Autoclavable Macintosh Laryngoscope with High-intensity Fiberoptic Illumination for Routine Anesthetic Use

J. J. Lewis, M.B., B.S.*

The conventional 3-v battery-operated laryngoscope, commonly used for endotracheal intubation, is far from ideal because of: 1) low-intensity illumination associated with the 3-volt battery system; 2) an annoying tendency for the light to flicker or go out completely as a result of marginal electrical contacts; 3) weak batteries; 4) defective bulbs. Most battery-powered laryngoscopes are not easy to sterilize quickly during daily use; most are merely washed and wiped with an antibacterial agent, at best.

Other surgical and medical endoscopes have been converted from low-voltage illumination systems (e.g., cystoscopes, esophagoscopes, bronchoscopes) to high-intensity illumination by the use of fiberoptic adaptation of the existing endoscope. With this end in view, the author has worked in collaboration with a design engineer in the development and testing of a suitable fiberoptic endoscope for routine anesthetic use and endotracheal intubation—autoclavability, reliability and intensity of illumination were all criteria to be met in the design of such an instrument. The Macintosh blade, which is the type most commonly used for laryngoscopy by anesthesia personnel, was used as the model most worthy of adaptation.

INSTRUMENT CONSTRUCTION

Figure 1 shows the design of the new instrument. The projection on the base of the handle forms the male connector to a standard fiberoptic light cord, which in turn is connected to any standard light box. From the point of attachment the light is transmitted along the encased fiberoptic bundle (diameter 0.125 inch) to emerge as light rays at the conventional place on the blade of the laryngoscope. As this is a transmitted beam of light, it emerges as a cold light of high intensity (depending on the type of line-voltage light box employed). The handle and blade containing the fiberoptic conductive system form a rigid, welded unit, there being no necessity for a hinge.

This instrument appears to be completely autoclavable. To date the fiberoptic laryngoscope has been autoclaved more than 500 times without measurable effect on its light-conductive capacity or obvious signs of other deterioration. The ends of the light bundles, when exposed to moist heat at high pressure, appear to be unaffected by repeated sterilization at 270°F, 30 pounds pressure for 3 to 15 minutes—the usual American Sterilizer Operating Room unit being employed.

The fiberoptic cord should not ordinarily come into contact with the patient’s mouth, and therefore does not require sterilization after each use. However, it should be noted

* Attending Anesthesiologist, Doctors Hospital, East End Avenue at 87th Street, New York, New York 10028. Accepted for publication May 10, 1975.
† Mr. Paul Binner, Vicon Products Corp., Pelham Manor, New York.
TABLE 1. Light Intensities of Battery-operated and Fiberoptic Laryngoscopes*

<table>
<thead>
<tr>
<th></th>
<th>Battery-operated Laryngoscope</th>
<th>Fiberoptic Laryngoscope (DNF Bulb)</th>
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</thead>
<tbody>
<tr>
<td>Number of instruments tested</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Range of light intensities (ft. candles)</td>
<td>10-70</td>
<td>300-475</td>
</tr>
<tr>
<td>Mean light intensity (ft. candles)</td>
<td>40</td>
<td>387</td>
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</tbody>
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* Light intensities were measured at the tip of the #3 laryngoscope blade by G.E. #213 light meter.

That these flexible cords are made of different materials and are not usually able to withstand repeated autoclave sterilization, so they must be "soaked" or "gassed." We have found the most suitable cord that allows maximum mobility to be a thin-coiled lightweight one (outside diameter 0.150 inch) approximately 9 feet long (fig. 1), as this comfortably reaches from a light box placed at the 5-foot level on top of the anesthesia machine to the patient's mouth area at the head of the operating table. Other light cords have been employed satisfactorily; however, the heavier cords naturally tend to restrict handle mobility slightly.

PERFORMANCE

The light intensity of the new instrument has been measured and compared with that of a random selection of conventional battery-type Macintosh #3 laryngoscopes, using a General Electric #213 light meter. In all, 11 battery laryngoscopes and five prototype fiberoptic instruments were tested. Results appear as table 1 (values for the battery-operated laryngoscopes were obtained within 2 minutes of switching on the light, as after this period light intensities tended to diminish rapidly to the region of two thirds the initial reading).

The mean fiberoptic light intensity is seen to be nine to ten times that of the battery-powered unit.

The intensity of the light is important, but even more so is the almost absolute reliability of the illumination. In more than three hundred intubations the light did not flicker or go out once!

CLINICAL EXPERIENCE

The author has used a fiberoptic laryngoscope of this type for the past 36 months in his daily anesthesia practice, employing the instrument at least once or twice daily for routine intubation. The intensity of the light enables the tube to be placed with maximal accuracy. Illumination usually extends all the way down the trachea to the carina, and it is easy to ascertain that the tip of the endotracheal tube is positioned exactly in the middle of the trachea at the time of placement. Anatomic or pathologic abnormalities of the larynx or trachea are more obvious prior to intubation. After each use the laryngoscope may be "flash"-autoclaved in readiness for the next intubation.

The author thanks Martin J. Clyman, M.D., for technical assistance and the use of his personal fiberoptic equipment in the development of this unit.

This laryngoscope may soon be available commercially. Information regarding its availability may be obtained from Vicon Products Corp., Pelham Manor, New York.