PHYSIOLOGICAL ANALYSIS OF THE COURSE OF STAPHYLOCOCCAL TOXEMIA IN DOGS IN DIFFERENT AGE PERIODS

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Investigations in this laboratory [1, 2, 5-10] have shown that the action of various bacterial toxins on dogs and puppies over 2-2½ months old is characterized by a standard sequence of changes in the cardiac rhythm, consisting of four phases. Bradycardia first develops, followed by tachycardia, and if lethal doses are given, this gives way to collapse, which itself consists of two phases: 1st - syncope and vagus escape, and 2nd - a change to automatic rhythm or fibrillation. The duration of the phases varies depending on the specific properties of the toxin.

The adaptive importance of the initial bradycardic phase, described by I. A. Arshavskii [3, 4] as anabolic, was established for its severity determines the duration of maintenance of homeostasis in the tachycardiac phase and also the time of onset of collapse and death of the animal. The object of the present investigation was to study in greater detail the course of staphylococcal toxemia, especially during the first two phases. In particular, we investigated the changes in basal metabolism taking place during the first, bradycardic phase.

EXPERIMENTAL METHODS

Experiments were performed on dogs in three age groups: puppies aged between 5 and 14 days (group 1), puppies aged between 18 and 40 days (group 2), and adult dogs and puppies over 2-2½ months old (group 3). Staphylococcal toxin (Institute of Experimental Medicine, AMN SSSR, batch 196) was injected in doses of between 0.2 and 1 ml/kg intravenously. Recordings were made of the ECG, respiration, and the EEG on a four-channel electroencephalograph. For recording the EEG needle electrodes were used (bipolar leads); these were implanted in the cranial bones at the site of projection of the sensorimotor area of the cortex. Respiration was recorded by means of an electrolytic detector. Changes in body temperature also were recorded. In a special series of experiments the oxygen consumption was measured by Grad's method.

EXPERIMENTAL RESULTS

The absolute lethal dose of staphylococcal toxin when injected intravenously into the animals of all age groups was 0.5 ml/kg. However, the adult dogs and puppies over 2-2½ months old in most cases died within 16-18 h after receiving these doses, and the younger puppies within 1½ -3 h. The maximal dose tolerated by the animals of all age groups was 0.2 ml/kg.

In the dogs and puppies of group 3, after injection of staphylococcal toxin in lethal doses (0.5-1 ml/kg), changes in the cardiac rhythm took place in four phases, similar to those developing after administration of dysentery, diphtheria, and typhoid toxins.

After intravenous injection of staphylococcal toxin in a dose of 0.5 ml/kg, the initial bradycardic phase lasted for 1 h 25 min-2 h, and was followed by a tachycardic phase lasting 16-18 h. Between 7 and 8 min before death the dogs developed a transient collapse, showing the two phases described above. An increase in the dose of staphylococcal toxin to 0.75 ml/kg shortened the bradycardic phase to 50-55 min and the tachycardic to 3½ -6 h. After injection of staphylococcal toxin in a dose of 1 ml/kg, the duration of the bradycardic phase was shortened to 20-25 min, and the duration of the tachycardic phase to 1 h 25 min-24 h 45 min. Hence, the larger the dose of staphylococcal toxin, the less pronounced the bradycardic phase, the shorter the tachycardia, and the sooner the animals died if the doses were lethal.
Fig. 1. Schemes of the phases of the changes in the heart rate in adult dogs (I, II, III) and in young puppies (IV, V) after intravenous injection of staphylococcal toxin in doses of 0.5 ml/kg (I), 0.75 ml/kg (II), 1 ml/kg (III), 0.5 ml/kg (IV), and 0.5 ml/kg (V).

Fig. 2. Changes in the EEG and ECG of adult dogs after intravenous injection of staphylococcal toxin in a dose of 0.75 ml/kg. A) Initial background; B) bradycardic phase 20 min after injecting; C) tachycardiac phase 1 h later; D,E) stages of collapse: atrioventricular rhythm (D) and fibrillation (E).

The relationship between the duration of the tachycardiac phase and the rate of onset of collapse, on the one hand, and the severity of the initial bradycardia on the other, is given in Fig. 1. This shows that the duration of the successive phases during the action of the same toxin depends on the dose.

The bradycardic phase of staphylococcal toxemia was characterized, not only by a slowing of the heart rate, but also by slowing the respiration and synchronization of the electrical activity of the brain, a small drop in the body temperature, and a fall of arterial pressure. The results of an experiment on an adult dog after injection of staphylococcal toxin in a dose of 0.75 ml/kg are given in Fig. 2. In the bradycardic phase the cardiac rhythm was