Clinical Evaluation of a New Anesthetic Mask

HAROLD WEISMAN, M.D.;* ROBERT O. BAUER, M.D.;†
ROBERT A. HUDKY, B.S.;¶ JOHN B. DILLON, M.D.;§

The ideal anesthetic mask, in addition to affording a good fit, should support the chin, exert minimal pressure on the face, and allow the anesthesiologist to observe the mouth for emesis or secretions.

A new mask ‡ which meets these criteria which can be autoclaved, has a long shelf life, molds readily to the contours of the face and is non-irritating. It has a built-in chin support, and its low profile considerably reduces the usual mask deadspace.

This study was designed to evaluate this mask during clinical use.

METHOD

The mask (fig. 1), which accepts standard 22-mm mask connectors, was used in 48 surgical procedures in adult patients selected at random. It was used throughout the surgical procedure or prior to endotracheal intubation. In these patients anesthesia was induced with a thiobarburate, intravenously, and was maintained with halothane, nitrous oxide and oxygen. Respiration was unassisted for a 20-minute period prior to blood sampling. Anesthesia concentrations presented to the patient were kept constant. Blood gas values with mask, endotracheal tube, and spontaneous respiration in the recovery room were determined in each of ten patients and compared.

Blood samples were drawn in 5-ml plastic syringes. Syringe deadspace was filled with 1 per cent heparin. The syringes were capped and sealed with a mercury-filled, permanently-occluded needle hub and the blood sample thoroughly mixed. Analyses were performed immediately in the operating room anesthesia laboratory. pH was estimated using a capillary glass electrode half cell together with a calomel reference half cell (Instrument Laboratories Inc., Cambridge, Massachusetts). This pH electrode was adjusted against U. S. Bureau of Standard reference standards, pH 0.840 and 7.364. $\mathrm{P_aCO_2}$ was estimated using the Severinghaus electrode. $\mathrm{P_aO_2}$ was also measured with a modification of the Clark electrode. Oxygen saturation of hemoglobin $\mathrm{SO}_2$ in the same sample was estimated spectrophotometrically using a modification of the Gordy and Drabkin method as adapted by special instrumentation.¶ In all patients respiratory rate, heart rate, and systolic and diastolic blood pressures were recorded at five-minute intervals.

RESULTS

The mask fit in most patients was good to excellent. In some edentulous patients, it was fair to poor. This was easily remedied by packing the patient’s cheeks with saline-moistened gauze sponges. In most patients the added chin support obviated the need for an oral airway and made it unnecessary to support the mask and chin. The anesthetist was able to have his hands as free as with an endo-
Fig. 1. Sierra Contoured Mask. Left: interior of the mask. Note the soft conformant lip which molds to the facial contours and effects a tight seal. The lower lip, which supports the chin, is also textured to conform to facial anatomic differences. Right: mask applied to the face.

The mouth was easily observed through the transparent mask and excessive pressure on the skin could readily be seen and alleviated. Cleansing of the mask after use was facilitated by its transparency, which made soiled areas obvious rather than difficult to see as with the conventional black rubber mask.

Results of analyses of blood gases obtained from ten patients during use of the mask and endotracheal anesthesia and at the end of anesthesia are summarized in table 1.

**Table 1. Mean Values of Duplicate Samples of Arterial Blood from Ten Patients Anesthetized by Mask and by Endotracheal Tube**

