



Oxygen Therapy

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I. INTRODUCING

DR. RALPH M. WATERS,
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pital and Medical School, University of
Wisconsin, Madison, Wis.

Our guest today is a representative of that group for which Wisconsin is justly proud, the practical pharmacologist. As head of the Department of Anesthesia in the Division of Surgery, he has had an excellent opportunity to observe the effect of anesthetic drugs, oxygen, carbon dioxide, etc. on patients. The Wisconsin Hospital group has also made a distinct contribution to economical hospital practices through their investigations of the use of oxygen. During Dr. Waters' stay he will address the medical students this afternoon and attend a dinner this evening, to give his views on a good service in anesthesia. While here Dr. Waters is the personal guest of Dr. Ralph Knight, and it is through his courtesy and cooperation that this meeting has been arranged. It affords us great pleasure to present our distinguished guest, Dr. Waters.

II. SUBJECT

OROPHARYNGEAL OXYGEN INSUFFLIATION.

Abstract by Rudolph Koucky.

The following abstracts are taken from the contributions of Dr. Waters and his associates. As they cover some of the points in Dr. Waters' discussion they may be used for reference.

The value of oxygen therapy is generally well understood. Recent discussions in the literature concern greater facility of administration, economy, the approximate amount of oxygen to be given, the development of statistics to show the reliability of the different methods, etc.

The Clinical Aspects of Oxygen Want

Anesthetists have had an unusual opportunity to observe the signs and symptoms of oxygen insufficiency. During

their work, the facilities for increasing the oxygen content of the inspired air to any desired percentage is always at hand so that they have been able to observe the responses to oxygen administration.

The following list of signs and symptoms observed in moderate and extreme reductions of alveolar oxygen tension in various individuals undergoing surgical treatment may be applied to patients in the medical wards.

"Signs of Acute Extreme Oxygen Want

1. Pulse--slow, bounding, often arrhythmic or irregular.
2. Pupil dilated, fixed.
3. Respiration depressed or arrested.
4. Systolic pressure raised markedly until respiratory arrest.
5. Muscles convulsive.
6. Color cyanotic or ashen.

Signs and Symptoms of Moderate Oxygen Want

1. Mental disturbances, anxiety, restlessness, delirium.
2. Air hunger.
3. Precordial pain.
4. Vomiting or retching.
5. Muscle twitching, contraction of individual muscles or groups.
6. Pulse--increased rate; arrhythmia or irregularity in cardiacs.
7. Systolic pressure--often slight rise or fall.
8. Respiration: Any disturbance such as sighing, yawning, noisy, irregular or arrhythmic, periodic, prolonged expiratory phase, obstruction due to edema of tongue, spasm of larynx, etc.
9. Cyanosis: accompanies the signs of moderate oxygen want in less than 25% of cases."

Patients with complete oxygen saturation evidenced by pink color may still show one or more of the undesirable signs and symptoms of oxygen insufficiency. By increasing the oxygen concentration, these symptoms are eliminated. This clinical fact still needs physiological explanation. It is possible that more "available oxygen" in

solution in the blood plasma is delivered to the tissue cells.

Oxygen Inhalation Equipment

This equipment may be grouped as follows: oxygen chamber, oxygen tent, nasal and face mask and pharyngeal insufflation.

Oxygen chambers give an almost ideal physiological condition and are especially suitable for delirious patients and children but the expense of installation, the careful supervision that is necessary, and the fact that they are not portable are significant objections.

Oxygen tents are easily portable, economical and generally efficient but the initial expense is considerable and they require trained supervision constantly. In addition, they occasionally disturb patients.

Use of the mask is mostly for emergencies and short administration.

Pharyngeal insufflation has proven to be a very satisfactory procedure. It is one of the most economical, simple, efficient, and easily available of all methods. The initial cost of the equipment is negligible. It requires much less supervision. Comparative studies of efficiency will be given later.

Technique of Pharyngeal Insufflation

"The technique of using pharyngeal insufflation for oxygen therapy is important, although very simple. A rubber urethral catheter, 10 to 16 French, is perforated with 4 to 5 extra holes in the terminal half inch. These openings are made to prevent a constant stream of oxygen striking the mucosa of the pharynx in one spot and irritating the membrane or annoying the patient. The actual placing and fixing of the catheter is of the utmost importance and requires great care. The tip of the catheter must lie in the oral pharynx, since it has been shown that with the tip in the nasopharynx, the oxygen will flow in one nostril and out the other, or around the catheter rather than toward the glottis. With oxygen flowing, the catheter is

