Manual of Critical Care Procedures

Edited by

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To my wife Diane;
Her extraordinary talent and effort made it all possible.

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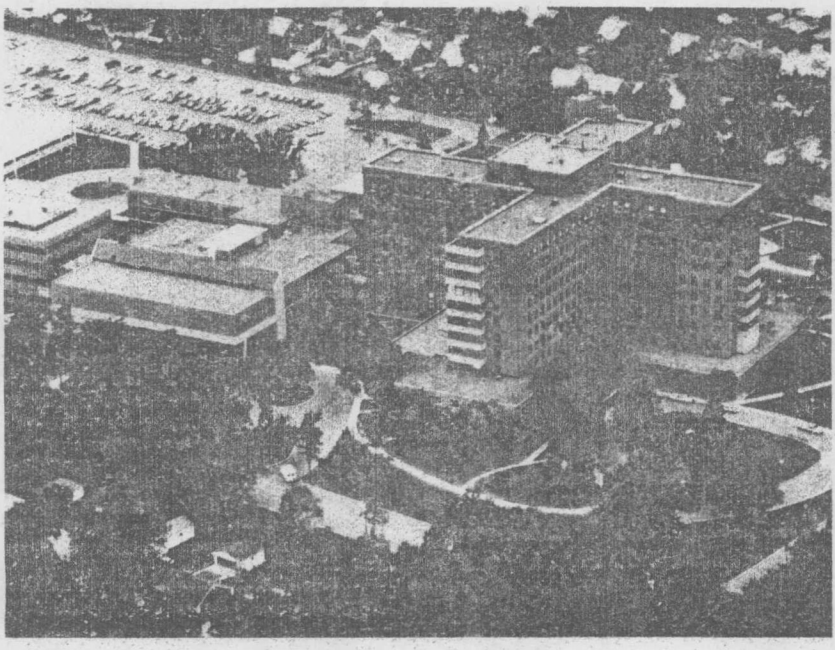

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Preface

Many surgical procedures are regularly performed in the critical care unit. General surgeons, thoracic surgeons, urologists, otolaryngologists, and anesthesiologists have played a role in the development of these techniques. However, most of the current practitioners of critical care medicine have internal medicine or pediatric backgrounds and therefore need more comprehensive training in procedures outside their fields of primary training, such as endotracheal intubation, chest tube insertion, cricothyroidotomy, and fiberoptic bronchoscopy.

Most of the available procedures manuals are directed toward emergency physicians, surgeons, or pulmonary specialists. This book addresses these audiences as well as critical care specialists. Extensive descriptions of the nonoperative procedures most frequently performed in the critical care unit—endotracheal intubation, Swan-Ganz catheterization, and chest tube insertion—are not available in a single reference.

The *Manual of Critical Care Procedures* proposes to fill this void by providing drawings, photographs, and explanations of the procedures needed in the practice of critical care medicine.

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Chapter 1

Endotracheal Intubation

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AIRWAY MANAGEMENT AND ENDOTRACHEAL INTUBATION

Proper airway management includes optimizing oxygenation, ensuring a patent airway through an oral airway or endotracheal intubation and insuring adequate ventilation. Airway management techniques are among the most important procedures performed by the critical care physician. These techniques have, for the most part, been developed by anesthesiologists for use in the operating room. The dramatic increase in the use of the mechanical ventilator since the 1950s has resulted in a large number of patients being intubated outside the operating suite. Intubation techniques used in the operating room under controlled conditions can differ from those used in the dyspneic, agitated patient so often seen by the critical care physician. The airway management techniques outlined in this chapter are particularly well suited to physicians caring for patients who are awake and in acute respiratory failure.

