Henry Ford Hospital Medical Journal

Volume 14 | Number 2 Article 5

6-1966

Comparative Effects Of Dry And Humidified Gases On Blood During Extracorporeal Circulation

Henry R. Hug

Rodman E. Taber

Follow this and additional works at: https://scholarlycommons.henryford.com/hfhmedjournal

 Part of the Life Sciences Commons, Medical Specialties Commons, and the Public Health Commons

Recommended Citation

Hug, Henry R. and Taber, Rodman E. (1966) "Comparative Effects Of Dry And Humidified Gases On Blood During Extracorporeal Circulation," *Henry Ford Hospital Medical Bulletin* : Vol. 14 : No. 2 , 139-141.
Available at: https://scholarlycommons.henryford.com/hfhmedjournal/vol14/iss2/5

This Article is brought to you for free and open access by Henry Ford Health System Scholarly Commons. It has been accepted for inclusion in Henry Ford Hospital Medical Journal by an authorized editor of Henry Ford Health System Scholarly Commons.

Henry Ford Hosp. Med. Bull.
Vol. 14, June 1966

COMPARATIVE EFFECTS OF DRY AND HUMIDIFIED GASES ON BLOOD DURING EXTRACORPOREAL CIRCULATION

HENRY R. HUG, M.D. AND RODMAN E. TABER, M.D.*

Extracorporeal oxygenation of blood during open heart surgery can be accomplished by the use of discs, screens, membranes or bubbling columns. Nonhumidified and occasionally humidified oxygen is used in the various oxygenating systems. We have been unable to find studies comparing the effects of dry and humidified oxygen upon blood during extracorporeal circulation. We were particularly concerned about the possibility of red blood cell damage from exposure to very dry gas such as compressed oxygen (4% water vapor). In order to determine whether humidification is necessary, the following study was undertaken.

MATERIALS AND METHODS

A bubble oxygenator constructed of teflon-coated stainless steel was used throughout the experiments.[1] The apparatus was originally designed and fabricated at the Henry Ford Hospital where it has been extensively utilized for clinical extracorporeal perfusions. A hemodilution technique was followed with a mixture of 750 cc of fresh heparinized human blood and 400 cc of 5% dextrose in quarter-strength saline. Fresh heparinized human blood was circulated through the oxygenator in a closed loop with a Sigmamotor pump for a period of 60 minutes at a flow rate of one liter per minute. Oxygen was bubbled through the blood in the oxygenator at a flow rate of three liters per minute. In seven experiments the oxygen was dry, and in seven it was humidified with an Ohio Chemical Jet Humidifier (Model #2175950-800) containing distilled water. All experiments were conducted at room temperature. Plasma hemoglobin determinations (Hunter method) were used to evaluate hemolysis. Blood samples for plasma hemoglobin determinations were obtained after one minute (to allow mixing of the blood), 30 minutes and 60 minutes of circulation.

RESULTS

The plasma hemoglobin values for both series of experiments are summarized in Tables 1 and 2. The mean plasma hemoglobin values after one minute were 19 mg% for dry oxygen and 25 mg% for humidified oxygen. At 30 minutes, the values were 45 mg% and 70 mg%, respectively, and at 60 minutes, 81 mg% and

*Division of Thoracic Surgery.

Table I

Plasma hemoglobin values in blood after various periods of exposure to dry oxygen.

Experiment	Perfusion Time 1 Minute (mgm %)	30 Minutes (mgm %)	60 Minutes (mgm %)
1	3	28	60
2	64	100	160
3	16	56	88
4	40	80	140
5	1	5	22
6	4	28	63
7	3	15	31

105 mg%. The mean values for the seven experiments in each group are graphically represented in Figure 1. The results were subjected to statistical analysis* to determine whether use of either dry or humified oxygen resulted in a significant difference in red cell breakdown as measured by the plasma hemoglobin determinations. At the 95% confidence level, the difference was not significant ($p<0.05$).

