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ELECTROCARDIOGRAPHIC RECIPROCAL COMPLEXES IN SOWS GROWN IN INDUSTRIAL CONDITIONS

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Abstract

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A total of 586 sows were studied by means of telemetric electrocardiography, 199 of them (33.96%) showed the presence of the pathological Q wave in their ECG. In 56 of them RC complexes were registered. Sows were kept in individual pens during fertilization and furrowing. They were moved to a common pen after positive pregnancy tests. The additional ventricular contractions registered in ECG were of the Q/r complex type. These contractions were marked as RC complexes and were not followed by a compensatory pause. The reasons for their presence were not clarified.

Key words: ECG, RC complexes, ECG telemetry

Introduction

We have not found any information on reciprocal complexes (RC) or echo complexes in the electrocardiogram (ECG) of animals in the literature we have had access to. These complexes have been present in humans as described in the dawn of electrocardiography by Mines (1914), quoted by Isakov et al. (1984).

Similar complexes were reported by Kostov (1995) under the term "additional ventricular contractions" in sows.

Kostov (2000, 2005) attributed electrocardiographic changes in sows, expressed in the presence of the pathological Q wave and the reduction of R wave amplitude to hypokinetic stress. Those changes depended on the rate of morphological damage of the heart and were recorded based on Q and R-wave amplitude.

Along with those changes, a peculiar type of waves was registered in ECG and they will be discussed here below.

Material and Methods

The studies were carried out on a large industrial facility in Bulgaria on 586 sows, 199 of which (33.96%) showed the presence of the pathological Q wave in ECG and 56 – of RC-complexes. Sows were kept in individual pens during fertilization and furrowing and in group pens after pregnancy detection.

ECG records were made with single-channel telemetric system "Hellige". One of the electrode (+) was placed to the right in the area of the limb cranial scapular margin and 3-4 cm under the spine

line and the second electrode (-) – to the left in the cardiac area at the level of olecranon. The velocity of the strip was 25 mm/s and acceleration – 1 mV=10 mm.

Results

Normal ECG of sow is shown on Figure 1. The ECG record shows that the P wave was negative, with a sharp apex and with an amplitude 0.3 mV and duration 0.04 s. After the P-Q segment, Q wave was registered with amplitude 0.35 mV and duration less than 0.03 s. The R wave was positive, with sharp apex, and an amplitude 1.4 mV and duration 0.04 s. The T wave was negative with an amplitude 0.4 mV and duration of 0.06 s.

The RC complexes in the ECG of a sow with normal wave amplitude are shown on Figure 2. As indicated, the P wave of the first cardiac cycle was bifurcated (P-mitrale). Two small amplitude contractions were recorded between the third and fourth cardiac cycles. These contractions resembling a ventricular complex of the Q/r type, described as reciprocal complexes (RC). The second of those complexes overlaid the P wave. A third contraction was registered in the cycle preceding T wave. The fifth cardiac cycle was normal, while the sixth was accompanied by similar complexes both before and after the ventricular complex. It is worth noting that those RC complexes did not cause a compensatory pause but only overlaid the main record during the relative refractory period.

In some cases those RC complexes accumulated on the posterior part of R wave (Figure 3). The first RC complex overlaid the T-P segment between the two cardiac cycles, while the second RC complex started from the apex of the R wave. The next RC complexes were located in the way described in the previous figure.

The normal ECG of sows in hypokinetic stress changed as shown on Figure 4. Major changes occurred in the Q wave, the amplitude of which

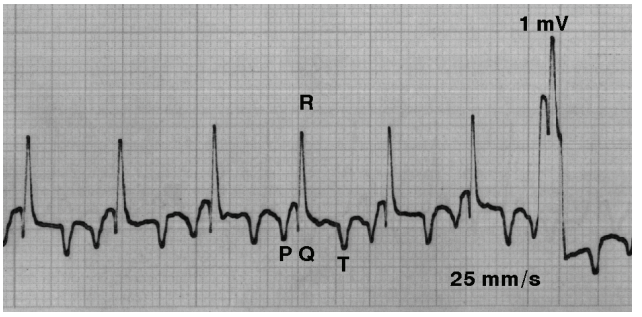

Fig. 1. Normal electrocardiogram of a sow

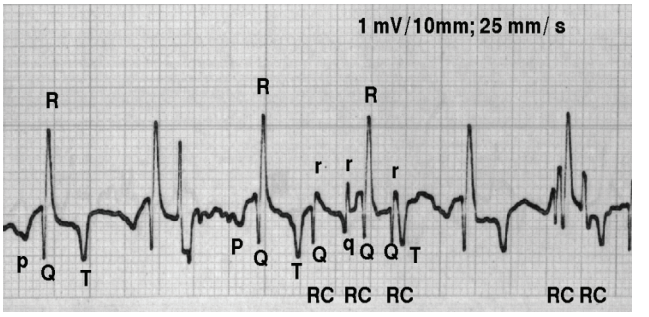

Fig. 2. Normal electrocardiogram of a sow with overlaying RC complexes

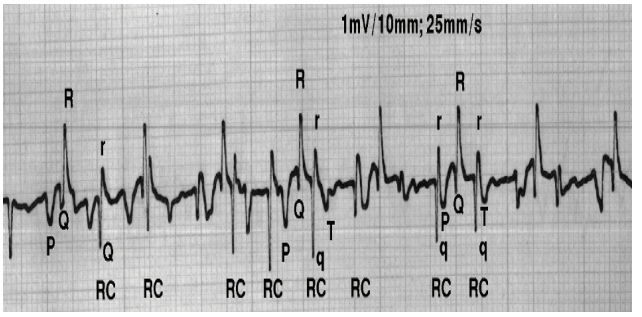

Fig. 3. Normal electrocardiogram of a sow with overlaying RC complex on the back part of R wave

