Airway Obstructed by Foreign Material: The Heimlich Maneuver

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To investigate the application of a cough-creating thrust for the removal of airway-obstructing foreign material, the thrust was applied to six adult male anesthetized volunteers at the waist, at the low chest level, and at the midchest level, with the subjects in both the horizontal-lateral and the sitting positions. Air volume, peak air flow rate, and airway measurements were made. Both the low chest and midchest thrusts produced significantly better results than did the abdominal thrust. There were no side effects attributable to the thrusts. The ease of application and consistently better level of results indicate that the chest thrust is the technique of choice. The application of the chest thrust should be integrated into the concepts of basic life-support and cardiopulmonary resuscitation.

Guildner CW, Williams D, Subitch T: Airway obstructed by foreign material: the Heimlich maneuver. *JACEP* **5**:675-677, September 1976. *airway, obstructed; Heimlich maneuver; cardiopulmonary resuscitation; life-support.*

INTRODUCTION

The Heimlich maneuver, described by Henry Heimlich, MD, in the June, 1974 issue of *Emergency Medicine*, has received wide attention in the news media as a means to relieve airway obstruction caused by choking on a piece of meat or other foreign material. The maneuver is performed by positioning yourself behind the victim and encircling his waist with your arms. The thumb side of your fist is placed against the patient's abdomen just above the navel and below the rib cage. The fist is grasped with your other hand and pressed into the patient's abdomen with a quick upward thrust. The procedure may be repeated.

METHOD

Six adult male volunteers, having given written, detailed, informed consent, were anesthetized with methohexital, intravenously, plus halothane, nitrous oxide, oxygen and succinyl choline prior to intubation. The succinyl choline was administered in a slow intravenous drip thus avoiding fasciculations.

An 8.5 mm sterile, plastic, low pressure-cuffed endotracheal tube was placed using direct laryngoscopy. The cuff was inflated sufficiently to prevent air leak during positive pressure ventilation. Succinyl choline was discontinued, spontaneous ventilation returned, and anesthesia maintained with 0.5% to 1% halothane.

During each application of the thrust, total airflow and peak flow rate were measured in each subject. Airway pressure curve recordings measured at the endotracheal tube were made with four of the subjects.

Total volume and peak flow rate were measured simultaneously with a Monghan M403 pulmonary function analyzer. A one-way valve was incorporated into the system so that only expired flows were measured. The analyzer was calibrated in line with a Collins 13.5 liter water spirometer before the studies were done.

Airway pressure measurements were made with an IR-4 Electronics for Medicine pressure recorder and an Altech MS10 pressure transducer. The equipment was calibrated prior to each thrust. A permanent printout was obtained for each recording (Figure). The transducer was inserted in the endotracheal tube so that it totally occluded the orifice.

The subjects were hyperventilated to the point of controlled respirations, so that no spontaneous respiratory effort would be recorded,

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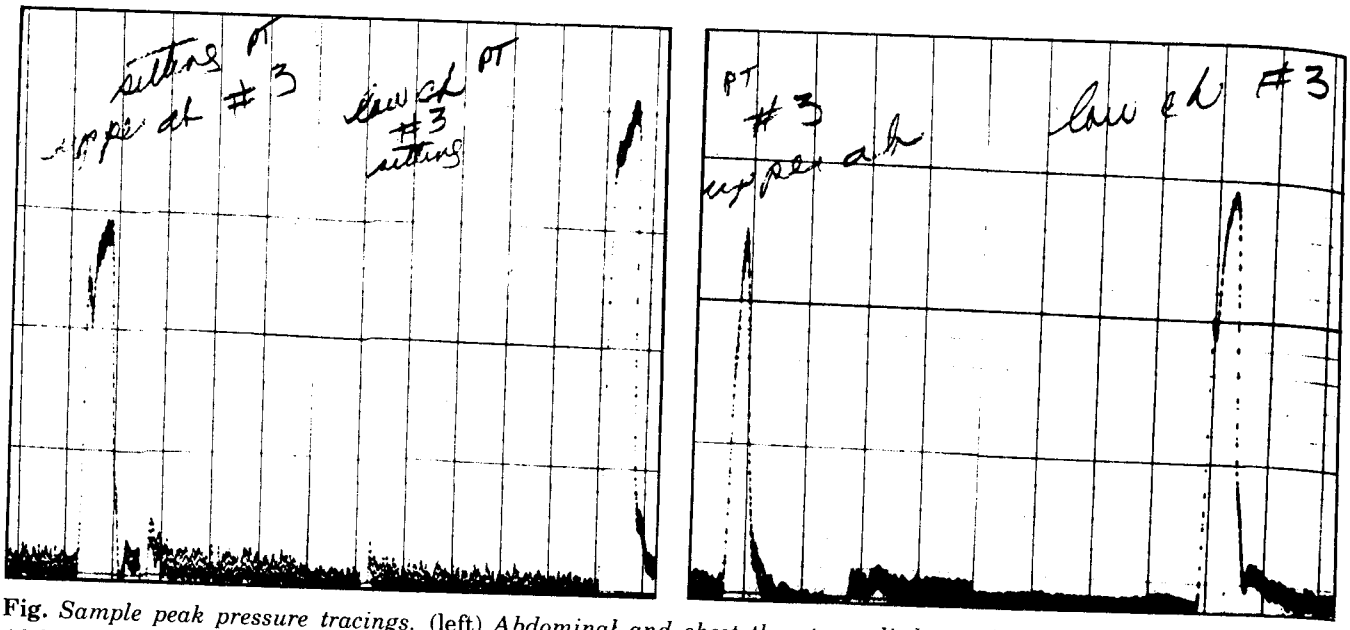

Fig. *Sample peak pressure tracings.* (left) *Abdominal and chest thrusts applied to subject in sitting position.* (right) *Abdominal and chest thrusts applied to subject in horizontal position.*

and allowed to reach a resting expiration (functional residual capacity) prior to each determination.

