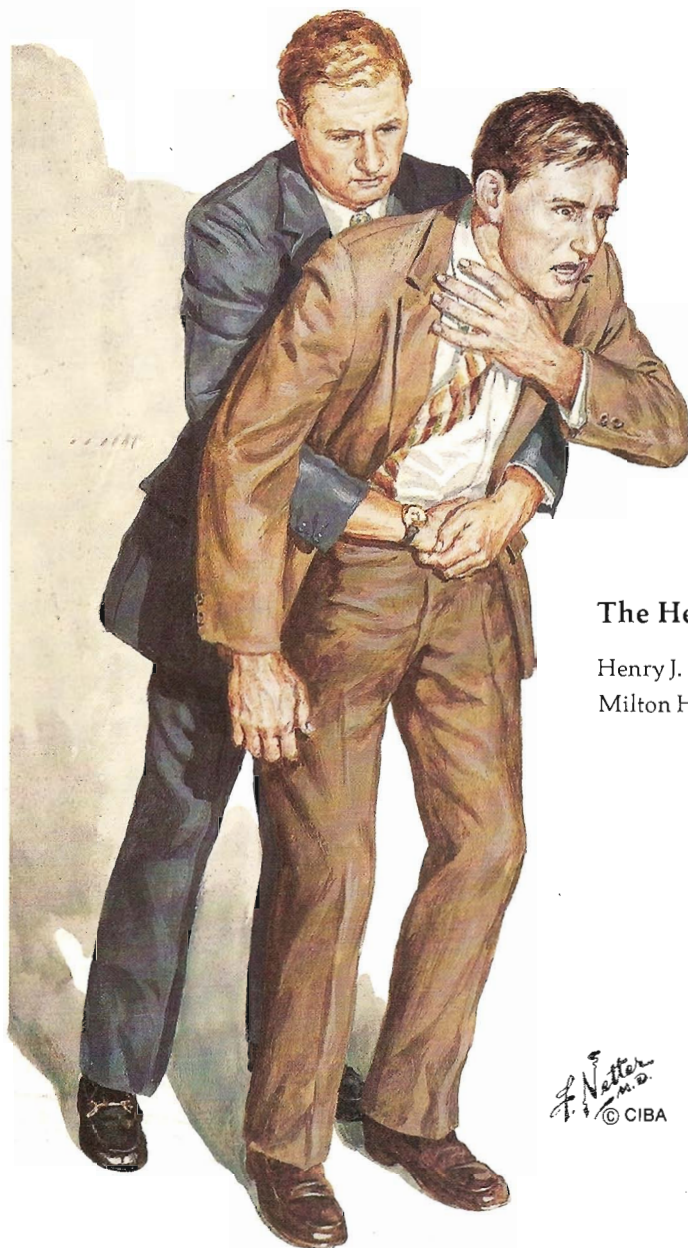


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The Heimlich Maneuver

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The Heimlich Maneuver

A Personal Description of the Maneuver by

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Description of the Heimlich Maneuver

Each year over 3000 Americans choke to death. Choking is the *sixth leading cause of accidental death* in the overall population and the *leading cause of accidental death in the home* for children under one year of age. I first became aware of these alarming statistics in 1973, and immediately began the work that led to the procedure now known as the Heimlich Maneuver. My initial investigations, done with animals, showed that a subdiaphragmatic thrust can force air from the lungs in sufficient quantity to expel an obstructing object in the airway. The results were reported in *Emergency Medicine* in June, 1974. In that report, I described how the procedure could be performed in man, and asked that instances in which the Maneuver was used be reported to me. The *Emergency Medicine* article received widespread coverage in the nonscientific press, largely as a result of the efforts of Arthur Snider, science editor of the *Chicago Daily News*. Almost immediately, reports of lives saved—to date, over 3000—began to come in. In October, 1975, the Heimlich Maneuver was endorsed by the American

Medical Association's Commission on Emergency Medical Services.

The Heimlich Maneuver is an effective and safe rescue procedure. At the same time, it is so simple that it can be easily learned and effectively performed by the layman. The ability of the layman to understand and use the Maneuver is crucial. In a choking emergency, there is no time to call for trained medical assistance—a person choking on a foreign object will die or suffer permanent brain damage *within four minutes*. Whoever is at hand when the crisis occurs must perform the rescue.

Usually the rescuer is a layman, and in most cases, he has had no formal training in the Heimlich Maneuver. In one reported instance, a mother was able to save her 9-month-old infant after having read only a two-paragraph description of the Maneuver in a popular women's magazine. In another case, a blind man who learned of the Maneuver in a "talking book," was able to save his wife after being alerted to the crisis by others present. Even children have saved lives using the technique.

An 11-year-old babysitter saved a 2-year-old child choking on a marble after getting emergency instructions on the telephone. The youngest rescuer on record is an 8-year-old who saved his younger brother while his mother looked on helplessly.

The Heimlich Maneuver can be performed on a victim who is standing or sitting, or on someone who has fallen to the floor unconscious. A person who is choking can also use the Maneuver to save himself. All variations of the technique are based on the subdiaphragmatic thrust. To save a life, the rescuer must know two things—how to recognize a victim of choking, and the basic Heimlich technique, with simple variations.

