A BOX MASK FOR ADMINISTRATION OF OXYGEN

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This mask is introduced primarily to reduce the wastage of oxygen which occurs with similar open methods and also to improve conditions as regards comfort for the patient. As it is an open method there is no isolation of the patient from his surroundings for prolonged periods, as occurs when tents are employed. In general the mask is just as efficient as the tent in providing the required pressure of oxygen; running expenses include only cost of oxygen. As there are no valves and the mask is freely open at its lower end to the air there is no resistance at all to breathing such as occurs when valves are included. The mask is very light, and although it may

be improvised from cardboard it is best made of thin aluminium. The aluminium mask may be obtained from Messrs. Siebe Gorman and Co., 187, Westminster Bridge Road.

Description

As used for the average adult, the box mask has, when in position, a gas capacity of about 1,000 c.cm. Its length is about 15 cm., its breadth 12 cm., and its depth 7 cm. For larger faces each of the dimensions may be increased 1 cm. and for smaller adult faces reduced by 1/2 cm. The long axis of the box lies in the long axis of the face (Fig. 1), while the plane of the breadth of the mask is parallel with the plane of the mouth. The plane of the depth of the mask is nearly at right angles to the plane of the face (Fig. 2). The back of the mask (Fig. 3) has a bottle-shaped opening to accommodate the nose, mouth, and chin; it is made airtight in this way by gentle pressure against the face, the mask being kept in position by tapes—attached to the mask by buckles on the sides—passing over the top of the ears. The bar below the chin is of no significance, and when removed allows wide opening of the mouth. As the mask is very light, only gentle pressure against the face

is required to keep it in position. The lower end of the box (12 cm. by 7 cm.) is entirely open to the air, while the top is completely closed except for the opening which admits the catheter. There must be no air space at all round the catheter where it enters the top of the mask; adhesive plaster will suffice to make this position airtight. The sides of the mask (15 cm. by 7 cm.) are closed. The front is also airtight, but there is a door in the lower half, which may be opened during meal times or administration of medicine (Fig. 1). Moisture from the lungs may condense on the inside surfaces of the mask; this is caught by a thin strip of lint fixed all round the lower edge of the mask by means of clips or small pieces of plaster. Small openings 1 cm. deep may be cut running parallel with and just above the lower ends of the sides and the lower end of the door. They serve as emergency openings if the lower end of the box comes into contact with the chest.

The complete arrangement is shown in Fig. 1. O_2 is the oxygen cylinder, with its standard automatic regulator (R); F is the bobbin flowmeter to measure the rate of oxygen flow; W is the water valve to moisten and, if necessary, warm the oxygen; to warm W it may be placed in a basin of warm water. At B there is a break in the diagram (Fig. 1), but this break does not exist in reality; it represents the light rubber tube leading from W to the catheter; it is an important piece of tubing, and must be fixed to the head of the bed above the patient, so that there is sufficient slack tubing to permit movement of the patient. Apart from the catheter all the tubing, both rubber and glass, is about three-quarters of a centimetre in diameter; the catheter itself is fixed to the opening at the top of the mask, so that any strain on the catheter will be transmitted to the mask and not to the end of the catheter, which lies either three inches in the nasal cavity or free outside and slightly above the level of the nose. When the catheter is in the nose there should be a sufficient length of it inside the mask to permit it to curve gently into the nose without pressure inside the nose. Three holes are made in the nasal end of the catheter; both No. 9 and No. 11 of the red rubber variety have been used with success. When the catheter is outside the nasal cavity its end must be directed up towards the top of the box, so that the oxygen impinges against the top wall; the catheter may be kept bent on itself by means of a ligature.

For the efficient working of the mask it must be airtight at its upper half. Of course at its open lower end a certain proportion of air is drawn up at each inspiration, and this mixes with the oxygen, of which there is a continual flow. When the catheter is outside the nose the rapid upward current of oxygen also sucks some air into the centre of the mask. There is a gentler flow of oxygen down the sides. We have tested three cardboard and three aluminium masks, and they all give very similar results. Sometimes aluminium mask No. 2 gave slightly lower results than the others; it has a greater capacity.

Results

Details of some of the results for alveolar CO_2 and O_2 with the box mask are given in Table I. With 4 litres of oxygen per minute and the catheter three inches inside the nasal cavity the alveolar oxygen pressure is about 40 per cent.; with 5, 6, and 7 litres a minute it is 50, 60, and 70 per cent. respectively. The figures are not altered by the position of the subject, being the same for both the sitting and the lying positions. With the catheter outside the nose, and about 5 to 6 litres a minute, the alveolar oxygen pressure is between 40 and 50 per cent.; with 8 litres per minute it is between 50 and 60 per cent. It must be emphasized that when the catheter is outside the nose its end must be turned up towards the top of the mask.

The subjects employed in these observations have a respiratory volume, when at rest, of 7 to 8 litres per minute. Alveolar air was taken with the oxygen flow stopped. The rate of flow was controlled by four different meters, two of which are standard water meters.