The maneuver was applied at two locations other than the abdomen — the low chest and midchest. For the low chest position, the rescuer is behind the subject, locates the xiphoid and grasps his fist two or three finger breadths above the xiphoid over the sternum. For the midchest position, the rescuer is behind the subject, grasps his fist at the nipple line over the sternum. For the Heimlich or abdominal position, the rescuer is behind the subject, grasps his fist at the waist or just above the belt line and thrusts up toward the diaphragm.

The thrust methods were applied at all three levels with the subject in the horizontal-lateral position and then repeated with the subject in the sitting position, leaning forward.

Four or five rescuers applied the maneuvers on each of the six subjects. The rescuers included four men weighing between 170 lb and 210 lb, one woman weighing 110 lb, and one 13-year-old boy weighing 95 lb. The subjects' weights ranged between 175 and 220 lb.

Every effort was made to have each rescuer apply the maneuver with the same vigorous, hard thrust at each of the three levels of application.

The technique of delivering a "sharp blow between the shoulder blades" was also applied several times. This procedure was so ineffectual in creating airflow or increased pressure within the chest, it was abandoned.

RESULTS

The recordings of airflow volume, peak flowrate and pressure are listed in the Table.

Each volunteer was interviewed 90 minutes after the end of the procedure and again the next day. Each was asked to report any aching, soreness, pain, or discomfort. All reported a sore throat lasting from 24 to 72 hours, most likely due to irritation from the endotracheal tube. None indicated any discomfort of the chest or abdomen nor has had any adverse effects from the procedures.

DISCUSSION

The low and midchest thrusts produced better results than did the abdominal thrust. The midchest thrust produced slightly better results with

Table
AIRFLOW VOLUME, PEAK FLOWRATE AND PRESSURE FOR EACH POSITION

	FVC-liter	(Range)	PF-liter min	(Range)	Peak Pressure mm HG	(Range)
Horizontal						
abdomen	.29	.08-.74	55	36-98	17	10-30
low chest	.35	.10-.87	68	33-105	25	20-32
midchest	.23	.08-.54	60	38-83	19	18-21
Sitting						
abdomen	.38	.08-.92	65	24-97	19	10-29
low chest	.52	.17-1.03	94	53-148	32	20-44
midchest	.44	.18-.84	99	54-154	34	26-42

the subject in a sitting position than did the low chest thrust, while the latter was more easily and quickly applied and produced better results with the subject horizontal. The data on airflow and pressures, which indicated the chest thrusts resulted in greater airflow and pressures than the abdominal thrust, suggests that the chest thrusts should be the more effective method.

The lack of side effects attributable to the thrust and the relative safety of the procedure were impressive.

CONCLUSION

We feel the emergency management of an obstructed airway due to foreign material should not be thought of as an isolated technique but rather should be integrated into the basic life-support concepts of cardiopulmonary resuscitation.[1] Also, there should be separate procedures for the conscious and unconscious victims of airway obstruction. We recommend the following:

Conscious victim with airway obstruction. This person, who usually has been eating or has a foreign body in his mouth, suddenly cannot speak, cough, or breathe. Prompt action is indicated, preferably while the victim is still conscious. He should not be left alone. When complete airway obstruction is recognized, the following sequence should be applied with the victim sitting or standing:

1) Back blows — four in rapid succession; if ineffective —

2) Abdominal or chest thrust — repeat until effective or until victim becomes unconscious.

Unconscious victim with airway obstruction. Sudden collapse and loss of consciousness requires immediate attention. Even when someone has been eating, this emergency may be due to stroke, fainting, heart attack or respiratory depression from some other cause, as well as to anoxia from foreign body obstruction of the airway.[2]

Whatever the cause, the first priority is to assure an open airway and provide artificial ventilation if necessary. If the patient is not breathing but can be ventilated, artificial ventilation should be instituted. If there is no pulse, cardiopulmonary resuscitation, including closed chest heart compression, should be initiated. If attempts to ventilate indicate foreign body obstruction, attention should immediately be directed to the additional manual maneuvers in the following sequence:

1) Ventilate (mouth-to-mouth). If unable to ventilate —

2) Back blows (four in rapid succession). If ineffective —

3) Abdominal or chest thrusts (four). If ineffective —

4) Finger probes (if jaw relaxed). If unsuccessful —

5) Repeat sequence of

   a) Ventilate

   b) Back blows

   c) Abdominal or chest thrusts

   d) Finger probes.

6) Persist.

REFERENCES

1. Standards for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC). Report from the National Conference on Standards for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC). *JAMA* **227** (suppl):837-868, 1974.

2. Foreign body obstruction of the airway. American National Red Cross First Aid Manual. 1976, p 4.

Correction: An error appeared in Table 2 of "Approach to Acid-Base Problems in the Critically Ill and Injured" by Wilson and Sibbald published in the July 1976 issue of *JACEP*. The Table with the corrected portion in bold face type appears below, in the right-hand column (alkalosis).

Table 2
ACID-BASE ABNORMALITIES
AS DEFINED BY THE pCO_2 AND BICARBONATE LEVELS

pCO_2 (mm Hg)	Bicarbonate (mEq/liter)		
	< 21	21 — 26	> 26
> 45	Combined metabolic & respiratory acidosis	Respiratory acidosis	Metabolic alkalosis & respiratory acidosis
35 — 45	Metabolic acidosis	Normal	Metabolic **alkalosis**
< 35	Metabolic acidosis & respiratory alkalosis	Respiratory alkalosis	Combined metabolic & respiratory alkalosis