RECOGNIZING THE CHOKING VICTIM

Foreign body obstruction of the airway usually occurs while the victim is eating. If the victim is a child, however, choking may also occur during play, when a small toy or object being mouthed slips back into the airway. Within four minutes of the onset of the attack, the victim will be dead or suffer permanent neurologic deficit. Thus, the rescuer must make the diagnosis immediately.

The first thing the rescuer should look for is what has come to be called the Heimlich sign (Plate 1). It indicates "I am choking." The victim gives the sign by bringing his hand to his throat, with the thumb and index finger spread widely to form a V. Often, a victim not aware of the sign or of its meaning will nonetheless give it instinctively by clutching his throat with his hand. When the sign is given, whether intentionally or instinctively, the rescuer should immediately ask, "Are you choking?" Although the victim will be unable to speak, he will usually be able to signal his assent nonverbally. The diagnosis is then absolutely clear, and the rescuer can begin the Maneuver at once. The Heimlich sign is now being taught routinely with the Heimlich Maneuver. Once it is universally known, the problem of diagnosing choking in the conscious victim will be virtually eliminated.

When the Heimlich sign is not given or goes unrecognized, the rescuer must look for other indications of choking. There are three signs that indicate complete obstruction of the airway (Plate 1): first, *inability to speak or breathe;*

second, pallor followed by increasing cyanosis; and third, loss of consciousness and collapse. As soon as the rescuer notices the first of these signs, he should immediately perform the Maneuver. To wait until the victim is unconscious so as to confirm the diagnosis is extremely dangerous, as by this stage the victim is only seconds from permanent brain damage and death.

Obstruction of the airway will be only partial in some victims of choking. Like victims of complete obstruction, these people will usually not be able to speak. However, they will be able to breathe, although often inadequately, and sometimes they will also be able to cough. Usually, a partial obstruction is not life threatening. Sometimes, however, hypoxia resulting from inadequate ventilation can be fatal, especially in older victims or in those with heart conditions. A partial obstruction may also be converted suddenly into a complete occlusion, for example, by the force of a back blow which can drive the object deeper into the airway. Thus, when a partial obstruction is not expelled spontaneously, the Heimlich Maneuver should be performed to relieve the victim's distress and to avoid potential complications.

The Unwitnessed Attack

Sometimes, a victim of choking becomes embarrassed by his predicament and succeeds in getting up and leaving the eating area unnoticed (Plate 2). In a nearby room, he loses consciousness and, if unattended, he will die or suffer permanent brain damage within seconds. Therefore, in teaching the Heimlich Maneuver, I stress that when one is choking, even if the obstruction is only partial, it is extremely dangerous to leave a room where other people are present. Similarly, no one in apparent respiratory distress should ever be allowed to leave the room alone.

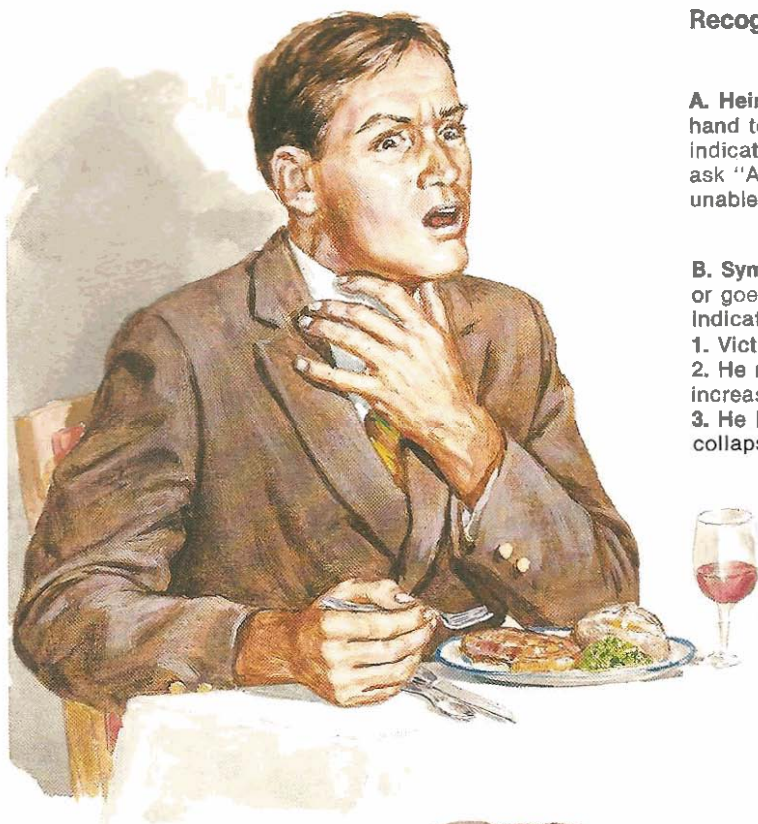
When someone is found unconscious and not breathing, and a choking attack was not witnessed, the situation is critical. A diagnosis must be made at once. If the victim is found in a hallway, restroom or area near a restaurant or eating place, and if there is no indication of physical injury, food choking should be assumed to have occurred and the Heimlich Maneuver should be applied immediately

Recognizing the Choking Victim

A. Heimlich sign. Victim may bring hand to throat (Heimlich sign) to indicate choking. Rescuer should ask "Are you choking?" Victim will be unable to speak but may nod his assent

B. Symptoms. When sign is not given or goes unrecognized, the following indicate choking:

1. Victim cannot speak or breathe
2. He rapidly becomes pale and then increasingly cyanotic
3. He loses consciousness and collapses



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A gnizing the Choking Victim

Victim may be embarrassed by his predicament and leave the eating area unnoticed



(Plate 3). Any delay, even to begin cardiopulmonary resuscitation (CPR), could be fatal; if after several subdiaphragmatic thrusts (page 10), an obstructing object is not expelled from the victim's throat, the rescuer should then begin CPR. Of course, CPR should be initiated first if the situation does not suggest choking. If there does turn out to be an obstruction in

the airway, it will become apparent when the first mouth-to-mouth breaths are given, and the Heimlich Maneuver can then be performed at once.