passed through the nares and slowly down the oral pharynx, until the patient finds that a bolus of oxygen is swallowed during deglutition. The patient quickly determines this point, and it is also very evident to the observer. The catheter is then withdrawn just short of this point. The proper distance in adults varies from $4\frac{1}{2}$ to $5\frac{1}{2}$ inches, and when viewed through the mouth, the tip of the catheter is about level with the tip of the uvula as it hangs during nasal breathing. By direct view through the mouth, one is enabled to be sure the tip of the catheter is properly placed. With the tip in place, the catheter is carefully fixed with adhesive to the patient's face to prevent it moving in the nostril or pharynx with consequent annoyance to the patient. It is marked where it passes the exterior nares in order to facilitate the proper placing of a fresh catheter in the other nostril after twelve hours. With the catheter properly placed and fixed, no sensation is experienced by the patient other than ease of breathing, nor does it interfere seriously with speech or swallowing. One disadvantage to the method at the present time is the type of catheters used. Ordinary urethral catheters do not always have a lumen of uniform size throughout and this may interfere with the amount of flow. A simple check is advisable. This is easily done by inverting a filled liter graduate in a basin of water and with the oxygen flow gauge set at a given rate, time the interval needed for the gas delivered from the catheter to displace the water."

To prevent possible drying of the mucous membrane, it is advisable to use some form of humidifier. The apparatus which was first used was made by Scanlan-Morris Company of Madison, Wisconsin, and is known as the Wisconsin Humidifier. (Another humidifier and water meter has been developed.)

Efficiency of Insufflation

"It has been shown by careful gas analysis that the efficiency of pharyngeal insufflation is not surpassed by either the chamber or the tent. The volume of oxygen used per minute is practically the same for any type of apparatus." In the

experiments of Dr. Waters and his associates, "gas analyses were made for oxygen by pharyngeal insufflation by means of nasal catheters after the method just described. With the oxygen rate of flow at $1\frac{1}{2}$ to 2 liters per minute, the concentration at inspiration was 23 to 27%; at 2 to 4 liters 34 to 36.7%; at 4 to 5 liters 40 to 50%; at 6 liters 45 to 70%; at 10 liters in excess of 70%." (Dr. Waters has new data based on analysis of bronchial samples of air which he will cite.) "In so far as the consumption of gas is concerned, these experiments show the favorable comparison of pharyngeal insufflation of oxygen with other methods. Various reports of gas consumption with oxygen chambers ordinarily show 7 to 8 liters per minute to maintain concentrations of 50 to 60%, while similarly in tents 5 to 6 liters of oxygen per minute are generally needed to maintain 60% concentrations, and with the face mask there is a like consumption of gas except when using a tight fitting mask in conjunction with carbon dioxide absorption by soda lime. The latter is limited in application."

In the above, mathematical calibration of the actual oxygen percentage have been done. Dr. Waters, however, feels that clinically the best estimate of the efficiency of oxygen administration is the pulse rate curve. He suggests the following procedures as the most reliable simple guide as to the benefit or lack of benefit of oxygen administration. When the therapy is first instituted as high a concentration as is mechanically available should be given. The pulse rate is recorded every 15 minutes and usually with these high concentrations the pulse rate will probably be reduced within the first few hours. If such effect is not secured and the operator is certain that the oxygen is being delivered at the glottis and there is no technical error, the attempt may as well be abandoned. If, however, a definite reduction has taken place, the oxygen flow is maintained at this rate until the maximum reduction of pulse rate has been obtained. The amount of oxygen concentration may then be reduced and when the slightest rise in pulse rate has occurred, the concentration should be increased again until the maximum effort is reestablished and maintained

at this point. When oxygen therapy no longer seems to be necessary, gradual reduction in the concentration should be carried out. Sudden interruption of oxygen therapy may give rise to a reaction not unlike that experienced by a person suddenly removed from sea level to a mountain peak. Normal individuals occasionally are greatly embarrassed by such a change. In some instances, extremely gradual reduction to normal atmospheric conditions are necessary.

Death from Oxygen

It is experimentally possible to produce death in animals by high concentration of oxygen. It has been found that an atmosphere of 80% or more of oxygen causes death in animals in from 2 to 5 days. The interesting observation that 20% oxygen plus 80% pure nitrogen is insufficient to maintain life has been made. Dr. Waters has considered a possibility that some of the rare gases might be necessary. Experiments with argon and helium so far have been unsuccessful.

III. CINEMA

OUTLINE OF CINEMA PRESENTATION OF THE TECHNIC OF OXYGEN THERAPY AS USED AT THE WISCONSIN GENERAL HOSPITAL, MADISON, WISCONSIN.

(Film prepared by Drs. Kent Tenney, Department of Pediatrics, University of Wisconsin, will be shown if it is available.)

1. Demonstrating the Administration of Oxygen by Oropharyngeal Catheter.
2. The Discussion will be divided into three sections:
 - I. Apparatus
 - II. Technic of placing the catheter.
 - III. Brief description of effect of oxygen on pulse rate.
3. Section I - Apparatus

Large supply tanks should be used as they obviate the necessity for frequent changes. They are easily

transported on the two wheel trucks shown.