<table>
<thead>
<tr>
<th>Anesthesia Airway Technique</th>
<th>pH</th>
<th>PaO2</th>
<th>PaCO2</th>
<th>Hb</th>
<th>Hematocrit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mask</td>
<td>7.332 (0.006)</td>
<td>48 (12)</td>
<td>162 (58)</td>
<td>95.9 (0.8)</td>
<td>38.5 (5.8)</td>
</tr>
<tr>
<td></td>
<td>7.319 (0.091)</td>
<td>49 (9)</td>
<td>151 (55)</td>
<td>94.9 (1.0)</td>
<td>43.1 (13.1)</td>
</tr>
<tr>
<td>Endotracheal tube</td>
<td>7.337 (0.032)</td>
<td>46 (7)</td>
<td>131 (39)</td>
<td>95.6 (0.4)</td>
<td>40.3 (4.9)</td>
</tr>
<tr>
<td></td>
<td>7.340 (0.048)</td>
<td>46 (7)</td>
<td>132 (92)</td>
<td>95.2 (0.4)</td>
<td>40.9 (5.4)</td>
</tr>
<tr>
<td>Recovery room with oxygen*</td>
<td>7.350 (0.037)</td>
<td>46 (7)</td>
<td>160 (59)</td>
<td>96.6 (0.3)</td>
<td>41.1 (4.3)</td>
</tr>
<tr>
<td></td>
<td>7.395 (0.067)</td>
<td>46 (9)</td>
<td>176 (69)</td>
<td>97.3 (0.1)</td>
<td>38.1 (3.5)</td>
</tr>
<tr>
<td>Room air</td>
<td>7.354 (0.058)</td>
<td>41 (4)</td>
<td>84 (10)</td>
<td>93.1 (0.6)</td>
<td>40.6 (4.6)</td>
</tr>
<tr>
<td></td>
<td>7.377 (0.054)</td>
<td>42 (3)</td>
<td>86 (5)</td>
<td>93.2 (0.4)</td>
<td>39.2 (4.3)</td>
</tr>
</tbody>
</table>

Values in ( ) are ± one standard deviation.

* = oxygen was administered to patients in recovery room by a nonrebreathing valved mask with an oxygen gas accumulator bag.
DISCUSSION

Blood gas values during use of the mask and the endotracheal technique were clearly equivalent, indicating comparably effective ventilation. The objection that might be offered that anesthetic concentrations varied between airway techniques, which altered ventilation and, subsequently, blood gas values, and favored the mask technique, is not valid, since they were kept constant for all techniques.

Although the mask is not constructed of a conductive material and is not recommended for use with explosive or flammable agents, this should be of little consequence since use of nonexplosive anesthetics is so common. The mask could be made conductive at increased cost, but the advantages of its transparency and nonirritating effects on the skin would be lost.

REFERENCES


CASE REPORTS

An Anesthetic Accident: Cardiovascular Collapse from Liquid Halothane Delivery

CHARLES J. KOPRIVA, M.D.,* AND EDWARD LOWENSTEIN, M.D.†

Profound hypotension and cardiovascular collapse occurred suddenly at the time of skin closure during and otherwise uneventful anesthetic course. During resuscitation, the odor of halothane in heavy concentration was noted in spite of no flow through the halothane vaporizer. Review of these events revealed a previously unreported hazard in the Vernitrol® vaporizer.

CASE REPORT

A 50-year-old white woman tolerated without incident two hours of halothane-oxygen endotracheal anesthesia for a thoracotomy. The anesthetic was turned off in anticipation of completion of skin closure, but the patient began to move earlier than anticipated. The halothane flowmeter valve was turned on approximately one-quarter turn, but the rotameter bobbin was not seen. The flowmeter control was turned an additional quarter turn, and it was then noted that the bobbin was at the extreme top of the flowmeter. The halothane was turned off and the system flushed with oxygen. At this time, no pulse or heart beat was detectable. The incision was reopened and the heart found to be beating ineffectively. Manual cardiac massage and intravenous ephedrine resulted in a spontaneous arterial blood pressure of 70/40 mm Hg, which rose progressively to normal levels after about ten minutes. During this time, the smell of halothane vapor was present in spite of frequent emptying of the rebreathing bag and high oxygen flow rates.

Inspection of the anesthetic machine after the incident revealed that the flowmeter bobbin moved the entire range of the halothane flowmeter (1,000 ml) when the control knob was turned a quarter turn. When the control knob was turned further, liquid halothane flowed briskly from the delivery tubing. Examination of the flowmeter needle valve assembly revealed a damaged needle seat, which was responsible for the extreme sensitivity of the flowmeter control.

* Research Fellow in Anaesthesia, Harvard Medical School, Clinical and Research Fellow in Anaesthesia, Massachusetts General Hospital, Boston, Massachusetts 02114.
† Associate in Anaesthesia, Harvard Medical School, Associate Anesthetist, Massachusetts General Hospital, Boston, Massachusetts 02114.
Supported in part by Public Health Service Research Grants GM 14738-02 and GM 1273-05.