

## ENDOTRACHEAL ANESTHESIA: THE RELATION OF NASO- TRACHEAL AND OROTRACHEAL INTUBATION TO RESPIRATORY MORBIDITY\*

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THE advantages of an endotracheal airway during anesthesia are such that during the past decade there has been a constant increase in its use. An extensive literature has grown up on the subject. Either the mouth or the nose may be chosen as the route by which the endotracheal tube is passed. The terms "orotracheal" and "nasotracheal" will be used in this paper to distinguish between these routes. There is considerable divergence of opinion as to the relative merits and demerits of these routes; but, whereas many opinions have been expressed on the subject, no statistics have as yet been published which compare the results of orotracheal with those of nasotracheal intubation.

There is one school of thought which feels that the disadvantages of nasal intubation are largely academic, and that they are outweighed by its practical advantages. (1) Some, indeed, go as far as to use the nasal route as a method of choice whenever possible. In their opinion, intubation by the "blind" technique (1) (2) is potentially less traumatic than any method involving laryngoscopy. The opinion is now generally held that laryngoscopy is essential to oral intubation. It can only be avoided by the acquisition of considerable skill in the management of one of the techniques of blind oral intubation as described by Kuhn (3), Boothby and Cotton (4), Troup (5), and Sykes (6). Thus the nasal route has the advantage of simplicity. Those workers who prefer the nasal route (1) (7) agree that, whereas it readily gives rise to minor complications, the incidence of these varies directly as the skill and experience of the intubator and the difficulty encountered in performing the intubation (8).

On the other hand, many anesthetists agree with Hewer (9) that though there are occasions when the nasal route is extremely useful, there are obvious theoretical objections to it. He cites Dawkins' (10) instance of postoperative pneumonia following nasal intubation where the organism found in the lungs was also present in the nasal mucosa. He also points out that intranasal adhesions from trauma are not unknown. Nevertheless, traumatic intubation by either route may provoke sequelae. Gentleness is the essence of success. If the argument

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suggesting transport of infection from the nose to the lower respiratory tract is sound, it should be possible to demonstrate statistically a higher incidence of the "major" complications such as bronchopneumonia and lung abscess following nasal intubation. Dawkins (10) in 1937, compared 1672 cases in which intubation had not been employed, with 863 cases, in all of which intubation had apparently been accomplished by the nasal route. His results showed a higher incidence both of respiratory complications and mortality in the intubated series, and he argued that nasal intubation was responsible for this increase.

TABLE I

## 8249 INHALATION ANESTHETIC ADMINISTRATIONS

(All the inhalation administrations at Wisconsin General Hospital in 1938 and 1939)

## A. BRAIN, THYROID AND ABDOMINAL SURGERY: 1856 CASES

	Intubated (35.2%)		Not Intubated (64.8%)	
	Cases	%	Cases	%
With Major Respiratory Morbidity.....	56	8.6	59	4.9
With Minor Respiratory Morbidity.....	98	15.0	165	13.7
With No Respiratory Morbidity.....	499	76.4	979	81.4
Totals.....	653	100.0	1203	100.0
Deaths in Those With Major Respiratory Morbidity....	24	3.7	22	1.8

## B. ALL OTHER SURGERY: 6393 CASES

	Intubated (10.8%)		Not Intubated (89.2%)	
	Cases	%	Cases	%
With Major Respiratory Morbidity.....	27	3.9	43	0.8
With Minor Respiratory Morbidity.....	40	5.8	155	2.7
With No Respiratory Morbidity.....	620	90.3	5508	96.5
Totals.....	687	100.0	5706	100.0
Deaths in Those With Major Respiratory Morbidity....	11	1.6	21	0.4

It is not the purpose of this paper to investigate in detail the entirely separate and wider problem of the relation of endotracheal anesthesia as a whole to postoperative respiratory morbidity. It has, however, been our opinion that intubation, per se, played a less important role in determining the incidence of respiratory complications than the type of operation and the condition of the patient. In order to demonstrate this point, the records of all the inhalation anesthetic administrations in the Wisconsin General Hospital during the years 1938 and 1939 have been analyzed separately. The results are shown in Table I. The incidence of respiratory morbidity and mortality

after interventions on the thyroid gland, in the abdomen, and on the brain is twice that occurring after all other types of operation, regardless of whether or not intubation was performed. These are the very cases in which endotracheal methods are most valuable, and are, therefore, more frequently used. Critics of intubation often fail to realize that the type of operation itself profoundly affects the incidence of respiratory sequelae. Moreover, intubation is often indicated for the relief of respiratory difficulties during the induction or maintenance of anesthesia. Under such circumstances, complications might be expected to occur, though intubation may actually reduce the frequency of respiratory sequelae by relieving the difficulties. Further discussion of the wider problem of the relation of intubation to the incidence of respiratory complications is outside the scope of this paper.