In Table II the results with the box mask are compared with those for other similar open methods^{1 2 3}—that is, with the patient not enclosed in a tent or using an apparatus with valves. It is obvious that even with the catheter outside the nose the box mask uses only half the amount of oxygen consumed by other methods. Of course tents can be run on 2 to 3 litres a minute and

TABLE I

Subject and Position	Rate of O ₂ flow, Litres per Min.	Alveolar Pressures % Atmosphere		Position of Catheter	Mask Used
		CO ₂	O ₂		
C. P., sitting ...	1.9	6.6	26.2	3 in. in nose	Cardboard, No. 1
	4.0	5.8	40.1		
	4.3	6.4	41.9		
" "	5.0	6.7	50.5	"	" "
	4.6	5.6	50.3		
	4.6	6.1	47.9		
" "	4.5	6.6	48.7	"	"
	5.0	6.5	53.0		
J. A. C., "	5.1	6.6	50.9	"	No. 2
	4.8	6.0	43.6		
C. P., "	5.0	6.1	53.6	"	No. 1
	5.7	6.1	56.7		
	6.0	6.1	56.6		
" "	5.7	5.9	57.5	"	Aluminium, No. 1
J. A. C., "	6.0	6.1	57.5	"	Cardboard, No. 2
	6.0	6.1	59.5		
" "	5.6	6.0	51.5	"	Aluminium, No. 2
	6.4	5.8	55.0		
	6.0	5.9	53.6		
" "	8.0	5.2	50.0	Outside nose	" "
	8.0	5.0	50.0		
C. P., "	7.0	6.9	73.1	3 in. in nose	Cardboard, No. 1
	6.5	6.6	72.0		
" "	5.0	6.5	48.9	Outside nose	" "
	6.0	6.0	43.2		
" "	6.6	6.5	47.8	"	" "
	8.0	6.5	52.0		
" "	8.0	6.3	54.0	"	" "
	8.0	6.3	60.3		
	8.0	6.4	54.5		
" lying down	5.5	6.7	62.7	3 in. in nose	" "
	5.9	6.3	66.8		
	6.0	6.2	67.4		
" "	6.3	6.8	44.9	Outside nose	" "
	6.0	7.0	44.2		

TABLE II

Method	Rate of O ₂ Flow, Litres per Min.	Alveolar O ₂ Pressure % Atmosphere
Catheter ² ...	7	34.5
Forked nasal tube ² ...	7	38-43
Double catheter ³ ...	8	39-42
" " ...	12	38-52
" " ...	16	52-63
Box mask (J. A. C.) (catheter inside nose) ...	4	40
" " " " " " ...	5	50
" " " " " " ...	6	60
" " " " " " ...	7	70
" " " outside " " ...	5-6	40-50
" " " " " " ...	7-8	50-60

maintain 60 per cent. alveolar oxygen pressure, but tents require also soda lime and special cooling mechanism and much more attention; also the patient is isolated when in the tent. The box mask thus appears to be superior to the other methods in all respects under ordinary circumstances; of course there may be cases more suitably treated in tents—for example, infants.

The carbon dioxide alveolar pressures shown in Table I are similar to those given by other methods, so that the box mask does not cause any undue accumulation of

carbon dioxide. This is to be expected with flows of oxygen at 4 or more litres per minute. There is a gentle flow of oxygen down the sides, and this has a cooling effect. With the catheter outside the nose this cooling effect is distinctly pleasant.

Similar results are obtained with the mask upside down—that is, with the open end at the top and the catheter directed downwards. This position is not so convenient.

At present observations are being made on children with a smaller box mask, and there is every reason to believe that it will be of value at least to older children.

Summary

A box mask is described which permits a great saving in consumption of oxygen and also gives less discomfort than other methods of administration. In actual practice no analysis of gas is necessary, the efficiency of the apparatus being controlled by a suitable flowmeter only. It is recommended to run the mask on 5 to 6 litres a minute, with the catheter or tube outside the nose and its end directed upwards. As with all other oxygen apparatus, no naked flames are allowed in its vicinity. Smoking is not permitted.

REFERENCES

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DECREASING MORTALITY AND ELIMINATING PHTHISIS IN MENTAL HOSPITALS

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The dual title of this paper is due to the two subjects being interdependent. In an effort to reduce the death rate phthisis was the first point of attack. It was soon found that the special measures taken to reduce phthisis had also a wider effect in lowering the general death rate.

The author of this paper, after twenty-six years' service in the medical branch of the Royal Navy, was appointed medical officer in sole care of the female side of a large mental hospital averaging 650 individuals. The Navy tends to make its medical officers statistically minded. The Blue Book *The Health of the Navy* issued to every officer is not only received but studied. The whole Service, from the director-general down to the most junior surgeon, is constantly working for the reduction, year by year, of the average daily sick list. Each medical officer of a ship strives to have the lowest sick list in his Division, announced from the flag-ship by signal on Sunday forenoon. So each Division competes to have the lowest sick list in the Fleet. A wider rivalry exists between the Fleets themselves on the various home and foreign stations.

It was strange on joining the mental service to find little evidence of such emulation. The anomaly could be seen of two mental hospitals not one hundred miles apart, and subserving similar sections of the community, in which the death rate of one was double that of the other. Apart from those under "group management," such as the London County Council, each mental hospital, good or indifferent, seemed to wear an air of isolated self-sufficiency. There is no sick list in the mental service; the tests of efficiency are the death rate and the recovery rate.

The very great advances made in recent years of treatment from the psychological side, and the limelight thrown on these methods, tend to obscure treatment purely physical. The two methods must go hand-in-hand.