Title : INTRAOPERATIVE CHANGES IN HEMOGLOBIN OXYGEN AFFINITY IN PATIENTS UNDERGOING CORONARY ARTERY BYPASS.

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Introduction. We have examined whether patients with ischemic heart disease have changes in $P_{50}$ intraoperatively and postcardiopulmonary bypass. Some data suggest that anesthetic agents may alter the hemoglobin oxygen dissociation curve (1), and Halothane may cause conformational changes in the hemoglobin molecule (2). Others have demonstrated change in $P_{50}$ due to cardiac failure (3), anemia (4), and after cardiopulmonary bypass (5).

Methods. Informed consent and institutional approval for the study was obtained. In 15 patients randomly anesthetized with morphine (2mg/kg) or halothane (0.5 to 1.0% end tidal concentrations) we inserted coronary sinus catheters under fluroscopic control, thermodilution pulmonary artery catheters, and radial artery catheters before induction of anesthesia. We measured thermodilution coronary sinus flow, cardiac output, pulmonary and arterial pressures, and sampled arterial, mixed venous, and coronary sinus blood to measure blood gases, oxygen saturations, oxygen content, and lactates. From the blood gases and saturations we calculated $P_{50}$ (6) under standard conditions (pH 7.4, BE 0, 37°C) in mixed venous ($mvP_{50}$) and coronary sinus blood ($csP_{50}$) before induction, 10 minutes after intubation, 10 minutes after sternotomy, 10 minutes post bypass and 10 minutes post bypass with the chest closed.

Results. We divided patients into two groups on the basis of preanesthetic $mvP_{50}$. Those with $mvP_{50}$ greater than 29 torr had even greater $csP_{50}$ prebypass (mean difference 2.7 ± 2.9 torr). This difference between coronary sinus and mixed venous hemoglobin oxygen dissociation was not evident after cardiopulmonary bypass (mean difference 0.1 ± 3.2 torr). In the patient group with $mvP_{50}$'s less than 29 torr, $csP_{50}$ was not elevated. However induction of anesthesia increased $P_{50}$ in both mv (26.1 ± 2.0 torr to 30.3 ± 2.0 torr) and cs blood (26.8 ± 2.1 to 30.2 ± 2.3 torr) for this patient group. This elevation remained throughout the operation.

In the elevated $P_{50}$ group, $csP_{50}$ correlated with cs oxygen content ($r=-0.75$, $P<0.01$) and $mvP_{50}$ correlated significantly with two measures of cardiac performance, i.e. arteriovenous oxygen content difference, ($r=0.63$, $P<0.01$) and wedge pressure ($r=0.61$, $P<.05$). Hemoglobin concentration correlated significantly with $mvP_{50}$ ($r=-0.58$, $P<0.05$).

Discussion. Patients with cardiac failure evidenced by increased wedge pressure and widened arteriovenous oxygen content difference have increased $mvP_{50}$'s and even greater increased $csP_{50}$'s. We speculate that this increase aids peripheral tissue oxygen unloading when oxygen delivery is inadequate because of cardiac failure. Since $csP_{50}$'s are higher than $mvP_{50}$'s it is also tempting to speculate that the heart is a contributor to the elevated $mvP_{50}$. Cardiopulmonary bypass or the events associated with it remove the mechanism responsible for the elevation since $P_{50}$ returns to normal post bypass. Since ventricular function curves are depressed postbypass when compared to control measurements, it is unlikely that the increased $P_{50}$ is no longer required for tissue oxygen delivery.

The sustained increase in $P_{50}$ after induction in both morphine and halothane anesthetized patients suggest that anesthesia is beneficial for tissue oxygen unloading. Nitrous oxide was the only agent administered to both groups.

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