EFFECTS OF BREATHING 100% OXYGEN AT GROUND LEVEL ON BLOOD CLOTTING TIME AND PLATELET COUNT

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Abstract

Blood clotting time and platelet count were determined on a group of normal healthy individuals of ages 20 to 30, exposed to 100% oxygen at ground level. Results show shortening of blood coagulation time and reduction of blood platelet count. No such changes were observed in control subjects who were fitted with mask and helmet but breathing atmospheric air. Clotting time and platelet count returned to normal within a short time after oxygen breathing was discontinued. The results of these investigations conducted at ground level (680 mm of Hg) is not applicable to aircrew who breathe 100% oxygen at much lower pressure.

Introduction

Considerable work has been done by various investigators, on the toxic effects of breathing 100% oxygen on different systems of the body.[1,2,3,5,7,8] Ohlesson believes that 100% oxygen causes a disturbance in CO_2 carrying capacity of blood resulting in changes in *pH* of blood, which in turn leads to dilatation and exudation from pulmonary capillaries with consequent decrease in vital capacity. Other effects[6] of breathing 100% oxygen are fatigue, paresthesias in the hands, feet and joints, anorexia, nausea and vomiting, for which no explanations are given.

Exposure of human subjects for 148 hours to 418 mm. Hg. of oxygen tension has shown that there was a change in vital capacity, which returned to normal afterwards[10]. However, no significant change in routine haemotological studies like total R. B. C., W. B. C., haemoglobin, and haematocrit values have been shown. Breathing oxygen in increased concentrations when coupled with high 'G' forces resulted in temporary atelectasis, oedema, or both.[3] It is known that when breathing 100% oxygen at 760 mm. *Hg.*, the tissues that are exposed to high oxygen pressure are respiratory tract alveoli, tunica intima and endocardium of the left heart. All the other tissues are exposed to only 60 mm. *Hg.*[6] However, there is a significant physical change in the plasma viz, a rise in the oxygen tension of plasma many times the normal. Since coagulation is physico-chemical change, and most of the substances responsible for coagulation being present in plasma, it was thought that when there is significant change in physical environment, changes in coagulation also might occur, which prompted this investigation. As coagulation of blood is a very complicated and an illunderstood

process involving a number of factors, it is very difficult to exactly pin point the factor or factors that are changed when 100% oxygen is breathed. This is further complicated by the non-availability of a simple and accurate method of quantitative determination of clotting time of blood.

Method

Coagulation time was determined on 19 subjects of the age groups 20 to 30 by Sabrazes capillary method[11] using an A. H. T. coagulation tube, 1⅛ mm to 1½ mm O. D. Finger pricks were made by using an automatic blood lancet. Appearance of fibrin thread when the capillary tube was broken, was taken as the end point and the time was noted by a stop watch. Ambient temperatures were noted in all investigations. The method was standardised by doing coagulation time on the same subject a number of times, and the reliability of the method was assessed. All the investigations were done by the same investigator.

Subjects were fitted with flying helmets and tight fitting masks. 100% oxygen was delivered from a G I cylinder using an A 12 regulator set at 100% oxygen. Leak tests were conducted by occluding the inspiratory tube. The observer sat close to the subject to ensure that the subject breathed 100% oxygen throughout the experiment. At the end of one hour period before the mask was disconnected, coagulation time of blood was recorded again.

Blood platelet count was done by the Brecher Cronkite method[4] before and after 100% oxygen breathing. Counts were made using an ordinary microscope, and were also rechecked by another observer. All precautions suggested in the method were strictly adhered to.

Results

The clotting time of blood before and after breathing 100% oxygen for 19 subjects are tabulated in Table I. The mean clotting times before and after 100% oxygen breathing being 4.98 and 3.76 minutes respectively; the standard deviations of the two distributions are found to be 0.614 and 0.621 and the coefficient of variation based on the above values of mean and standard deviations are 12.3 and 16.5. The difference between the mean clotting times of the two distributions (1.22) is nearly 13 times the standard error of the difference (0.095).

Platelet count of blood carried out for 9 subjects before and after 100% oxygen breathing is given in Table II. The mean count in lakhs before and after 100% oxygen breathing are found to be 3.14 and 1.99 lakhs, the standard deviation being 0.64 and 0.47. The coefficients of variation are 20.4 and 23.7 respectively. When the 't' test is applied to test the significance, it is found that value of 't' for 8 d.f. is equal to 9.2 while its table value for 8 d.f. at 5% level of significance is 2.31. This shows that results are significant.

