The course of respiration and circulation in death due to typical hanging

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Received June 3, 1991 / Received in revised form September 2, 1991

Summary. Experiments were carried out on 15 dogs to investigate the course of respiration and circulation during the agonal period of death due to typical hanging. Animals were asphyxiated by a method simulating typical hanging. Electrocardiogram (ECG), electroencephalogram (EEG), blood pressure (BP) in the femoral artery and intrathoracic pressure (ITP) were registered.

In typical hanging, the course of respiration was characterized by shorter stages of dyspnoea and initial apnoea and a longer stage of the terminal respiration when compared with obstructive asphyxia. However, the whole time of the course of respiration and circulation in typical hanging was almost the same as that in obstructive asphyxia. The BP increased rapidly, was maintained during the dyspnoea stage, and then decreased gradually. EEG disappeared with, or a short time after, the end of the dyspnoea stage. The increased heart rate in the dyspnoea stage remained until circulatory collapse. The analysis of the ECG complexes revealed that the heart muscle adapted to oxygen deficiency during typical hanging.

Key words: Typical hanging – Obstructive asphyxia – Obstruction of the neck arteries – Respiration and circulation

Introduction

Hanging is due to constriction of the neck as a result of suspension in such a manner that the weight of the body, or a part of the body of the victim pulls upon the ligature. The neck veins, arteries and the air way may all be obstructed in typical hanging [1, 2].

The course of respiration and circulation during obstructive asphyxia has been described by Brinkmann et al. [3] and Suzuki et al. [4]. However, the pathophysiology of respiration and hemodynamics during the agonal period of death due to typical hanging has not been investigated.

In the present work, experimental animals were asphyxiated by a method simulating typical hanging, and the course of respiration and circulation in death due to typical hanging was investigated and compared to those due to obstructive asphyxia.

Materials and methods

Experiments were carried out on 15 healthy mongrel dogs weighing 8–10 kg. The dogs were anaesthetized with an intravenous administration of sodium pentobarbital 25.0 mg/kg body wt and were placed in a supine position with the legs fastened to a table. The trachea, bilateral common carotid arteries, vagus nerves, internal jugular veins, and cervical vertebral column were exposed. The dogs were asphyxiated by occlusion of the trachea with a ligature.
of the bilateral common carotid arteries, vagus nerves and internal jugular veins. Bilateral vertebral arteries were ligated at the same time with the rope running horizontally round the exposed cervical spine at the level between the fourth and the fifth transverse process of the cervical vertebrae, by applying tractive forces in the range between 50–60 kg. To avoid variable results from general anaesthesia, the experiment was begun when the blood pressure (BP), intrathoracic pressure (ITP), electrocardiogram (ECG) and electroencephalogram (EEG) became stable. At that stage, the animals were still unconscious and they did not react to the pain stimulation.

The BP, ITP, ECG and EEG were recorded by the same methods as those described in our previous papers [5, 6]. These recordings were preserved in a data recorder, and the ECG complexes were later analyzed in detail.

Results

The respiration and circulation of the experimental animals during the agonal period of death due to typical hanging were as follows. Just after the ligature of the trachea, arteries, veins and nerves, the dyspnoea stage consisted of large inspiratory movements with a slight expiratory component. The respiratory movements increased rapidly to the maximum after 1 or 2 respiratory movements were maintained for 1–1.5 min and ceased after a respiratory movement with prolonged inspiratory phase. The cessation of the respiratory movement (the initial apnoea) lasted for 0.5–1 min before the terminal respirations occurred. These consisted of a number of respiratory movements with sharp inspiratory character, which occurred sporadically lasted for about 2–3 min, and disappeared just before the circulatory breakdown (Fig. 1). In a few animals, the dyspnoea stage consisted of only 2 or 3 large respiratory movements with the prolonged inspiratory character (Fig. 2). The whole time of the course of respiration and circulation in typical hanging was 4–6 min.

The BP increased precipitously after ligature to the maximum of one and a half times the original level which maintained for about 1–1.5 min till the end of the dyspnoea stage and then decreased gradually. The circulatory breakdown occurred with the end of the terminal respirations. The heart rate increased after 2 or 3 respiratory movements and remained regular until circulatory breakdown (Figs. 1, 2).

The EEG disappeared approximately 1.5–2 min after ligature or a short time after the end of the dyspnoea stage. Convulsive waves appeared during the terminal respiration (Figs. 1, 2).

The analysis of the ECG complexes showed as follows. No distinguishable changes occurred during the dyspnoea stage. During the period of initial apnoea, ST segment elevation and tall upright T waves were seen. The voltage of T waves increased and reached approximately the same level as the R waves at the beginning of the stage of terminal respirations and then decreased gradually. However, the voltage of R waves did not decrease. The P waves did not disappear until the circulatory breakdown (Fig. 3).

Discussion

In the course of respiration during obstructive asphyxia in dogs, the dyspnoea stage immediately followed the occlusion of the trachea, and lasted for 2–3 min. Then

Fig. 1. A record obtained from the dog asphyxiated by a method simulating typical hanging. ECG, electrocardiogram; EEG, electroencephalogram; BP, blood pressure; ITP, intrathoracic pressure; arrow (↑); the starting point of the experiment

Fig. 2. The dyspnoea stage shows only 3 large respiratory movements with prolonged inspiratory character