#### STATISTICAL COMPARISON OF ROUTES OF INTUBATION

The purpose of this survey is to determine what evidence can be produced to guide an anesthetist in his choice between the nasal and oral routes of intubation. The records of 2719 cases in which intubation had been performed have been analyzed by means of the Hollerith punch card system as described by Rovenstine (11). The oral and nasal routes were used with almost equal frequency. All intubations performed by members of the department of Anesthesia of the Wisconsin General Hospital during the years 1937, 1938 and 1939 are in-

TABLE II  
TOTAL INTUBATIONS 2719

	Nasotracheal (48.3%)		Orotracheal (51.7%)	
	Number	%	Number	%
Cases With Major Respiratory Complications Postoperatively.....	75	5.7	94	6.7
Cases With Minor Respiratory Complications Postoperatively.....	236	18.0	162	11.5
Cases With No Respiratory Complications Postoperatively.....	1001	76.3	1151	81.8
Totals.....	1312	100.0	1407	100.0
Deaths In Those With Major Respiratory Complications	27	2.06	35	2.49

*Major Respiratory Complications* include all types of pneumonia, lung abscess, empyema, partial or massive pulmonary collapse, pulmonary embolus, pleurisy, and major degrees of oxygen lack, obstruction or depression.

*Minor Respiratory Complications* include cough, tracheitis, bronchitis, laryngitis, pharyngitis, hiccough, and minor degrees of oxygen lack, obstruction or depression.

cluded; the remaining 660 cases were the work of one of us in the service of other hospitals during the years 1933 to 1939 inclusive.

The complications following nasal and oral intubations in the entire series have been compared (Table II). Nasal intubation was followed

by fewer major and more minor complications than oral intubation. The definition of "deaths" presents some difficulty. It is a common occurrence to find evidence at autopsy of a "major" respiratory complication apart from the precipitating cause of death. Often, indeed, such a condition is diagnosed before death, frequently in association with a purely surgical complication sufficient in itself to account for the death of the patient. It is impossible to determine the extent to which anesthesia contributed to the incidence of these complications. Therefore, in this paper, all who died having exhibited serious respiratory complications in the postoperative period are included under the heading of "deaths," whether or not these were the cause of death. The only exceptions to this rule are those few instances in which patients exhibited a major respiratory complication before operation, suffered no exacerbation of it directly attributable to the operation, and eventually succumbed to it.

It is essential to determine whether the preoperative condition of the patient's respiratory system had any influence upon the incidence of respiratory complications following intubation. For this purpose Table III was compiled. The cases have been divided into those with normal respiratory systems, those with minor, and those with major affections before operation. Among the normal subjects, nasal intubation was followed by a greater number of minor complications and a smaller number of major complications than was oral intubation. These findings in this large group outweighed those of the smaller groups with pre-existing disease when all were considered together in Table II, thus giving nasotracheal intubation an apparent advantage which it possesses only in individuals free of respiratory disease. The incidence of fatal complications was almost identical. The patients who exhibited any respiratory disease before operation showed a higher incidence of both major and minor complications after nasal intubation than those intubated by the oral route. Any pre-existing respiratory disease increases the incidence of postoperative complications, regardless of route of intubation. Section C of Table III includes the results of intrathoracic operations undertaken for the relief of the pre-existing condition. Therefore the complications shown are those associated with thoracic surgery as well as anesthesia.

In many cases in which endotracheal anesthesia is desirable, both the nasal and the oral route are equally available to the anesthetist. In making his choice between them, the anesthetist should consider the above factors, and not use any particular method as a matter of routine. In Table IV, a comparison is made of the results of 660 cases in which nasotracheal anesthesia by the blind technique was used wherever possible, with those of 2059 cases in which more discrimination was used, but in which oral intubation by direct vision was the method preferred by the majority of the workers.