TABLE I

Clotting Time of Blood Before and After Breathing 100% Oxygen for 1 Hour

No.	Subjects	Before (Mts)	After (Mts)	Difference (Mts)
1.	S. M.	5.0	3.50	1.5
2.	J P.	5.0	3.33	1.67
3.	J. O.	5.0	4.0	1.0
4.	S. B. K.	4.75	3.75	1.0
5.	A. R. S. R.	4.75	4.0	0.75
6.	R. D.	4.0	2.50	1.5
7.	J. N.	4.75	3.75	1.0
8.	S. M. K.	5.25	3.0	2.25
9.	K. H.	5.0	4.0	1.0
10.	Y. B.	5.25	3.58	1.67
11.	D. H.	4.83	4.0	0.83
12.	V. H.	4.83	4.0	0.83
13.	G. O.	5.25	3.58	1.67
14.	K. N.	4.25	3.50	0.75
15.	K. S. N.	5.75	4.83	0.92
16.	N. N.	4.75	3.25	1.5
17.	V. H. S.	5.0	3.50	1.50
18.	C. S. N.	4.33	3.50	0.83
19.	A. Y.	6.83	5.33	1.5
Mean	—	4.98	3.76	1.22
S. d.	—	0.614	0.621	—
C. V.	—	12.3	16.5	—
	Standard error of difference			0.095

TABLE II

Platelet Count of Blood Before and After Breathing 100 % Oxygen For 1 Hour

No.	Subjects	Before (in lakhs)	After (in lakhs)	Difference (in lakhs)
1.	C. S. N.	3.89	2.07	1.82
2.	S. M.	3.50	2.46	1.04
3.	K. H.	2.84	2.06	0.78
4.	V. H.	2.78	1.83	0.95
5.	D: H.	3.62	2.18	1.44
6.	V. H. S.	3.66	2.67	0.99
7.	N. N.	2.68	1.86	0.82
8.	K. N.	3.39	1.79	1.60
9.	R. D.	1.87	1.00	0.87
Mean	—	3.14	1.99	1.15
S. d.	—	0 64	0.47	—
C. V.	—	20.4	23.7	—
	Standard error of difference			0.125

TABLE III

Clotting Time of Blood for Control Group before and after Breathing Air for 1 Hour

No.	Subjects	Before (Mts)	After (Mts)	Difference (Mts)
1.	K. H.	5.33	5.50	0.17
2.	J. P.	5.0	5.0	0
3.	G. O.	4.75	4.75	0
4.	C. S. N.	3.75	3.83	0.8
5.	V. H.	5.25	5 25	0
6.	K. N.	4.50	4.50	0
7.	S. M.	4.75	4.75	0
8.	A. R. S. R	4.25	4.50	0.25
9.	R. D.	5.25	5.25	0

Discussion

Shortening of coagulation time after breathing 100% oxygen may be explained on the basis of Ohlesson's theory [8] of disturbance in carbon dioxide carriage and resultant change in *pH* of blood.

Breathing 100% oxygen at atmospheric pressure causes a transport of 1.8 to 2cc of oxygen per 100 cc of blood as simple solution. This partly satisfies the metabolic needs of the body and consequently less oxygen is required from haemoglobin, thereby resulting in less reduction of haemoglobin. When breathing air, most of the carbon dioxide formed in the tissues is at first taken up by the reduced haemoglobin, and then converted to $KHCO_3$ and $NaHCO_3$ and thus *pH* of blood is maintained. When 100% oxygen is breathed, most of the haemoglobin remains in the oxygenated form, a condition unfavourable for bicarbonate shift. Carbon dioxide now will have to be carried as simple solution (H_2CO_3) thereby increasing the carbonic acid content of blood. It has been pointed out by Almroth E. Wright [12] that coagulation time is shortened by an increase in the carbonic acid content of blood. The shortening of clotting time noted in 100% oxygen breathing may be explained on this basis.

Pulmonary capillary damage resulting from 100% oxygen breathing might be responsible for increased destruction of platelets. Thus the thromboplastic and other platelet factors so formed might be an additional contributory factor for shortening of coagulation time.

Subjects for this study had taken part in other investigations involving breathing of 100% oxygen and hence the changes noticed in clotting of blood may not be attributed to the fear factor stimulating the sympatho adrenaline nor-adrenaline system. Few pilot studies conducted on subjects, fitted with mask and helmet and breathing air from an oxygen cylinder showed no such changes (Table III). This also eliminated the effects of posture and pressure of the mask on the face, and resistance encountered in breathing through a mask from cylinder.

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