4. The tanks may be equipped with pressure and flow gauges.
5. Some type of humidifier should be used whenever possible as it adds greatly to the patient's comfort. The simple apparatus shown here is very effective and has a flow gauge incorporated in it.
6. The catheter selected should be the smallest that will permit a free flow of oxygen. One that has been softened by frequent boiling is better than a new one.
7. Extra holes are burned through the tip of the catheter.
8. Section II
Technic of placing the catheter.
9. The catheter is placed along the floor of the nose into the oropharynx.
10. In order to show the correct position of the catheter we first show it being introduced in an anatomical specimen cut in sagittal section.
11. As most catheters have a natural "droop" in one direction which will facilitate its entrance into the pharynx, it is well to determine this by rotating it in the fingers just before inserting.
12. The catheter is now in the correct position.
13. For the sake of emphasis it will be partially withdrawn and re-introduced to the correct position.
14. If placed too deep--as shown here--oxygen will be swallowed.
15. If placed too shallow--as shown here--much oxygen will be lost and little benefit obtained.
16. When correctly placed the tip can often

--but not always--be seen between the uvula and the tonsillar pillar.

17. The approximate depth to which the catheter must be inserted may be marked by measuring from the tragus to the nares.
18. When all equipment is ready a freshly boiled catheter is marked and greased with vaseline. Light oils and jellies are not good as they soon leave the catheter dry and harsh.
19. With the oxygen flowing at the rate of about 6 liters per minute the catheter is now carefully introduced to the marked depth.
20. Unless the swallowing reflex is greatly diminished, the most accurate method of determining that the catheter has been correctly placed is to introduce it beyond the measured depth until the patient is seen to swallow a bolus of oxygen and then withdraw it just to the point where swallowing is no longer observed.
21. When the correct position has been found the catheter should be firmly fastened in position with adhesive. If it is allowed to move about in the nose and pharynx, much discomfort results.
22. The catheter should be removed and a clean one inserted in the opposite nostril at least once every 12 hours.
23. However, as some patients can not tolerate even temporary interruption of oxygen it is best to insert the clean tube before removing the old one.
24. Section III
Effect of oxygen on pulse rate.
25. No attempt is made here to discuss fully the indications for oxygen. However the effect on the pulse rate has been found to be the best single guide as to the effectiveness

of oxygen. The following post-operative chart illustrates these variations.

26. In discontinuing oxygen, great care must be used and here too the pulse rate acts as a reliable guide.

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Possible influence of rare gases on physiology.
Current Researches in Anesthesia and Analgesia, 13: 238-239, (Nov. to Dec.) 1934.
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Amer. Med. 28: 213-216, (May) 1933.

IV. SOUND MOVIES

Title: Contacts

Showing the method of spread in tuberculosis. Produced by the Hennepin County Tuberculosis Association and the Department of Visual Education of the University of Minnesota. The part of the doctor is played by Dean Malcolm S. MacLean. The cast is students in dramatics at the University of Minnesota, selected through an elimination contest. Other persons will be recognized - notably Dr. Mariette. The benediction is by Father O'Brien. The musical score is by Abe Pepinsky, of the University Symphony.

V. GOSSIP

Gracie Gardner and Gene Kasper were married November 24th with great pomp and ceremony. They are honeymooning in the East and will visit Gladys Benson and Cy Hansen at Rochester, New York, where Cy is head of the Department of Deep Therapy. Thus, does another successful University Hospital romance arrive safely at port.... Wally Ritchie is back from his honeymoon... Obstetrical Fellow John Hynes and Mrs. Hynes proudly present their new daughter born December 4th. The line forms to the right for special previews before the young lady makes her official bow to society. Congratulations from the staff.... Former information clerk, Harold Clausen, graduated from our Dental College with highest honors, did a year of graduate work at the Dental College and then formed a partnership with a practicing dentist in Marshall, Minnesota. The combination would delight the technocrats in every way. Needless to say, he is doing very well and is very appreciative of the opportunity he had to learn how to handle patients and study medical problems first-hand while working his way through school..... While in Chicago, the editor of this column saw Paul Fesler, Jack Sagel, Bob Strand, Margit Grytbak, Carolyn Hammond, George Berg. They did him the honor of coming down to the Chicago Medical Society Public Forum to listen to the "Story of Cancer." All wished to be remembered to their Minnesota friends. An afternoon spent at WBBM, the Columbia outlet in Chicago, revealed that Skippy, Carol, Socky, Myrt and Marge, Jack Armstrong, Norm Sher and Gracie Dunn, Milton Charles, and many others of the radio profession were very human and had many of the same problems that bothered the perpetrator of the Minnesota Public Health Association broadcast. Skippy acts just like he sounds, is 14 yrs. old, has a tutor and is a very nice little chap. Our special Christmas meeting next week will be the final Staff Meeting for 1934. We hope to make it of special interest to all and we hope that we will have a full attendance.

VI. NOTICE

The Pickett-Thomson Research Bulletin on the Common Cold is missing from the Medical Library. Anyone having this book, please return it to Dr. Dixon's office.