Differential Diagnosis

Although there is a chance of mistaking a heart attack for a choking episode, in general



the danger of misdiagnosis has been overstated. In fact, the reverse is more likely to occur—an uninformed witness will often assume a choking victim is having a heart attack. The setting in which the incident occurs—in or adjacent to an eating area—usually indicates the correct diagnosis. The observation that the victim cannot speak or

breathe confirms it. In a survey of autopsy findings in a series of 56 people who died suddenly in restaurants, Eller and Haugen (1973) found that 55 had died of airway obstruction and only one of a heart attack. In addition, because heart attacks are rare in young people, it can be safely assumed that anyone under 30—particularly any child—who suddenly



Recognizing the Choking Victim

Anyone found unconscious and not breathing in a restroom or hallway adjacent to an eating area is probably a victim of food choking. The unconscious victim is only seconds from permanent brain damage and death, and the rescuer should perform the Heimlich Maneuver immediately (supine position)

stops breathing, becomes cyanotic and falls unconscious for no apparent reason is choking.

THE HEIMLICH MANEUVER— VICTIM STANDING

When the Heimlich Maneuver was first introduced, instructions were given for the standing and the supine victim only. Although the technique has since been refined so that it can be used when the victim is seated and so that victims can save themselves, most rescues continue to be performed by another person with the victim in the standing position.

When the victim is standing, the rescuer positions himself behind the victim (Plate 4) and encircles the victim's waist with his arms. With one hand, he makes a fist and then places its knob (Plate 5) against the victim's abdomen, slightly above the navel and well below the tip of the xiphoid process. The rescuer then grasps the fist with his free hand and presses into the victim's abdomen with a quick upward thrust. It may be necessary to repeat the thrust as many as six times to clear the airway. Each new thrust should be a separate and distinct movement. Resumption of breathing, return to normal color and restoration of consciousness indicate that the airway has been cleared.

Once the airway has been cleared, the bolus of food or other obstructing object should be found and identified. When I first conceived of the Maneuver, I thought that the ejected object would have to be removed manually from the victim's mouth. As reports of successful applications of the Maneuver came in, however, rescuers repeatedly used phrases such as "popped out of the mouth," "hit the wall," "flew across the room" and "popped out like a cork from a champagne bottle" to describe the way in which objects were expelled when the Maneuver was performed. Thus, after most rescues, the obstructing object is expelled forcibly from the mouth, and a finger sweep of the mouth is unnecessary. Only in those rare cases in which the bolus remains in the oropharynx must it be manually removed, *with great care being taken not to drive the object back into the throat*. If the object is not removed, it may be reaspirated or swallowed, especially by frightened or crying children.

Whenever the Heimlich Maneuver has been performed, even if there are no apparent complications, I recommend that the victim be examined by a physician as soon as possible. Complications are rare, but if the Maneuver has not been properly performed, they can be significant (page 18). In most instances, however, the victim reports that he sat down and finished his meal.

Modifications have been made to the basic Maneuver since I first described it in 1974. The most important one is a change in the method used to deliver the subdiaphragmatic thrust. Originally, the rescuer was directed to stand behind the victim, wrap his arms around the victim's waist, grasp his own *wrist* and press into the abdomen with a quick upward thrust. This early version of the Maneuver was sometimes referred to as the "bear hug" or "hug of life." Although the technique proved effective in clearing the airway, nine reports of rib fractures associated with the hug were received. Presumably the fractures were caused by the lateral pressure of the rescuer's arms on the victim's rib cage.

Because of these reported injuries, the technique was revised to eliminate chest compression. In the standard technique now taught, the rescuer is instructed to deliver the thrust with his *hands* only. The action consists of a sharp flexion movement at the elbows, rather than a "hug." To emphasize the distinction between the old technique and the new, I now use the phrase "the victim's life is in your *hands*."

THE HEIMLICH MANEUVER— VICTIM SEATED

Among the early reports of successful use of the Maneuver were several descriptions of rescues performed while the victim was seated. The Maneuver appeared to work equally well when the victim was in this position, and since many people are sitting at the dining table when choking occurs, appropriate instructions were devised for a rescuer to attempt the Maneuver in this fashion.

The techniques for the sitting and standing victim are almost identical. When the victim is seated, the rescuer stands or kneels behind the chair (Plate 6), encircles the victim's waist with his arms, positions his hands and delivers the

thrust just as he would if the victim were standing. The only difference is that now the back of the chair is interposed between the rescuer and the victim. The chair back provides a firm support for the victim's back and seems to enhance the effect of the subdiaphragmatic thrust. If the victim is sitting in a dining booth, airplane seat or chair too large for the rescuer to reach around, the rescue can still be performed while the victim remains seated. He is simply turned sideways so that the rescuer can get behind him and perform the Maneuver.