Airway Management: Maintaining Patency

An adequate airway is needed to transfer oxygen to the lungs and to control secretions adequately. Moribund, traumatized, or comatose patients may have a compromised upper airway because of obstruction by the tongue, blood, or vomitus. In a patient with acute respiratory insufficiency, life can be maintained for extended periods merely by using oxygen, an oral airway, and a self-inflating bag and mask for ventilation. Using suction and placing the head in the proper position are the first steps in maintaining an adequate airway. Proper head positioning aligns the posterior pharynx, larynx, and trachea in the straightest possible position (see Figures 1-1A through 1-1C); this allows for a bulk flow of gas with the least possible resistance. With the head ideally positioned, a nasal or oral airway can be placed that will keep the tongue and soft tissues from obstructing the upper airway.

Nasal Airways

Usually made of rubber or plastic, nasal airways may be inserted into either nares. If necessary for patient comfort, a solution of phenylephrine (Neo-Synephrine) may be used to dilate the nasal passages, followed by topical anesthesia with lidocaine (Xylocaine) or tetracaine (Cetacaine). Viscous lidocaine can be placed on the airway prior to insertion, but this technique can cause the patient more discomfort because the lidocaine has little time to act as the airway is sliding into position. The airway selected should be as

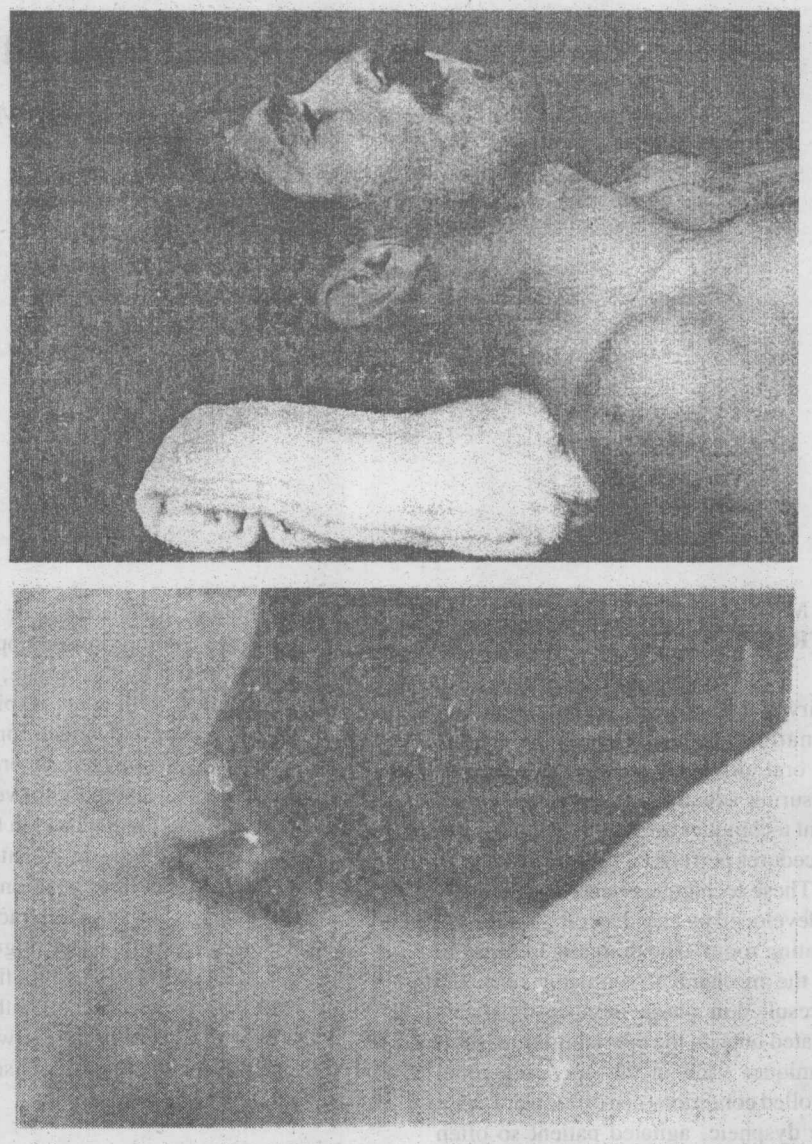

Figure 1-1A Proper Position of Head, Neck, and Thorax, Allowing for a Relatively Straight Alignment of Pharynx, Larynx, and Trachea

