

Title : EFFECTS OF HEMODILUTION WITH AN ARTIFICIAL BLOOD (FLUOSOL-DA) AND HES ON TISSUE OXYGENATION

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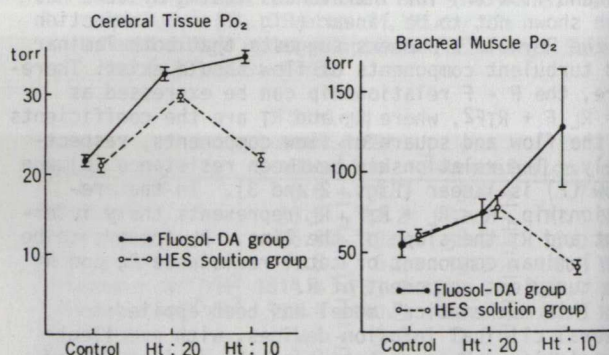
Introduction: Hemodilution has been frequently used in clinical situation for saving the banked blood and for decreasing the side effects of blood transfusion. However, the presently used diluting solutions possess little oxygen carrying capacity. Perfluorochemical has a high gas solubility and has been investigated as a substitute for red blood cell. The purpose of this study is to evaluate effects of perfluorochemical emulsion, Fluosol-DA (FDA), and hydroxyethylstarch (HES) on tissue oxygenation during normovolemic hemodilution in dogs.

Methods: Twelve adult mongrel dogs were divided into two groups of six, FDA and HES solution group. Anesthesia was induced with 25 mg/kg of pentobarbital sodium and pancronium bromide was administered as necessary to obtain muscle relaxation. The animals were ventilated mechanically with 100% oxygen throughout the experiment. Catheters were inserted through femoral arteries and veins for the measurement of pressures, cardiac output by the thermal dilution method, blood sampling and fluid administration. Two teflon membrane catheters, attached medical mass spectrometer, were inserted into cerebral tissue and brachial muscle to measure the tissue P_{O_2} and P_{CO_2} directly and continuously. When the steady state was accomplished, control measurement were made. After the control measurements, hemosangination from femoral artery and infusion of FDA or HES solution were started simultaneously. The volumes of infused solution and shed blood were the same. When the hematocrit (Hct) was reduced to 20% and to 10%, the second and third measurements were made.

Results: The infused volumes of FDA or HES solution and shed blood were the same and were about 50 ml/kg at Hct of 20%, and about 100 ml/kg at Hct of 10% in both groups. Hemoglobin concentration was reduced to about 6 g/dl at Hct of 20%, and about 3 g/dl at Hct of 10%. The reduction of red cell mass were comparable at each stage in two groups. Mean arterial pressure was slightly decreased during hemodilution and significant reduction from control level was shown at Hct of 10% in both groups. Cardiac output was significantly increased during hemodilution in both groups. Other hemodynamic parameters were not significantly different between two groups. P_{aO_2} was significantly elevated during hemodilution with FDA at each stage, while, with HES solution it was maintained at the control level. $P\bar{V}O_2$ in FDA group was significantly increased from 48 mmHg to 73 mmHg at Hct of 20%, and to 83 mmHg at Hct of 10%. In HES solution group, it was reduced significantly from the control level at Hct of 10%. P_{aCO_2} was not significantly changed from the control value, and they were no significant differences between two groups. P_{vCO_2} was not changed at Hct of 20%, and was increased at Hct of 10% in both groups.

Changes in cerebral tissue P_{O_2} in both groups were shown in Fig. 1. In FDA group, cerebral tissue P_{O_2} was increased from 21 mmHg to 33 mmHg at Hct of 20%, and continuously increased to 37 mmHg at Hct of 10%. In HES group, it was slightly increased at Hct of 20%, and then decreased to the control level at Hct of 10%. Fig. 2 showed the changes in brachial muscular tissue P_{O_2} . Brachial muscular tissue P_{O_2} was increased in proportion to severity of hemodilution with FDA. While in HES group, it was slightly increased during moderate hemodilution and then reduced below the control level during severe hemodilution. Cerebral tissue P_{CO_2} and brachial muscular tissue P_{CO_2} were not changed at Hct of 20%, and were slightly but significantly elevated at Hct of 10% in both groups. Those alterations of tissue P_{CO_2} were paralleled to the one of $P\bar{V}CO_2$.

Fig: Changes in cerebral and brachial muscular tissue P_{O_2} during moderate and severe hemodilution with Fluosol-DA or HES solution



Conclusion: Oxygen transport to cerebral and muscular tissue were compared during moderate and severe hemodilution with FDA and HES solution. The muscular tissue P_{O_2} during severe hemodilution (Hct 10%) with HES solution was lower than the control value. On the other hand cerebral and muscular tissue P_{O_2} values during severe hemodilution with FDA were significantly higher than the control values. These results suggest that FDA may be a better choice for hemodilution.