When confronted with a difficult case or a poor risk patient, the

TABLE III

## A. PATIENTS WITHOUT PREOPERATIVE RESPIRATORY DISEASE: 1868 CASES

	Nasotracheal		Orotacheal	
	Number	%	Number	%
Cases With Major Respiratory Disease Postoperatively.	34	3.7	50	5.2
Cases With Minor Respiratory Disease Postoperatively.	134	14.7	108	11.3
Cases With No Respiratory Disease Postoperatively . . . .	741	81.6	801	83.5
Totals . . . . .	909	100.0	959	100.0
Deaths In Those With Major Respiratory Complications	12	1.32	13	1.36

## B. PATIENTS WITH MINOR RESPIRATORY DISEASE PREOPERATIVELY: 700 CASES

	Nasotracheal		Orotacheal	
	Number	%	Number	%
Cases With Major Respiratory Disease Postoperatively.	35	9.4	26	7.9
Cases With Minor Respiratory Disease Postoperatively.	97	26.2	44	13.4
Cases With No Respiratory Disease Postoperatively . . . .	239	64.4	259	78.7
Totals . . . . .	371	100.0	329	100.0
Deaths In Those With Major Respiratory Complications	14	3.77	12	3.65

## C. PATIENTS WITH MAJOR RESPIRATORY DISEASE PREOPERATIVELY: 151 CASES

	Nasotracheal		Orotacheal	
	Number	%	Number	%
Cases With Major Respiratory Complications Postoperatively . . . . .	6	18.7	18	15.1
Cases With Minor Respiratory Complications Postoperatively . . . . .	5	15.6	10	8.4
Cases With No Respiratory Complications Postoperatively . . . . .	21	65.7	91	76.5
Totals . . . . .	32	100.0	119	100.0
Deaths In Those With Major Respiratory Complications	1	3.12	10	8.40

*Major Preoperative Respiratory Disease* is similar to Major Postoperative Respiratory Disease, with the addition of pulmonary tuberculosis, bronchiectasis, and intrathoracic neoplasms.

*Minor Preoperative Respiratory Disease* is similar to Minor Postoperative Respiratory Disease, with the addition of rhinitis, emphysema, and oral sepsis.

No pre-existing respiratory disease was recorded postoperatively unless it became worse after anesthesia.

anesthetist will resort to the technique in which he is most experienced. It is not surprising, therefore, that major respiratory complications were commoner in the groups intubated by a favored method. This trend was more noticeable in the 660 cases where the nasotracheal route was used whenever possible (in 75.4 per cent.), than in the 2059 cases

where the orotracheal route was merely preferred (used in 60.4 per cent.). Insistent use of nasotracheal intubation was associated with an undue increase in minor sequelae, but this correlation was not evident when orotracheal intubation was employed by preference. The mortality rate was unaffected.

TABLE IV

## A. 660 INTUBATIONS IN WHICH THE NASAL ROUTE WAS USED WHEREVER POSSIBLE

	Nasotracheal (75.4%)		Orotracheal (24.6%)	
	Number	%	Number	%
Cases With Major Respiratory Complications Postoperatively.....	39	7.8	7	4.3
Cases With Minor Respiratory Complications Postoperatively.....	141	28.3	24	14.8
Cases With No Respiratory Complications Postoperatively.....	318	63.9	131	80.9
Totals.....	498	100.0	162	100.0
Deaths In Those With Major Respiratory Complications.....	9	1.80	3	1.86
	Blind technique 88.6% Direct vision 12.4%		Blind technique 12.0% Direct vision 88.0%	

## B. 2059 INTUBATIONS IN WHICH THE ORAL ROUTE WAS PREFERRED BY THE ANESTHETIST

	Nasotracheal (39.6)		Orotracheal (60.4%)	
	Number	%	Number	%
Cases With Major Respiratory Complications Postoperatively.....	36	4.4	87	6.9
Cases With Minor Respiratory Complications Postoperatively.....	95	11.7	138	11.1
Cases With No Respiratory Complications Postoperatively.....	683	83.9	1020	82.0
Totals.....	814	100.0	1245	100.0
Deaths In Those With Major Respiratory Complications.....	18	2.2	32	2.6
	Blind technique 37.2% Direct vision 62.8%		Blind technique 0.0% Direct vision 100.0%	

Since some workers feel that laryngoscopy is undesirable when it can be avoided, whereas others feel that it always should be employed (12), a further analysis of the nasotracheal intubations was made to compare the complications following intubation with and without direct vision of the glottis (Table V). More than 56 per cent. of the nasal intubations were done by the blind technique. Among these cases the

incidence of minor complications was greater but major complications were unaffected. Cough was by far the most frequent minor complication. Perhaps the more effective relaxation of the pharyngeal struc-

TABLE V

COMPARISON OF RESPIRATORY COMPLICATIONS FOLLOWING BLIND AND DIRECT VISION  
NASOTRACHEAL INTUBATION: 1312 CASES

A. NASOTRACHEAL INTUBATION—DIRECT VISION

566 Cases, or 44% of all nasotracheals

	Number	%
Cases Showing Major Complications . . . . .	32	5.7
Cases Showing Minor Complications . . . . .	72	12.7
Cases Without Respiratory Complications . . . . .	462	81.6
Deaths . . . . .	15	2.65

B. NASOTRACHEAL INTUBATION—BLIND

746 Cases, or 56% of all nasotracheals

	Number	%
Cases Showing Major Complications . . . . .	43	5.8
Cases Showing Minor Complications . . . . .	164	22.0
Cases Without Respiratory Complications . . . . .	539	72.2
Deaths . . . . .	12	1.6

tures necessary for visual intubation reduces the likelihood of trauma from insertion of the tube. Trauma may occur during laryngoscopy, but this factor did not seem to affect the incidence of respiratory complications.