large as can comfortably be inserted in the nasal passage (Figure 1-2); it should not be so long as to stimulate the posterior pharynx and cause coughing or gagging. Most large adults require a size 8 mm and smaller adults need a size 6 mm. Nasopharyngeal airways are useful to help suction patients because they provide the suction catheter a "straight shot" as it passes down the posterior pharynx through the laryngeal structures. Their disadvantages include the discomfort involved in placing them and the difficulty in getting a large enough suction catheter through a narrow, bending airway. Complications include nasal trauma, gagging, and retching.

Figure 1-1B Head and Neck Are Extended Too Far, Aligning Posterior Pharynx Too Inferior to the Larynx, Resulting in an "Uphill" Intubation

Oral Airway

Usually made of firm plastic (Figure 1-3), oral airways are placed in the mouth after first depressing the tongue. Place the end upright while inserting it in the mouth and then turn it upside down so that the curve follows the natural curve of the tongue. Then tape the oral airway into position. Oral airways are less comfortable for patients as they cause more gagging. In addition, if they are improperly placed, they may cause upper airway obstruction by pushing the tongue posteriorly. Properly positioned oral airways are particularly useful when bagging a patient since they generally position the tongue more anteriorly, allowing for a more patent airway.

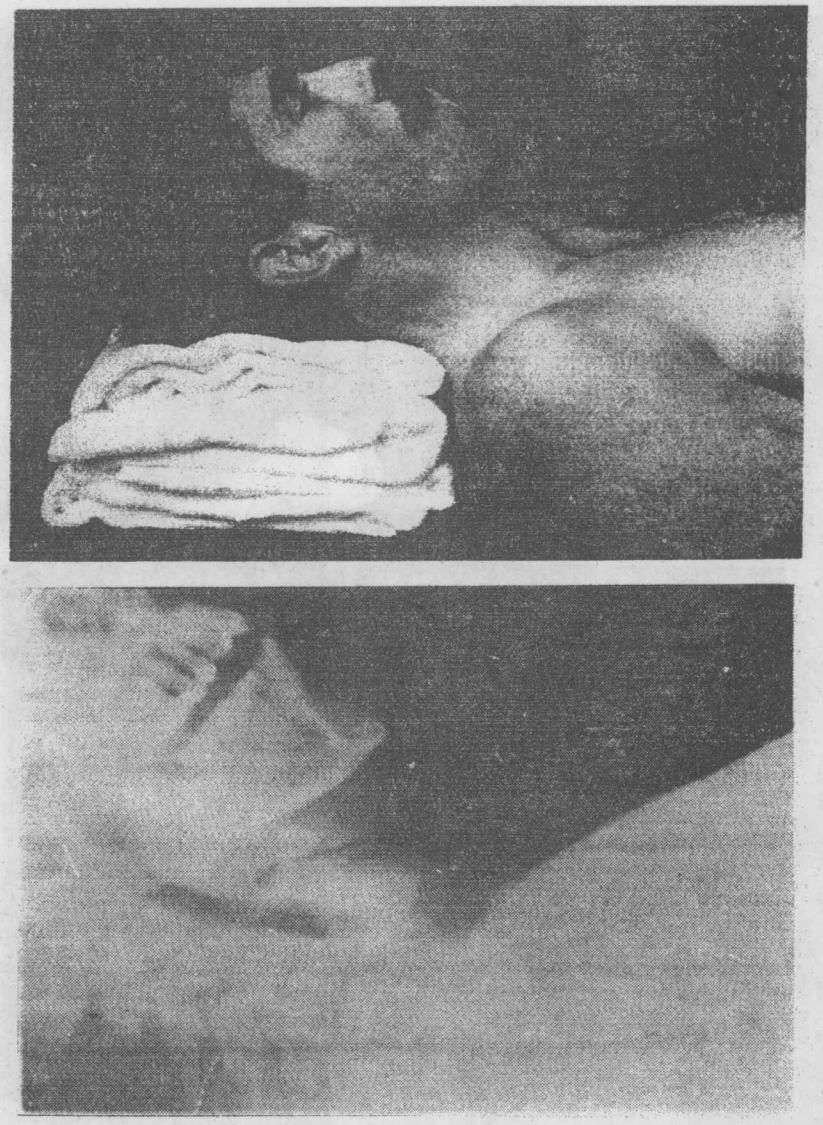

Figure 1-1C Head Flexed Too Far, Causing Obtuse Angle for Trying to View the Larynx

Endotracheal Intubation