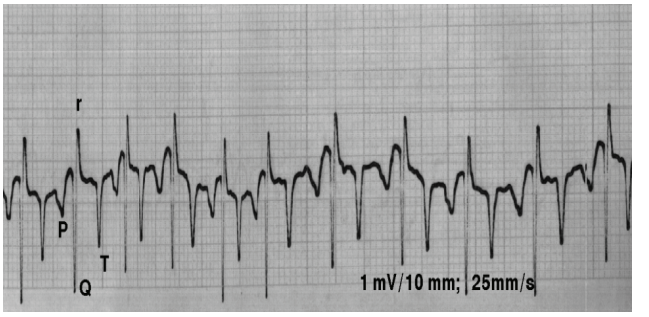

Fig. 4. Electrocardiogram of a sow with alterations caused by hypokinetic stress

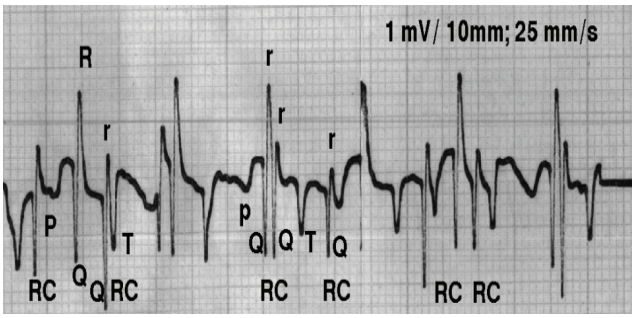

Fig. 5. Electrocardiogram of a sow caused by hypokinetic stress with overlaying RC complexes

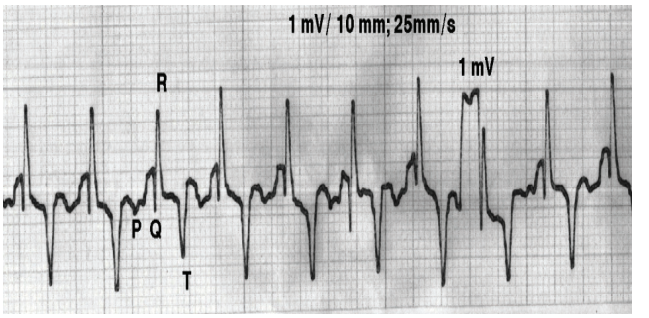

Fig. 6. Electrocardiogram of a sow with bifurcated P wave (P-mitrale)

exceeded 0.5 mV and the amplitude of the R wave decreased. Such ECG is characteristic of the chronic stage of cardiac infarction in man. Those changes and their dynamics as well as the morphological changes have been described in our previous publications.

RC complexes appeared not only on normal ECG records but they overlaid the already altered cardiac cycles caused by hypokinesis in industrial conditions (Figure 5). As seen in the figure, externally, RC complexes and cardiac cycles were almost identical. Except for their amplitude and the fact that RC complexes did not contain the elements of a complete cardiac cycle the P and T waves were missing. The ratio of Q and R waves in this ECG was 1:1. The cardiac cycle was preceded by an RC complex, located before P wave and was finalized with a second RC complex before T wave. In the third cardiac cycle, the RC complex was accumulated on the posterior of the R wave. The RC complex appeared again in the TP segment between the third and fourth cardiac cycle. The remaining cardiac cycles were also accompanied by RC complexes.

Changes of ECG atrial complex were often registered in a large number of studied animals and were expressed as P wave bifurcation (P-mitrale) (Figure 6).

Discussion

Extrasystoles and RC complexes can be regarded as arrhythmias caused by impulse generation (non-automatic mechanisms).

One of the mechanisms of those phenomena is Re-entry – circular movement of the impulse, returning back to the point of generation. There is also a second so-called micro-reentry, meaning that the process takes place in a small space.

There are several types of RC complexes, depending on the location of the ectopic focus: atrial, atrioventricular and ventricular.

We assume that the registered RC complexes originated from nodus atrioventricularis and affected the atrioventricular septum of the heart with the appearance of Q wave and flattened r wave. As can bee seen from the ECG, P and T waves were missing and were not accompanied by a compensatory pause, resulting in sustaining the normal sinus rhythm of the heart.

Another peculiarity observed was that they appeared during the electric pause of ECG in T-P segment, at the end of S-T segment and, occasionally, in P-Q segment and the posterior part of the R wave. This showed that the impulse developed according to the micro-reentry mechanism and appeared during the relative refractory period of the myocardium.

We proved that the reasons for the main alterations of ECG with pathological Q wave were caused by hypokinesis of sows in industrial facilities. It is the cause of myocardium hypoxia, triggered by a spasm of the coronary arteries (no atherosclerosis changes were present).

We can not say what are the reasons for the occasional appearance of RC complexes, because

the trials were carried out on four industrial complexes but they were recorded on only one of them. Likely, the RC complexes on this facility were due to additional damage, caused by viral, bacterial or toxic agents as well as zoo hygienic factors.

Conclusions

Additional ventricular contractions of the Q/r complex were registered in ECG recordings. They were described as RC complexes and were registered in sows grown in industrial conditions. The reasons for their presence were not clarified.

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