THE ADMINISTRATION OF OXYGEN BY MEANS OF A DEVICE INSERTED IN THE NOSTRIL: A PRELIMINARY REPORT

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THE purpose of this study is to evaluate a device to be inserted into the nostril for administration of oyxgen. This appliance was designed at this hospital by Louis R. Krasno in 1945, and in the past six years it has been used in over 4000 cases. In our experience it is a valuable addition to oxygen therapy. It is especially useful for patients who require continuous oxygen therapy over a long period of time; in such cases extreme irritation or possible injury to the nasal mucosa becomes an important consideration.

As used in this hospital, the nostril device consists of a blank end of French number 14 latex rubber catheter of the type usually used for oropharyngeal insufflation, plus a cylindrical piece of sponge rubber of a size to fit snugly in the external nares (fig. 1). These devices may be cut conveniently in large numbers by means of a cork borer of suitable diameter or may be prepared with an ordinary bandage scissors. The device is pierced through the center with a hemostat, the end of the catheter is held in the jaws of the hemostat and then the device is easily passed over the catheter which is adjusted so that its end is flush with the outer surface of the device to be inserted in the nostril. Because of the constricting tendencies of the sponge rubber, care must be taken that the lumen of the catheter is not interfered with, which might result in an annoying whistling sound. After the device is inserted in the external nares, the catheter is taped to the bridge of the nose and the forehead in the usual manner.

The remainder of the equipment employed is that usually available for oxygen administration; it consists of a large tank of oxygen, a regulator and a humidifying device. The accuracy of the liter flow gauge used in this study was checked periodically by means of water displacement tests.

During the preliminary stages of this study, it was decided that a comparative expression of results would give a more accurate estimate of the value of the nostril device. Such a comparison would be of added

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importance since all of the patients were to have surgical procedures and, therefore, some respiratory depression might take place. However, in cases of abdominal operations and bronchoscopy this would not always apply. Consequently, a series of alveolar air samples at the rate of flow indicated was collected, first, using the nasal catheter and immediately afterward using the nostril device.

All air samples were drawn endobronchially using a method similar to that employed by Rovenstine (1). A leaded number 9 ureteral catheter was passed with the aid of a laryngoscope into a bronchus to

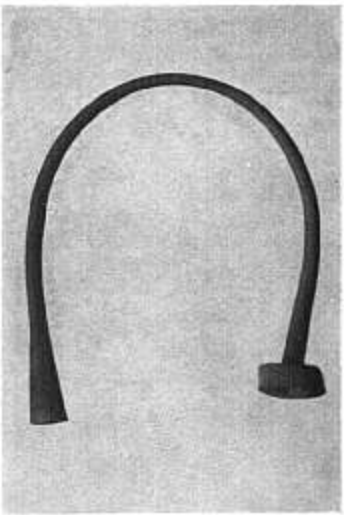

FIG. 1. Oxygen nostril insert consisting of a No. 14 French tubing and sponge rubber end.

a point about 6 cm. beyond the carina. The laryngoscope was withdrawn and the distal end of the catheter passed up through the nasopharynx and the external nares. This point of exit was found to be less disturbing than through the mouth.

Following insertion of the catheter, the patient was returned to bed and a roentgenogram of the thorax was taken to confirm the position of the catheter (fig. 2).

Usually, patients were able to tolerate the catheter for several hours, in one patient the catheter was left in place for five hours after operation without producing marked discomfort. As might be expected, some patients could not tolerate the catheter for more than several minutes, and the study was terminated abruptly when the patient coughed.

When the roentgenogram had been taken and patient was resting quietly, administration of oxygen by means of nasal catheter was begun. This catheter, French number 14, was inserted into the oropharynx to a point opposite the tip of the uvula and then fastened securely to the forehead. Oxygen was started at a rate of 5 liters per minute and allowed to flow for thirty minutes, at the end of which time a sample was

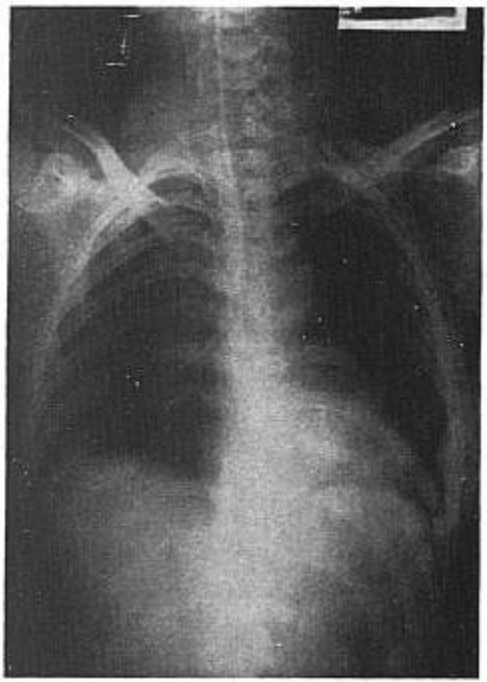

FIG. 2. Chest x-ray demonstrating bronchial catheter in place.

