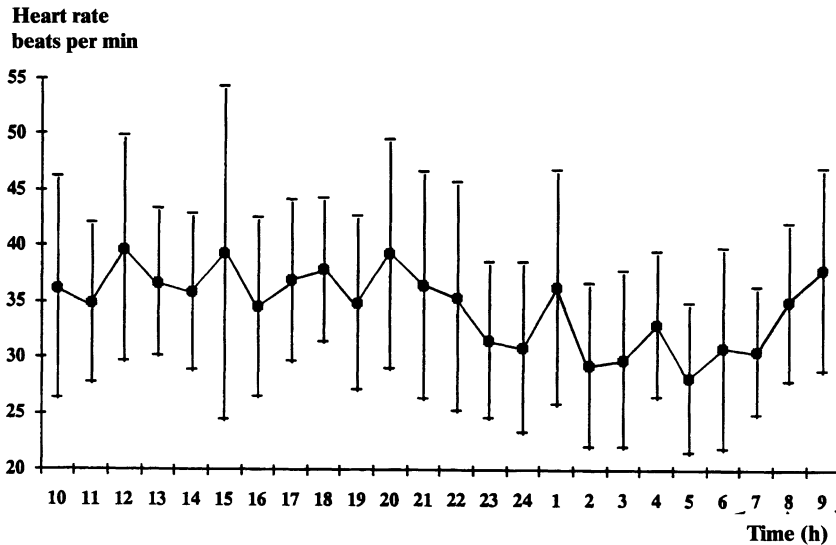


Figure 1. Means \pm standard deviations of heart rates (beats/min) of 9 horses during a 24 h period. The time of day is in x-axis.

used. However, if these sites had been used, it would not have been possible to protect the electrodes from the horses' attempts to remove them, when the horses were in their loose boxes.

The normal resting sinus rate in adult horses is 26 to 50 beats per min (Fregin 1982, McGuirk & Muir 1985), and the normal resting heart rate is 22 to 50 beats per min (Hilwig 1987). However, the recording of the heart rate by ECG or auscultation may *per se* cause some sympathetic stimulation, which may produce heart rates higher than the actual resting rate and make the determination of the "normal" resting rate difficult. In the present study, 3 of 9 horses had periods of bradycardia (sinus rate lower than 26 per min or heart rate lower than 22 beats per min), and 3 horses had transient sinus tachycardia (more than 50 beats per min) also at night. These fluctuations in the heart rate

were likely to be produced by variations in autonomic nervous system tone. The lowest heart rates had a tendency to appear in the early morning h in horses. This agreed with the findings that in humans the heart rates during sleep are lower than during the waking period (Brodsky *et al.* 1977, Viitasalo *et al.* 1982, Romano *et al.* 1988). In the present study it was not known when the horses were asleep.

Sinoatrial and 2nd degree atrioventricular heart blocks are arrhythmias due to vagal tone, and they are found in normal resting horses (Fregin 1982, McGuirk & Muir 1985). They were also detected in the present study in 3 of 9 horses. Sinus arrhythmia and arrest are usually normal findings in horses (McGuirk & Muir 1985). In humans an irregular sinus rhythm with adjacent cycle lengths varying by 10 to 50 per cent is defined as mild, by 50 to 100 per cent as moderate, and by

100 per cent or more as marked sinus arrhythmia (Brodsky *et al.* 1977). Using this criteria, in the present study 7 of 9 horses had periods of mild sinus arrhythmia. In two other horses the sinus arrhythmia was classified moderate, but both horses had also cycle lengths varying more than 100 per cent, which could not be differentiated from sinoatrial heart blocks.

The clinical significance of atrial premature contractions in asymptomatic horses has not been well confirmed (Fregin 1982), and the meaning of the single supraventricular premature depolarisations detected in this study remained unknown. In humans without heart disease, infrequent premature beats are clinically insignificant (Brodsky *et al.* 1977), and the same is probably true with horses, too.

In conclusion, Holter monitoring system constructed for human studies seemed to be adequate for recording long-term ECG in resting horses. In several horses, periods of sinus bradycardia, tachycardia, and arrhythmia, as well as heart blocks were detected. They were likely to be produced by variations in autonomic nervous system tone and are probably "normal" findings in resting, undisturbed horses. This information may be useful in evaluating the clinical significance of changes in heart rate and rhythm in horses. Although the material was limited there was preliminary evidence that in order to record the real resting heart rate and rhythm of a horse, the ECG should be recorded over a long period, and also at night and without the presence of the investigator.

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Sammanfattning

Långvarig elektrokardiografi med Holter apparatur på kliniskt friska hästar.

Elektrokardiografi gjordes på 9 hästar under 24 t. Tre hästar hade övergående sinusbradykardi och 3 hade periodisk sinustakykardi. Tre hästar hade ledningsstörningar, och hos alla djur förekom period-

visa sinusarrytmier. Dessa förändringar i hjärtfrekvens och -rytm förorsakades sannolikt av variation i det autonoma nervsystemets tonus, och de är sannolikt "normala" fynd hos hästar i vila. Ventrikulära ekstrasystoler förekom inte, men några enskil-

da atriella ekstrasystoler registrerades. Dessa fynd tyder på, att EKG borde kanske registreras också på natten och över ett långt period, om man vill studera den verkliga hjärtrytmen och -frekvensen hos hästen i vila.

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