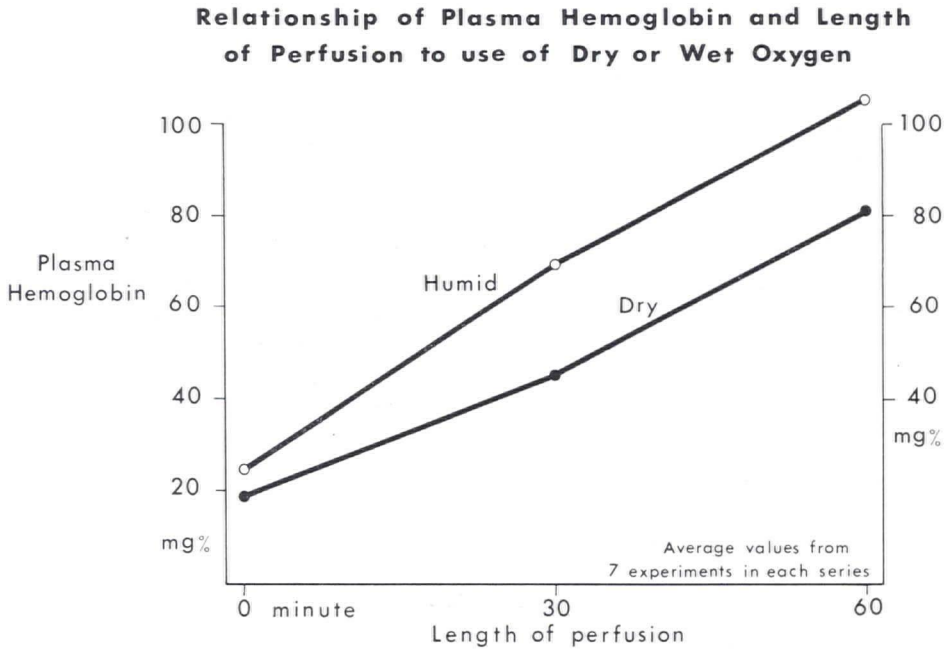

Figure 1

Mean plasma hemoglobin values after various periods of extracorporeal oxygenation with dry and humidified gas. The difference between the two methods was not statistically significant.

*With the assistance of Mr. Sik T. Wong, Division of Medical Computer Development, Henry Ford Hospital.

Table II

Plasma hemoglobin values in blood after various periods of exposure to humidified oxygen.

Experiment	Perfusion Time		
	1 Minute (mgm %)	30 Minutes (mgm %)	60 Minutes (mgm %)
1	20	60	100
2	24	140	228
3	36	88	128
4	54	83	101
5	16	26	35
6	6	44	84
7	18	46	60

Comment

The need for humidifying gases during inhalation therapy to prevent drying of the mucous membranes is a well-established principle. It might be predicted that blood exposed to dry gas at a liquid gas interface would be traumatized more by the desiccating effect of the gas than by a humidified gas. During some of the clinical perfusions at the Henry Ford Hospital, a humidifier was incorporated into the oxygen line but it created an increased resistance to the flow of gas which had a deleterious effect on the accuracy of the oxygen flow meter. Now that investigation of the use of humidified oxygen shows that it possesses no advantage over dry gas from the standpoint of red cell trauma, this additional apparatus has been eliminated from the already complex machinery of extracorporeal oxygenation.

Summary and Conclusions

1. This study was undertaken to compare the effect of dry and humidified oxygen on blood during extracorporeal oxygenation. Plasma-hemoglobin determinations were used to evaluate acute red cell damage as manifested by hemolysis.

2. No significant difference was found whether dry or humidified gas was used.

3. Nonhumidified oxygen is therefore desirable as it simplifies the extracorporeal perfusion apparatus by eliminating the humidifier.

REFERENCE

1. Taber, R. E. and Tomatis, L. A.: Operation of a bubble-type pump oxygenator, Surg. Clin. N. Amer. 39:1539-1551, Dec. 1959.