THE HEIMLICH MANEUVER— VICTIM SUPINE

The victim has either been standing or seated in 90% of reported uses of the Heimlich Maneuver. However, in about 7% of cases the rescue has to be performed on a supine victim. (In the other 3% of cases, the victim has saved himself.) There are only two situations in which the supine position is indicated: first, when the victim has already fallen unconscious to the floor; secondly, when the rescuer is too small to reach around the victim or too weak to deliver an adequate thrust. When the victim is already lying unconscious on the floor, vital time can be wasted trying to pull him to a standing position. And when the rescuer is too small or too weak, the Maneuver cannot be performed effectively unless the victim is supine.

If the victim is unconscious and lying face down on the floor, the rescuer should roll the victim onto his back, with his face up. Facing the victim, the rescuer kneels astride the victim's hips and positions his hands as shown in Plate 7. He presses into the abdomen, toward the diaphragm, with a quick upward thrust.

The same procedure can be used with a conscious victim if the rescuer is small or weak (Plate 8). While kneeling astride the supine victim, the weak or small rescuer can use his own body weight to achieve sufficient force for the thrust. Using the supine position, children have saved their parents, and petite wives their husky husbands.

Precautions

The rescuer must kneel *astride* the supine victim: if he kneels to one side, as some first

aid organizations incorrectly recommend, the thrust will not be delivered in the midline, and rupture of the liver or spleen could result. In addition, the expulsive force of the thrust is diminished when it is delivered from the victim's side.

The position of the victim's head is also vital. The head should be facing up and aligned to the midline as much as possible, although it does not need to be held rigidly in position. Many people trained in first aid ask why the head is not deliberately turned to the side to prevent aspiration should the victim vomit. The answer is that turning the head twists the throat, blocking the expulsion of the obstructing foreign object. If vomiting does occur during the rescue (and the incidence of vomiting is quite small), the victim's head is quickly turned to the side and his mouth cleaned out.

The only time that head position is not crucial is when the Maneuver is performed on a drowning victim (page 22). Water will be able to pass through the airway even if the throat is contorted.

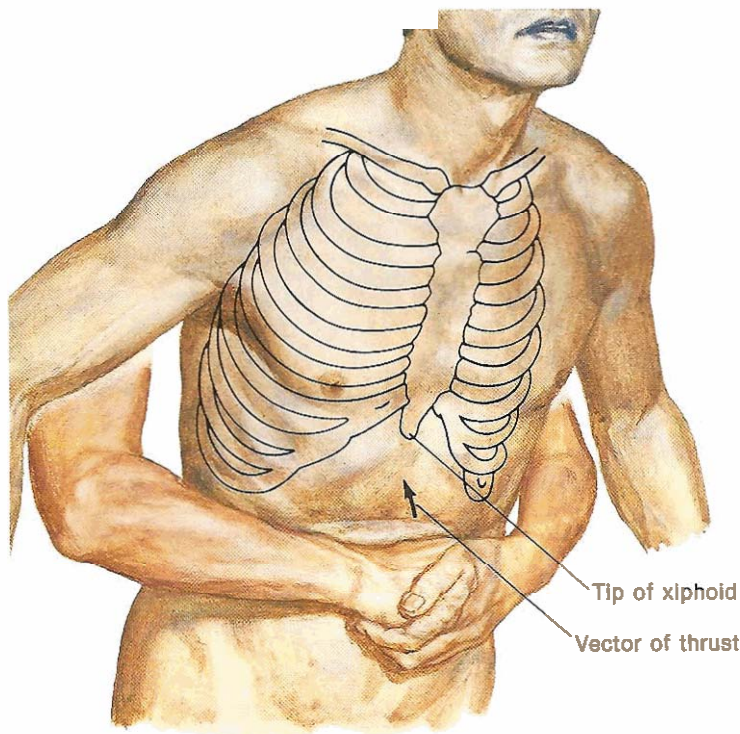
THE HEIMLICH MANEUVER— SELF-SAVE TECHNIQUE

The instructions for the self-save technique, like those for rescue of a seated victim, were developed as a result of information sent to me by people, aged 10 to 85, who had performed the Maneuver on themselves. To date, 37 people have reported saving their own lives using one of the two techniques illustrated (Plate 9).

Both of the self-save techniques are simple adaptations of the basic subdiaphragmatic thrust. In the first variation, the victim simply performs the standard Heimlich Maneuver on himself. He places his hands in the same position as he would if he were saving someone else. (The knob of his fist should be directly against his own abdomen, slightly above the navel and well below the rib cage.) He then presses upward, toward the diaphragm, with a quick motion. Several thrusts may be needed to clear the airway.

