CHANGES OF CONCENTRATION OF HEMOGLOBIN DURING ANESTHESIA IN MAN AND IN ANIMALS

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FOLLOWING a review of the literature in 1915 Casto (1) concluded that ether is a hazardous anesthetic agent "on account of the rapid reduction of hemoglobin during the first 20 minutes of etherization." Later Boycott and Jones (2) found that ether anesthesia caused an increase of the percentage of hemoglobin in the circulating blood of rabbits. Sodium amytal (3) and pentothal sodium (4) were found to produce a reduction of the corpuscular volume of the blood of dogs as shown by the hematocrit. By roentgenologic observation, Hausner, Essex and Mann (4) were able to prove that ether anesthesia caused a contraction of the spleen of the dog while pentothal sodium anesthesia caused a dilatation of the spleen. It was concluded that these changes of the concentration of the erythrocytes in the peripheral blood of the animals were largely due to the changes of the volume of the spleen.

The contrasting pharmacologic effects of the two drugs, ether and pentothal sodium, were considered as a partial explanation of the findings by Essex and one of us (Pender, 5) that experimental traumatic shock is produced in the dog by intestinal manipulation more rapidly under ether anesthesia than under pentothal sodium anesthesia. However, Harkins (6) has pointed out that in human beings the spleen is relatively smaller than in dogs and no such great variations of hemoconcentration due to splenic action are to be expected in clinical practice as are obtained in studies on dogs. It was then decided to compare the changes of concentration of hemoglobin brought about in the dog by these two anesthetic agents with the changes brought about in man under relatively similar circumstances.

METHODS

The determinations of hemoglobin were done with the Cenco-Sheard-Sanford photelometer. All pentothal sodium was given intravenously

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as a 2.5 per cent solution by the Lundy intermittent injection technic. Ether anesthesia was induced in the dogs in an ether chamber and maintained either by the open drop technic or by auto-inhalation (7). Ether anesthesia in man was induced with nitrous oxide and oxygen by means of the carbon dioxide absorption technic. Blood samples for all determinations of hemoglobin were taken from superficial veins before administration of the anesthetic was begun and fifteen minutes after the second plane of the third stage of anesthesia had been reached. The initial determination of hemoglobin in each case was designated arbitrarily as 100 per cent. The determination of hemoglobin made after the fifteen minutes of anesthesia was expressed in percentage of the initial determination.

RESULTS

The average decrease of concentration of hemoglobin after fifteen minutes of pentothal sodium anesthesia was practically the same in man and in animals (table 1). In five (22 per cent) of the studies on animals with pentothal sodium, the concentration of hemoglobin did not decrease and in two studies (9 per cent) a slight increase of concentration of hemoglobin occurred. In man, only three patients (20 per cent) failed to show a decrease and none showed an increase of concentration of hemoglobin under pentothal sodium.

TABLE 1

AVERAGE CONCENTRATIONS OF HEMOGLOBIN AFTER FIFTEEN MINUTES OF ETHER OR PENTOTHAL SODIUM ANESTHESIA

	Studies	Concentration of Hemoglobin *
	Ether	
Man	15	102.4 (96.2–114) †
Dog	15	112.1 (103–125)
	Pentothal Sodium	
Man	15	95.7 (81.3–100)
Dog	23	94.0 (87–109)

* Expressed in percentage of the initial concentration of hemoglobin determined in each case before the anesthetic agent was administered.

† Figures in parentheses represent the range of observations.

With ether, the average concentration of hemoglobin was increased definitely more in the animals than in man. In all the studies on animals there was an increase of concentration of hemoglobin after ether anesthesia. In man, ether failed to cause an increase of the concentration of hemoglobin in eight cases (53 per cent) and an actual decrease occurred in three cases (20 per cent).

COMMENT

The fact that twenty-five of the patients received preanesthetic medication with pentobarbital sodium, morphine and atropine and the other five patients received only atropine cannot be disregarded, since the dogs did not receive any preanesthetic medication. However, in the five cases in which patients received only atropine premedication followed by ether anesthesia, the concentration of hemoglobin failed to increase in one case and decreased in another case during etherization. Another fact of possible importance is that ether anesthesia was induced in man with nitrous oxide but in the animals only with air. Nitrous oxide alone should not produce any change of the number of erythrocytes or the concentration of hemoglobin (8) but it might possibly alter the reaction to ether.

CONCLUSIONS

Under the conditions of the study as described, the average concentration of hemoglobin was decreased to about an equal extent in man and in the dog by pentothal sodium anesthesia. The average concentration of hemoglobin was increased in both groups by ether anesthesia but to a greater extent in the animals than in man.

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