### DISCUSSION

We feel that sufficient cases have been considered to limit the significance of uncontrollable variables. This series of 2719 cases includes the work of a number of persons possessing varying degrees of skill and experience, and varying views as to the indications for the use of either route. Other factors, such as the age and health of the patients, are decisive in determining complications. This series includes patients of all ages. We feel that it is established that certain operations are more conducive than others to respiratory morbidity, whether or not intubation was performed. It cannot be claimed, however, that intubation was entirely blameless, since the route of intubation did influence results where upper respiratory infection was present. On the other hand, it is a fact that many patients would not tolerate the conditions imposed by anesthesia and surgery were it not for the presence of the tube guaranteeing a free airway and a means of removing blood, pus, mucus, or vomitus from the lower respiratory tract.

It is obvious that even minor preoperative respiratory disease increased the incidence of morbidity after operation, but the increase was greater where the tube had been passed through the nose. Probably the theory of contamination of the lower tract by pathogens from the

nose and nasopharynx accounted for much of this increase. On the other hand, the flora of the normal upper air passages were apparently innocuous when artificially introduced into the lower tract. This does not mean that exogenous organisms on dirty tubes are harmless when carried into the lower respiratory tract on the tube.

There was a constantly greater incidence of minor respiratory disorders after nasotracheal intubation, compared to orotracheal, regardless of the basis of comparison. This may be partly ascribed to the greater likelihood of trauma in the delicate narrow nasal passages, and to the more frequent use of the blind technique in nasal intubation. This latter, of itself, seemed to increase the incidence of minor complications. In our opinion, the skill and gentleness with which any intubation is performed profoundly influences the occurrence of sequelae.

There are, of course, surgical and anesthetic considerations which make one method or another desirable, apart from the question of sequelae. For example, nasal intubation is desirable in operations in the mouth, so that the tube does not impede the surgeon. The oral route is preferable when the inflatable cuff of Guedel and Waters (13) is used.

#### CONCLUSIONS

From these analyses it would appear that:

1. The nature of the operative procedure and the preoperative condition of the patient were more important than the methods of anesthesia in determining postoperative respiratory morbidity.

2. Nasotracheal intubation showed a higher incidence of minor respiratory sequelae than orotracheal, especially when performed by the "blind" technique.

3. The incidence of major complications was not influenced by effecting direct vision of the glottis during intubation.

4. In patients with pre-existing respiratory disease, the incidence of both major and minor complications was higher after nasal than after oral intubation of the trachea. In the normal subject there was little difference between the two routes. Other things being equal, nasotracheal intubation should be avoided in the presence of respiratory disease, and where mechanical difficulty to intubation is anticipated.

5. When one route was used whenever possible, that preferred route appeared to disadvantage statistically, presumably because it was used in the worst risks, as a matter of choice.

6. Under no circumstances should any method be used as a "routine." The choice should be approached with an open mind, and each case should be judged individually on its merits.



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## COMING MEETING

The American Medical Association will hold its Scientific Assembly and Exhibit in Cleveland from June 2-6, 1941, inclusive. The new Section on Anesthesiology will consist of three half-day sessions. The Secretary of the Section has received many offers of papers; consequently, those who are interested in applying for a place on the program should not delay in writing to the Secretary. It is hoped that there will be as many exhibits on Anesthesiology as possible in the Scientific Exhibit. Application for space for exhibits should be sent to Dr. Thomas G. Hull, Director, Scientific Exhibit of the American Medical Association. The titles for papers for the Scientific Assembly should be submitted to Dr. John S. Lundy, Secretary of the Section on Anesthesiology, Rochester, Minnesota.

## COMING EXAMINATIONS

AMERICAN BOARD OF ANESTHESIOLOGY: *Oral*. Part II. Cleveland, Ohio, May 31-June 1, 1941. Final date for filing application is April 1, 1941. Sec., Dr. Paul M. Wood, 745 Fifth Ave., New York.