The victim can also attempt to save himself using a firm edge instead of his hands. He positions himself over the edge of a horizontal object such as a chair back or table, and presses his abdomen against the edge with a quick

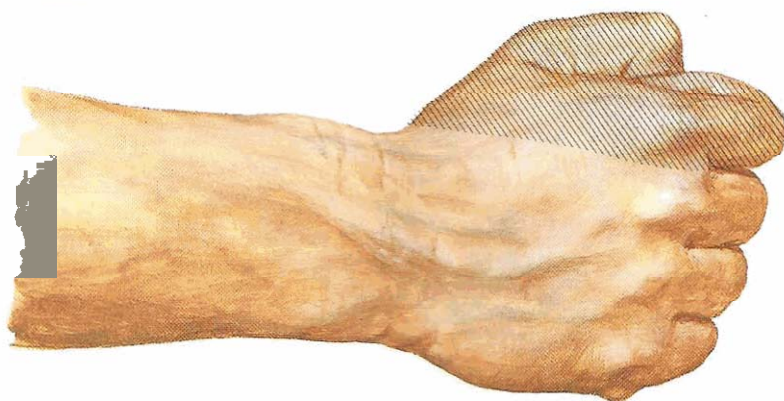
Heimlich Maneuver— Position of Rescuer's Hands



Rescuer's fist positioned against victim's abdomen, slightly above navel and well below tip of xiphoid. Knob of fist (see below) should be directly against the abdomen. Rescuer grasps fist with other hand and presses into abdomen with a *quick upward thrust*. The action consists of sharp flexion at the elbows, *not* of a "bear hug," thus eliminating compression of the rib cage

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Rescuer's fist (viewed from above). Note thumb and index finger form a knob (shaded area). Knob is placed directly against abdomen, increasing depth and effectiveness of the thrust



movement. Again, it may be necessary to repeat the movement several times to dislodge the object.

One woman, alone at a lakeside cabin, successfully used the latter technique when she began to choke on a piece of meat. She ran to the porch and pressed her upper abdomen into the railing. The chunk of meat flew 8 to 10 feet out of her mouth.

THE HEIMLICH MANEUVER— INFANT VICTIM

Choking or gagging is so common in young children that hardly a parent gets through the early child-rearing years without at least one

frightening episode. Fortunately, most incidents are resolved with a good, strong cough. When a child's airway does become completely obstructed, however, the parent often instinctively uses techniques such as probing in the mouth with the fingers and inverting the child and slapping between the shoulder blades. All of these techniques are potentially dangerous. Probing with the fingers may drive the object further into the throat; inverting the child may cause a partially obstructing object in the trachea to fall against the vocal cords, causing complete obstruction; and slapping the back is ineffective and wastes precious time (page 21).

Heimlich Maneuver—Victim Seated



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Same technique as for standing victim.
Back of chair acts as a support and
enhances effectiveness of Maneuver

Heimlich Maneuver—Victim Supine

Victim on back with face up. Facing victim, rescuer kneels astride victim's hips. Rescuer then places his hands one on top of the other with the heel of the bottom hand on victim's abdomen, slightly above the navel and below the rib cage. He presses into abdomen with a *quick upward thrust*. Thrust repeated several times if necessary



The standard Heimlich Maneuver as used for adults has been performed safely on children as well. The rescuer simply lessens the force of the subdiaphragmatic thrust when the victim is a child. In very young children, the force of the thrust can be controlled by pressing into the abdomen with the middle and index fingers of both hands instead of with the fist and covering hand as used in the regular Maneuver. The rescuer either holds the infant in her lap or places the child on a firm surface and stands at his feet. With the index and middle fingers of both her hands in position (Plate 10), the rescuer presses into the abdomen with a quick upward thrust. Several thrusts may be necessary.

Should *repeated* attempts to dislodge the obstruction fail, the following technique can be used *with caution*. (This alternative method is itself dangerous and should only be used in extreme circumstances.) The rescuer drapes the infant over her arm or thigh (depending on the child's size) so that the child's abdomen

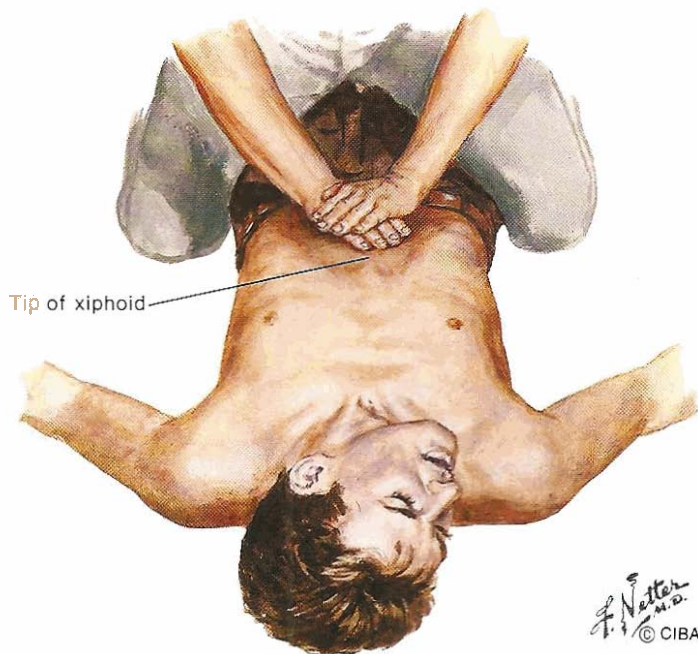
rests on the supporting arm or thigh and his head hangs down. She then strikes between the infant's shoulder blades with sharp, firm blows. The blows, in combination with the pressure of her arm or thigh on the infant's abdomen, simulate the subdiaphragmatic thrust of the Heimlich Maneuver.