withdrawn. Thirty minutes was thought to be sufficient time to permit stabilization of alveolar gas tensions. Immediately after sampling, the flow rate was increased to 7 liters per minute, maintained at this rate for thirty minutes and another sample withdrawn. After a 9 liter sample was collected the catheter was removed, the nostril insert installed and the procedure repeated.

For further comparison, the recently introduced tracheal suction catheter is being used. This catheter, French number 20, has a double

lumen and is designed for use both for oxygen administration and for suction (fig. 3). It is placed in the trachea at the same time the ureteral catheter is passed into the bronchus. Studies made in the past with alveolar oxygen concentrations have shown that nasopharyngeal insufflation offers a lower concentration of oxygen than that obtainable through oropharyngeal insufflation. Tracheal insufflation, on the basis of anatomic considerations alone, should offer an even greater alveolar

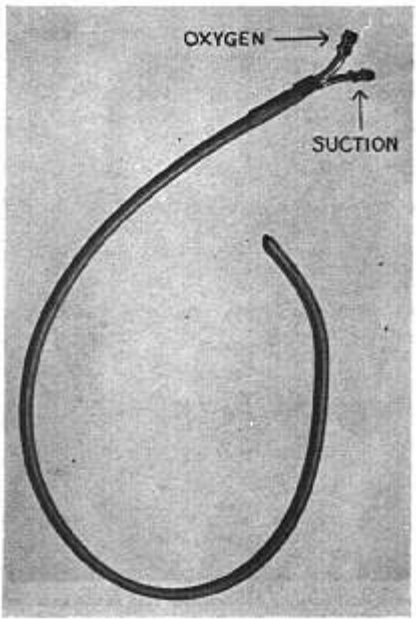

FIG. 3. Double lumen tracheal catheter for suction and oxygen administration.

concentration of oxygen. Figure 4 shows a tracheal catheter and a ureteral catheter in proper position.

The method of drawing samples was the same for all types of administration. To collect a sample, an airtight connection was established between the distal end of the ureteral catheter and the inlet of an evacuated gas sampling bulb. The stopcock of the bulb was opened near the end of each normal expiration and closed before the beginning of the next inspiration. This was done about three to six times or until the gas sampling bulb contained about 50 cc. of alveolar air at at-

mospheric pressure. The flow of oxygen was not interrupted during sampling.

All samples were analyzed for carbon dioxide and oxygen concentrations in the Van Slyke manometric gas apparatus, following the method of Van Slyke, Sendroy and Liu (2).

Table 1 shows the results obtained with the first series of subjects. Two points are immediately evident. First, alveolar oxygen concen-

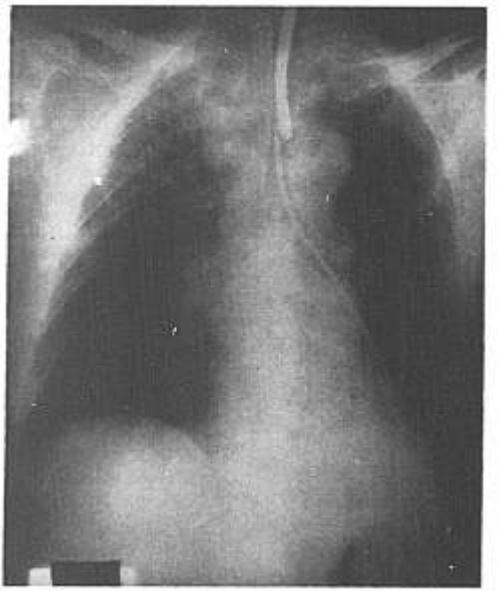

FIG. 4. Chest x-ray demonstrating endobronchial tube and endotracheal tube in place.

trations are higher when oxygen is administered by means of nasal catheter than by the nostril device, as was expected. Second, the figures under the columns titled "liters per minute" vary within fairly wide limits. Because of varying degrees of respiratory depression following operation this, also, was to be expected. However, since this was a comparative study, using the nasal catheter as standard, the result expressed as a percentage difference between the nostril device and the catheter method is thought to be valid. In the column titled "percentage difference" will be found the average amount by which alveolar oxygen concentrations obtained with the nasal catheter can be expected to exceed the alveolar oxygen concentrations obtained

with the nostril insert method. We have found this difference to be 6.34 per cent for the 5 liter oxygen flow, 6.67 per cent for the 7 liter flow and 5.20 per cent for the 9 liter flow.