More than a hundred years ago William Macewen[1] first demonstrated the possibility of endotracheal intubation during anesthesia in a human. After a rigid tube was digitally placed into the larynx of a young male, general anesthesia was administered and a pharyngeal epithelioma removed. In later years endotracheal intubation blossomed in the operating suite. Not until the Scandinavian polio epidemic of the 1950s, however, was the routine use of intubation for long-term ventilatory support established.[2]

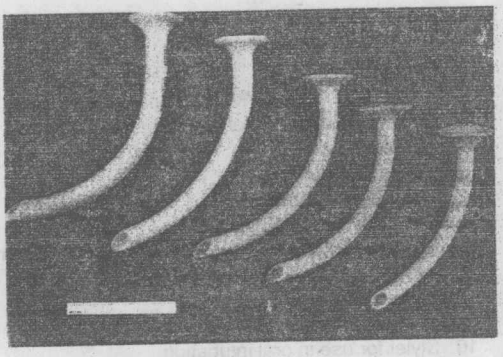

Figure 1-2 Nasopharyngeal Airways of Various Sizes

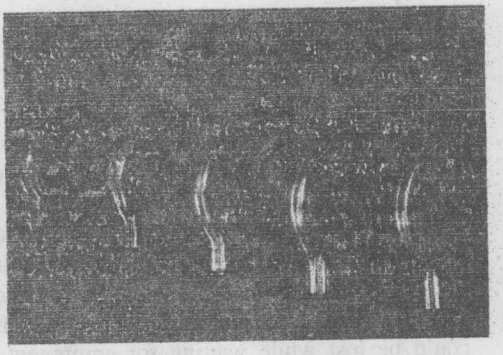

Figure 1-3 Oral Airways of Various Sizes

INDICATIONS FOR INTUBATION

Four main indications for intubation exist: airway maintenance, secretion control, oxygenation, and ventilation.

Airway Maintenance

Disorders that might cause compromise of the airway require intubation; the poorly responsive patient with an impaired cough, gag, or swallowing mechanism may require an endotracheal tube. Upper airway obstruction from epiglottiditis or tumor or from a functional obstruction, such as sleep apnea, may require the airway control provided by endotracheal intubation.

Secretion Control

The inability to expectorate pooled secretions from the tracheobronchial tree can cause atelectasis and resultant ventilation perfusion abnormalities and hypoxemia; the secretions can also act as a good culture medium for microorganisms. Intubation may be required for any patient with a condition that diminishes the ability to deep breathe and cough, such as obtundation, coma, and neurologic deficit as may be seen in multiple sclerosis, Guillain-Barré syndrome, and stroke. Another cause of poor secretion control is severe obstructive airway disease, which can flatten the diaphragm, thereby diminishing the patient's ability to breathe deeply and cough.