The hazards associated with the alternative technique are significant. Great care must be taken to hit the child with sufficient force to dislodge the obstruction but not so hard as to cause injury. Also, when the child's head is hanging down, there is always the risk that an object in the trachea causing only partial occlusion can fall against the vocal cords and completely obstruct the airway.

HOW THE MANEUVER WORKS

The immediate stimulus to my work on upper airway obstruction was the introduction on the market of a large plastic instrument for

Maneuver performed on undressed victim to show position of hands



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the treatment of choking. This instrument, which was being distributed to restaurants in 1973, seemed ill-conceived. It was unlikely that a choking attack would occur when both the instrument and someone who knew how to use it were present. Moreover, there was a considerable danger that a layman would accidentally push the obstructing object deeper into the airway or injure the structures of the throat while probing with the instrument.

Consideration of the drawbacks of this plastic instrument led me to the realization that our approach to treating airway obstruction needed drastic revision. The goal was to find a method of pushing the obstruction out of the airway from *below*. The obvious substance available to create the needed force was the air in the lungs.

Airflow Studies

No matter what phase of respiration the victim is in when choking occurs, a considerable reservoir of air remains in his lungs. This

volume of air is made up of the remainder of the tidal volume and the expiratory reserve. When the diaphragm is elevated with the sub-diaphragmatic thrust of the Heimlich Maneuver, this air is expelled through the bronchi and trachea with considerable force (Plate 11). The flow of air thus created expels the obstructing object from the airway—outward.

Alterations in airflow caused by the Maneuver were documented in a study by myself, Hoffmann and Canestri (1975). Normal airflow patterns and changes in these patterns when the Heimlich Maneuver was applied were measured in healthy, conscious volunteers with a closed-pressure gauge and recording spirometer. When the Maneuver was applied at the midpoint of normal expiratory respiration, the average airflow of 52.5 liters/min rose to 205 liters/min, an increase of 152.5 liters/min. At the end of forced expiration, the Maneuver caused an average increase in airflow of only 53 liters/min. The

volume of air expelled averaged 0.94 liter in 0.25 sec when the Maneuver was applied during the early expiratory phase and 0.35 liter when the Maneuver was performed at the end of the forced expiratory phase. Air pressure when the Maneuver was applied during the early expiratory phase averaged 31 mm Hg. Independent studies were conducted by Patrick (1976), a physician and Professor of Electrical Engineering at Purdue University, and by Fink (1976), Professor of Anesthesiology at the University of Washington. They proved that it is the flow of air produced by the Maneuver that provides kinetic energy to the obstructing object to drive it toward the mouth. That is why objects which totally obstruct the airway and those which only partially obstruct are both forcefully expelled by the Heimlich Maneuver.

The Subdiaphragmatic Thrust

The technique on which the Maneuver is based was first developed by means of animal studies. Both chest compression and elevation of the diaphragm were considered as possible means of forcing air from the lungs. However, elevation of the diaphragm proved to be consistently more effective than chest compression in expelling a bolus obstructing the airway. This finding is consistent with current knowledge about the physiology of respiration. Best and Taylor (1973) recognize that the contraction of the intercostal muscles contributes little to tidal volume, while diaphragmatic movement accounts for 525 ml of the 500 to 700 ml of the resting tidal volume.

The anatomic practicality of the subdiaphragmatic thrust in man was confirmed at routine thoracotomy. Pressure applied by the surgeon's fist to the abdomen below the rib cage caused the diaphragm to rise several inches into the pleural cavity. In the intact chest, the elevation of the diaphragm would obviously compress the lungs and force air out through the airway.

EVALUATING THE EFFECTIVENESS OF THE MANEUVER

After having devised what I hoped was an effective and practical life-saving technique, I faced a dilemma—extensive documentation

with human choking victims would be necessary for the Maneuver to be accepted by the medical community, and that documentation would take several lifetimes for any one physician to accumulate. Consequently, in my 1974 *Emergency Medicine* article and in the newspaper articles that followed, I asked anyone using the technique or knowing of someone who had used it to report the results to me. As I mentioned previously, reports began to come in almost immediately. The first was from a 70-year-old restaurateur who had seen many people die from so-called "café coronaries." One day he read a description of the Maneuver, and the very next day was able to save the life of a neighbor who was already cyanotic and quickly losing consciousness by the time he intervened.

Whenever a report of someone using the Maneuver comes in, a questionnaire asking for specific details and for the personal data necessary to evaluate the success of the Maneuver is sent. (A copy of the form can be obtained by writing to the following address: Henry J. Heimlich, M.D., Elet Hall, Xavier University, Cincinnati, Ohio, 45207.) To date, some 1134 of these forms have been returned, and the data reported critically evaluated.

Evaluation

Evaluating the life-saving potential of the Maneuver was an immediate concern. The crucial question was whether the victim would have survived the choking episode if the Heimlich Maneuver had not been performed. In 152 of the 1134 reports analyzed, the victim was already unconscious—and thus seconds from brain damage and death—when the Maneuver was performed. These reports were considered to be valid documentation of lives saved. In another 218 cases, complete obstruction was reported by either a rescuer or a victim who had had some medical training (physicians, nurses or paramedical technicians). These reports were considered to represent more accurate observations than might be expected from a layman.