In view of the fact that the nostril insert device represents an additional method for nasopharyngeal oxygen insufflation, its relative merits and those of the nasal catheter should be discussed.

TABLE 1

ALVEOLAR OXYGEN AND CARBON DIOXIDE CONCENTRATIONS IN VOLUMES PER CENT

Patient	Operation	Liters per Minute					
		5		7		9	
		O_2	CO	O_2	CO_2	O_2	CO_2
		Nasal Catheter					
D. M.	Pneumonectomy	45.11	5.67	52.01	5.81	59.92	5.57
F. I.	Pneumonectomy	45.70	5.02	52.08	5.08	58.18	4.30
N. R.	Thoracoplasty	32.90	3.87	38.52	3.82	43.29	3.97
E. H.	Pneumonectomy	37.96	4.73	47.75	4.59	49.35	3.52
A. B.	Chest exploration	56.80	7.42	69.62	7.21	76.45	6.78
E. G.	Excision of mediastinal cyst	45.80	5.23	58.21	5.39	64.43	4.83
		Nostril Insert					
D. M.	Pneumonectomy	37.79	4.37	41.31	5.25	46.90	3.33
F. I.	Pneumonectomy	43.68	6.16	46.46	6.09	53.62	5.76
N. R.	Thoracoplasty	30.54	4.88	32.21	4.71	40.64	4.80
E. H.	Pneumonectomy	33.62	3.95	38.74	4.98	43.99	4.87
A. B.	Chest exploration	49.15	6.91	63.16	7.17	75.14	7.17
E. G.	Excision of mediastinal cyst	30.46	4.96	55.95	5.43	60.02	5.56

	Percentage of Difference		
	5 Liters	7 Liters	9 Liters
D. M.	6.32	10.70	13.02
F. I.	2.02	5.62	4.56
N. R.	2.36	6.31	2.65
E. H.	4.34	9.01	5.36
A. B.	7.65	6.46	1.31
E. G.	15.34	2.26	4.41
Average percentage difference	6.34	6.67	5.20

The disadvantages of the nasal catheter are familiar to those acquainted with its clinical use. A tube such as the nasal catheter in the nasopharynx or oropharynx or both is uncomfortable and poorly tolerated, if at all, by some patients. Also, there is added discomfort from the withdrawal and insertion of catheters which must be changed frequently.

The advantages of the nostril device, on the other hand, are derived primarily from the ease with which it is tolerated for long periods of continuous administration, a possible alveolar oxygen tension which compares favorably with that when the nasal catheter is used, and simplified maintenance. In our experience patients seldom complain of discomfort caused by the nostril insert device. This is in part due to the fact that oxygen enters at the external nares which permits utilization of a larger part of the natural humidifying mechanism than is possible with the nasal catheter, and in part owing to the absence of excess stimulation to the hairs of the nasal passages.

The ease of maintaining the nostril insert method of oxygen administration makes it especially advantageous clinically. The large sponge rubber sheets from which insert devices are prepared are inexpensive and, as a result, they may be discarded after use. For greatest comfort we have found that a new device should be inserted once in each twelve hour period. However, no untoward complications will result should renewal be delayed for several hours or overlooked entirely.

The disadvantages of the nostril insert method are few and the difficulties presented sometimes are overcome by adjustment. The results in table 1 show that the nostril insert method of administration of oxygen offers a lower oxygen tension than is obtained with the nasal catheter. Since the two methods provide therapeutic alveolar oxygen concentrations, they would appear to be interchangeable in most instances of oxygen want. In cases in which higher oxygen concentrations are desired, the oxygen mask is the method of choice.

It is also true that a continuous stream of air flowing against the mucous membranes and turbinates may tend to irritate them. This difficulty usually is eliminated simply by shifting the insert from one nostril to the other, a task easily performed by the nurse or the patient when the necessity arises.

The most serious disadvantage of the nostril insert device is that nasal passages obstructed or occluded by mucus or deflected septa will not permit entry of oxygen. This difficulty can be dealt with by determining the patency of the nasal passages before the device is inserted into the nostril. Usually, nasal passages that will not permit oxygen therapy by means of the nostril insert device will not permit oxygen therapy by nasal catheter.

SUMMARY

On the basis of the results presented here, the use of the nostril insert device is justified as a means of conveying a therapeutic concentration of oxygen to those patients for whom oxygen therapy is indicated.

REFERENCES

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