Oxygenation

It is virtually impossible to administer 100% oxygen consistently by cannula or mask because of the entrainment of ambient air. Tightly fitting anesthesia masks may be used to give 100% oxygen for short periods, but they are uncomfortable and interfere with eating; they may also increase the risk of aspiration in the poorly responsive patient. If the patient is unable to maintain a PO_2 (partial pressure of oxygen) of 70 mm Hg or greater on a 100% mask with reservoir bag, then intubation may be necessary. A cuffed endotracheal tube effectively isolates the trachea and lungs to a source of 100% oxygen. In addition, positive end-expiratory pressure (PEEP) or continuous positive airway pressure (CPAP) can be effectively administered.

Ventilation

Patients requiring ventilation may have acute respiratory acidosis or respiratory fatigue. Ventilatory support is most effectively administered via a cuffed endotracheal tube.

TECHNIQUES OF ENDOTRACHEAL INTUBATION

Successful intubation of the trachea starts with proper preparation. Having adequate equipment and positioning the patient properly are most important.

The ready availability of proper equipment is imperative for safe and successful intubation. Spending a few moments gathering all the necessary equipment will save precious time that could be lost while waiting for equipment to arrive during a difficult intubation. It is wise to carry all requisite equipment in your black bag, because uncommonly used equipment, such as a Siker blade or flexible laryngoscope, often are not readily available. A complete list of the necessary equipment is shown in Table 1-1. (See Figures 1-4 and 1-5.)

Table 1-1 Equipment for Endotracheal Intubation

1. Oxygen source
2. Resuscitation bag (PMR or Hope) and mask
3. Suction equipment: flexible catheters and rigid Yankaur
4. Stable, flat surface
5. Small pillow or towel
6. Oral airways of various sizes
7. Endotracheal tubes in at least two sizes: 7.5-mm and 8.0-mm may be used in most adult patients
8. Water-soluble lubricant
9. 10-ml or 20-ml syringe to inflate cuff
10. Stylet for use in oral intubation
11. A functioning laryngoscope with both straight (Miller) and curved (MacIntosh) blades
12. Magill forceps
13. Topical anesthesia
14. Vasoconstrictor for nasal intubation
15. Sedatives and muscle relaxants
16. Tape or other means of securing tube
17. Tincture of benzoin

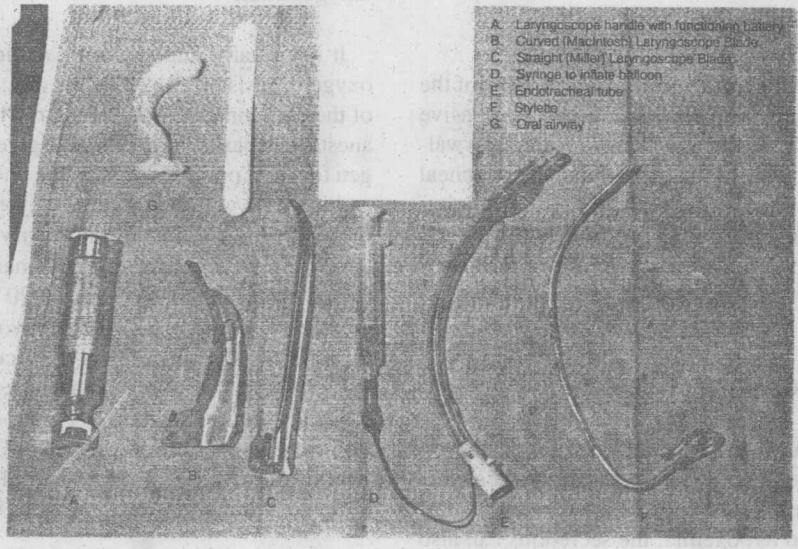

Figure 1-4 Basic Equipment Necessary for Endotracheal Intubation
A. Laryngoscope Handle with Working Battery
B. Curved (MacIntosh) Laryngoscope Blade
C. Straight (Miller) Laryngoscope Blade
D. Syringe to Inflate Balloon
E. Endotracheal Tube
F. Stylet
G. Oral Airway