One particularly significant report came from Dr. R. K. Haugen, who had coined the term "café coronary" in 1963. Dr. Haugen confessed to initial skepticism about the Maneuver. He noted, however, that he had

Heimlich Maneuver— Adult Victim with Child Rescuer



When victim is standing, child may be too short to reach around victim's waist or too weak to deliver effective thrust

Victim should then lie in supine position. Rescuer kneels astride victim and positions her hands on victim's abdomen, slightly above the navel and below the r'b cage. She then presses into abdomen with *quick upward thrust*. Thrust is repeated if necessary. Kneeling astride victim, the rescuer can use her own body weight to enhance force of thrust



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later "witnessed a café coronary and easily applied the Heimlich Maneuver with magnificent results," and says that he is "now a *firm* believer" (R. K. Haugen, 1978: personal communication).

Analyzing the Results

A computerized analysis of the data collected from 563 reports was conducted independently by Hughes (1976). His analysis emphasized the following points:

1. The rescuer need not be conversant with CPR techniques to successfully use the Heimlich Maneuver: 70% of the rescuers were laymen, unskilled in CPR.
2. The Heimlich Maneuver can be effectively taught through the mass media: of the 201 rescuers who indicated where they learned the technique, 50% listed magazine or newspaper articles and approximately 25% listed television programs.
3. The Maneuver is usually performed on the victim of a witnessed choking attack: 94% to 96% of the crises occurred in the presence of other people.
4. No more than four to six subdiaphragmatic thrusts are usually required to expel the obstruction: 95% of rescuers were successful with six or fewer thrusts. Only one to two thrusts were necessary in 62% of cases.
5. Most rescues (82%) are performed with the victim standing.

Complications

Complications following use of the Maneuver have proved to be surprisingly few. During the first months after the words "bear hug" appeared in the press, nine reports of rib fractures were received and the technique was revised accordingly in October, 1975. Rib fractures cannot occur with the new technique when it is properly performed (page 9). Twenty-three instances of vomiting, none with detrimental effect, have been recorded. The only other complication occurring with any frequency has been abdominal soreness.

One report of a serious complication—rupture of the choking victim's stomach—has caused some alarm even though his life was saved by the Maneuver and subsequent surgery. The incident occurred at a party where alcohol intake was high and, because the

rescuer could not be located, the technique used to perform the Maneuver could not be confirmed. It seems likely from the nature of the injury that encircling compression was used. Injury to the stomach must therefore be considered a potential danger, especially when the now outdated "bear hug" technique is used for the rescue.

Unsuccessful Attempts

The Heimlich Maneuver, like most procedures, is not 100% effective. Six reports of unsuccessful rescue attempts have been received and there are undoubtedly others that have not been reported. The data from these reports have been analyzed and reveal that these failures are the result of one of three factors:

1. Apparent incorrect technique in applying the Maneuver. In some cases, when a first rescuer was unsuccessful, a second performed the Maneuver with immediate results.
2. Position or extent of the obstruction. Obstructions tightly lodged in the trachea (e.g., a crayon in a child's trachea), or extending into the bronchus (e.g., a "string" of lobster) may be quite difficult to dislodge even with the Maneuver.
3. Substances aspirated throughout the lungs (e.g., peanut butter) would be impossible to expel with the Maneuver.

In another case, the airway was successfully cleared with the Maneuver, but the victim suffered permanent brain damage because critical minutes were wasted with back blows. Deaths from choking have also been reported in instances where back blows or probing in the mouth were used *instead* of the Maneuver. Incorrect diagnosis has also resulted in fatality.

DISCUSSION OF ALTERNATIVE METHODS

Because of the demonstrated effectiveness of the Maneuver, the method has been universally accepted. However, discussion of specific aspects of the technique and of certain proposed auxiliary procedures continues. As already mentioned, some first aid organizations suggest, incorrectly, that the rescuer should kneel at the side of the supine victim rather than astride his hips (page 10). The

Heimlich Maneuver—Self-Save Technique

A. Standard Heimlich technique. Victim positions his own hands slightly above the navel and below the rib cage, and presses his fist into his abdomen with a *quick upward thrust*. Thrust is repeated several times if necessary



B. Alternative technique. Victim positions himself over edge of fixed horizontal object such as a chair back, railing or table edge, and presses abdomen into edge with quick movement. Movement repeated if necessary

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Heimlich Maneuver—Infant Victim

Infant is either held in rescuer's lap or placed face up on a firm surface with the rescuer at his feet. Rescuer places index and middle fingers of both hands on child's abdomen, slightly above navel and well below the rib cage, and presses into abdomen with a *quick upward thrust*. Several thrusts may be necessary to expel the object



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question of the value of back blows and of the use of chest compression in place of the subdiaphragmatic thrust has also received considerable attention.

Back Blows

Giving back blows to someone who is choking is, for many people, almost an instinctive reaction. But it can be both a waste of time and dangerous. Review of the 1134 reports of choking episodes reveals that back blows were tried repeatedly on 174 of the victims before the Maneuver was applied. Thirty-five of these victims had lapsed into unconsciousness—and were thus seconds from death—before back blows were abandoned and the Maneuver successfully performed. In two other cases reported to me, the victims, both 2-year-olds, died while back blows were being given; the Maneuver was never tried. To determine the scientific basis for the traditional use of back blows, Dr. Milton Uhley and I have both reviewed the medical literature on upper airway obstruction. Dr. Uhley's research was conducted independently and is remarkably extensive and detailed (page 24). Neither of us could find a single scientific publication demonstrating the effectiveness of back blows.

