THE EFFECT OF THE METHOD OF RESTORATION OF CARDIAC ACTIVITY ON THE SURVIVAL OF DOGS AFTER FATAL BLOOD LOSS COMPLICATED BY VENTRICULAR FIBRILLATION

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It is known that for restoration of cardiac activity after clinical death complicated by ventricular fibrillation, condensor discharges combines with propulsion of the blood in the arteries [3, 4, 6-8, 10, 12] may be successfully used. However, experimental data have shown that the majority of animals which have undergone five minutes of clinical death from hemorrhage complicated by ventricular fibrillation, subsequently die [3, 4]. This may be related to a delayed restoration of effective cardiac activity and, consequently, prolongation of hypoxia.

In the literature it is stated that after ventricular fibrillation caused by electrotrauma, the organism may be revived by a combination of electrical defibrillation and external cardiac massage, which in these circumstances can sustain effective blood circulation for a longer period of time [1, 2, 8, 11].

On the basis of these data it appeared expedient to study the possible use of external cardiac massage together with pumping of the blood into the arteries and defibrillation in case ventricular fibrillation set in at the time of fatal blood loss.

METHODS

The experiments were performed on 14 dogs weighing 11-17 kg each. Before the experiments all dogs were given pantopon (8 mg/kg) subcutaneously. Clinical death was induced by free letting of blood from the femoral artery for five min.

In one of the fourteen dogs ventricular fibrillation arose spontaneously after three minutes of clinical death. In the remaining dogs ventricular fibrillation was produced by electroshock. An alternating current (220 v) was introduced through the trunk of the animal via an oblique loop three minutes after the onset of clinical death.

To restore the vital functions of the organism we used an artificial respirator to pump air into the lungs and to pump the blood in 0.5-1 ml 0.1% epinephrine solution into the femoral artery, and external cardiac massage. The latter was performed by pressing on the anterior wall of the thoracic cage in the region of the lower third of the breastbone with the palm of the left hand which is covered by the palm of the right for strength. Pressure is exerted on the breastbone 40-60 times a minute. The massage proceeded for one minute together with forcing blood into the artery. Then defibrillation was performed with a discharging condensor (4000-5000v) through electrodes placed on each side of the thorax. If the fibrillation was not halted, external cardiac massage was resumed and after 20-40 seconds defibrillation was repeated.

To compare the effectiveness of using arterial pumping of blood and external cardiac massage to eliminate hypoxia during ventricular fibrillation we analyzed the data from 132 experiments on reviving dogs after clinical death caused by blood loss (from the archives of the laboratory of experimental physiology of the Academy of Medical Sciences, USSR). In these experiments we used pumping of blood and epinephrine into the arteries in combination with artificial respiration to restore heart action after five minutes of clinical death. In 21 dogs ventricular fibrillation was observed and was eliminated after intra-arterial pumping of blood with the aid of condensor discharges. If cardiac activity after the use of the condensor discharge was not restored, the arrangement was repeated until positive results were obtained.

Thus, all the material studied may be divided into three groups. The first group (basic) consists of 14 experiments in which clinical death from blood loss was complicated by ventricular fibrillation, and after re-establishment of cardiac activity external massage was used in combination with intra-arterial pumping of blood and defibrillation. The second group included 21 experiments in which after similar conditions of clinical death intra-arterial blood pumping and defibrillation were used for resuscitation but not external cardiac massage. The third group included 111 experiments in which clinical death from blood loss was not complicated by ventricular fibrillation and cardiac activity was restored by intra-arterial blood pumping.

RESULTS AND DISCUSSION

In all 14 dogs (Group I) in which we used external cardiac massage in addition to intra-arterial blood pumping, effective cardiac activity was restored in one or two minutes after the initiation of resuscitation. Four out of nine dogs survived in which the period of death lasted less than 16 min; five dogs in whom death lasted more than 16 min died.

In dogs of the second group, in which external massage was not used, intra-arterial transfusion and defibrillation as well led in all cases to restoration of the cardiac activity. However, in 2/3 of the animals this occurred later than two minutes from the start of resuscitation. Corresponding with the later restoration of cardiac activity and consequently, with the more prolonged hypoxia, the number of viable animals in this group was extremely small. Out of 15 dogs in which the duration of death was less than 16 min, one survived. All six dogs which underwent death for longer than 16 min died.

Thus, the use of external cardiac massage enables a larger number of animals to survive after five-minute clinical death complicated by ventricular fibrillation. This, evidently, may be explained by the decreased period of hypoxia in dogs in Group I as a consequence of more rapid restoration of cardiac activity and more effective circulation produced by the massage during the time from the initiation of resuscitation until the moment spontaneous cardiac activity returns. However only those dogs survived in which the period of clinical death did not exceed 16 min. With longer periods of clinical death all animals died. It is known that the viability of the organism after resuscitation post clinical death from blood loss is determined by the length of the preceding period of death [5].

In experiments of the third group, in which fibrillation did not occur and cardiac massage was not used, the survival of the animals after 10-26 min of clinical death was the same as in the experiments of Group I, when clinical death was complicated by ventricular fibrillation, and intra-arterial transfusion and defibrillation as well as external cardiac massage were used for restoring cardiac activity. When clinical death was greater than 16 min, the survival of the animals in Group III was essentially greater than in Group I: out of 41 dogs in the Group III nine survived, whereas in Group I only one survived out of five. Cardiac activity in dogs of Group III was restored earlier (after 30-40 seconds of resuscitation) than in dogs of Group I (after 1-2 minutes of resuscitation). Consequently, the period of ineffective cardiac activity in dogs in which clinical death was complicated by ventricular fibrillation and in the complex arrangement for restoring vital functions including cardiac massage was more prolonged than in dogs without fibrillation in which cardiac massage was not utilized.

In addition to the data evidencing the advantages of external cardiac massage in comparison to intra-arterial transfusion, there is evidence in the literature indicating that external massage ensures less adequate circulation than spontaneous cardiac activity [8].

These data suggest that while external cardiac massage is being carried out in the experimental animal hypoxia develops, rendering an unfavorable effect on the survival of dogs after clinical death complicated by fibrillation. Evidently this fact causes the lack of positive results in the use of external cardiac massage in cases where the length of the period of clinical death exceeds 16 min.

Thus, the experiments we have carried out show that the use of external cardiac massage in the resuscitation of dogs after five-minute clinical death from blood loss, complicated by ventricular fibrillation, produces an increase in animal survival.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