After the Maneuver was introduced, a study reportedly demonstrating the beneficial effect of administering blows between the shoulder blades was published (Gordon, *et al.*, 1977). Anesthetized baboons were used in the experiments. Meat was placed in their throats and was said to have been jarred loose by back blows. However, the relaxing effect of the anesthesia on the muscles of the throat—the choking victim's throat is in severe spasm (Gordon, 1967; P. Safar, 1974: personal communication)—was not considered in evaluating the data. In addition, two studies were done on intubated humans under general anesthesia. One reported that back blows produced no air flow or pressure effect (Guildner, *et al.*, 1976); the other reported no air flow but did demonstrate a pressure spike (Gordon, *et al.*, 1977). Patrick (1976) and Fink (1976) have proved, however, that air flow provides the kinetic energy needed to expel an obstructing bolus whereas a pressure spike has no effect (page 16). For example, when a pin is suddenly

jabbed into a piece of meat, the pressure at the point of the pin can be tremendous but it will not move the meat. On the other hand, a rapid flow of air from a bellows will readily displace an object.

In addition to being ineffective, back blows can also be dangerous when used on an upright victim, a fact already well documented in the 19th century (page 28). In our day, Patrick and Fink demonstrated in their studies that back blows can drive the obstruction deeper into the airway. The danger is graphically demonstrated in the following incident. According to a report in my possession, a victim was choking on a piece of food and a rescue was attempted with the Maneuver. Just as the victim's airway was cleared by the airflow generated by the subdiaphragmatic thrust, someone slapped him on the back, causing the bolus to fall back again. The Heimlich Maneuver then had to be repeated to clear the airway a second time.

Chest Thrust

Chest compression has been suggested as an alternative to the subdiaphragmatic thrust of the Maneuver. One study (Guildner, *et al.*, 1976) seemingly demonstrated a slightly higher airflow with chest compression than with the subdiaphragmatic thrust. Again, anesthetized volunteers were used in the experiments, and no attempt was made to compensate for the effect of the anesthesia when the results were formulated. Anesthesia causes relaxation of the intercostal muscles, diminishing resistance to chest compression, and eliminates the elasticity of the diaphragm.

A strong case can be made against the use of chest compression on choking victims even if future studies show a statistically significant increase in airflow with the technique. The risk of serious injury associated with any procedure that calls for compressing the chest is high. A review from the Mayo Clinic (Enarson and Gracey, 1976) of life-threatening complications associated with the sternal thrust used in CPR lists crushed chest, fractured ribs, pneumothorax, and rupture of the heart, lungs, liver or spleen as possible secondary injuries. The incidence of injury is significant even when CPR is performed by physicians

and highly trained medical technicians. Unfortunately, it is impossible to predict how much pressure applied with a sternal thrust will crush a chest. Thus, to use this technique to treat airway obstruction when an effective and considerably safer alternative is available would be tragic.

Chest compression should only be considered in place of the subdiaphragmatic thrust when the victim is markedly obese or in such advanced pregnancy that there is literally no space between the rib cage and the enlarged uterus in which to perform the subdiaphragmatic thrust. Pressure should then be applied to the midsternum *with care* and with awareness of the possibility of damage to underlying structures. Reports have shown that the standard Heimlich Maneuver can be used successfully and with no ill effects in women in the third and fourth months of pregnancy. Although rescues of victims in more advanced pregnancy have not been reported, it is probable that the subdiaphragmatic thrust could continue to be used safely and effectively as long as there is still sufficient space between the rib cage and the uterus.

THE DROWNING VICTIM

The Heimlich Maneuver has also been used with success on victims of drowning. Dr. Victor Esch, chief fire surgeon in Washington, D.C., and four highly trained lifeguards elsewhere in the country and in Canada, independently elected to try the Maneuver for rescue of drowning victims after all other resuscitative measures had been tried and failed. The Maneuver was tried in five separate drowning incidents (Heimlich, 1978). In each instance, the rescuer reported that water "gushed" from the victim's mouth and the victim then began to breathe. It was concluded that these victims had inhaled water in the lungs which prevented the passage of air. Dr. Esch confirmed this hypothesis later in his own patient by demonstrating evidence of pneumonia on x-ray films taken soon after hospitalization. He recommends performing the Heimlich Maneuver as a first step in the resuscitation of a drowning victim, reasoning, "You can't get the air into the lungs until you get the water out."

With the drowning victim, the Heimlich Maneuver acts in the same way as did the old life-saving techniques of rolling the victim over a barrel or, as was done along the German canals in the 1700s, letting the victim hang face down over the back of a horse so that his abdomen and chest were compressed as the horse trotted. Similar techniques are still used today in some states where lifeguards are taught to drape the victim face down over the shoulder and jog up the beach before starting resuscitative procedures.

PREVENTING CHOKING

With care and common sense, many choking incidents can be avoided. Food should always be cut in small pieces and chewed thoroughly and slowly, especially if the diner wears dentures. Talking and laughing while chewing or swallowing should also be avoided. Finally, drinking of alcoholic beverages before or during meals should be moderate.

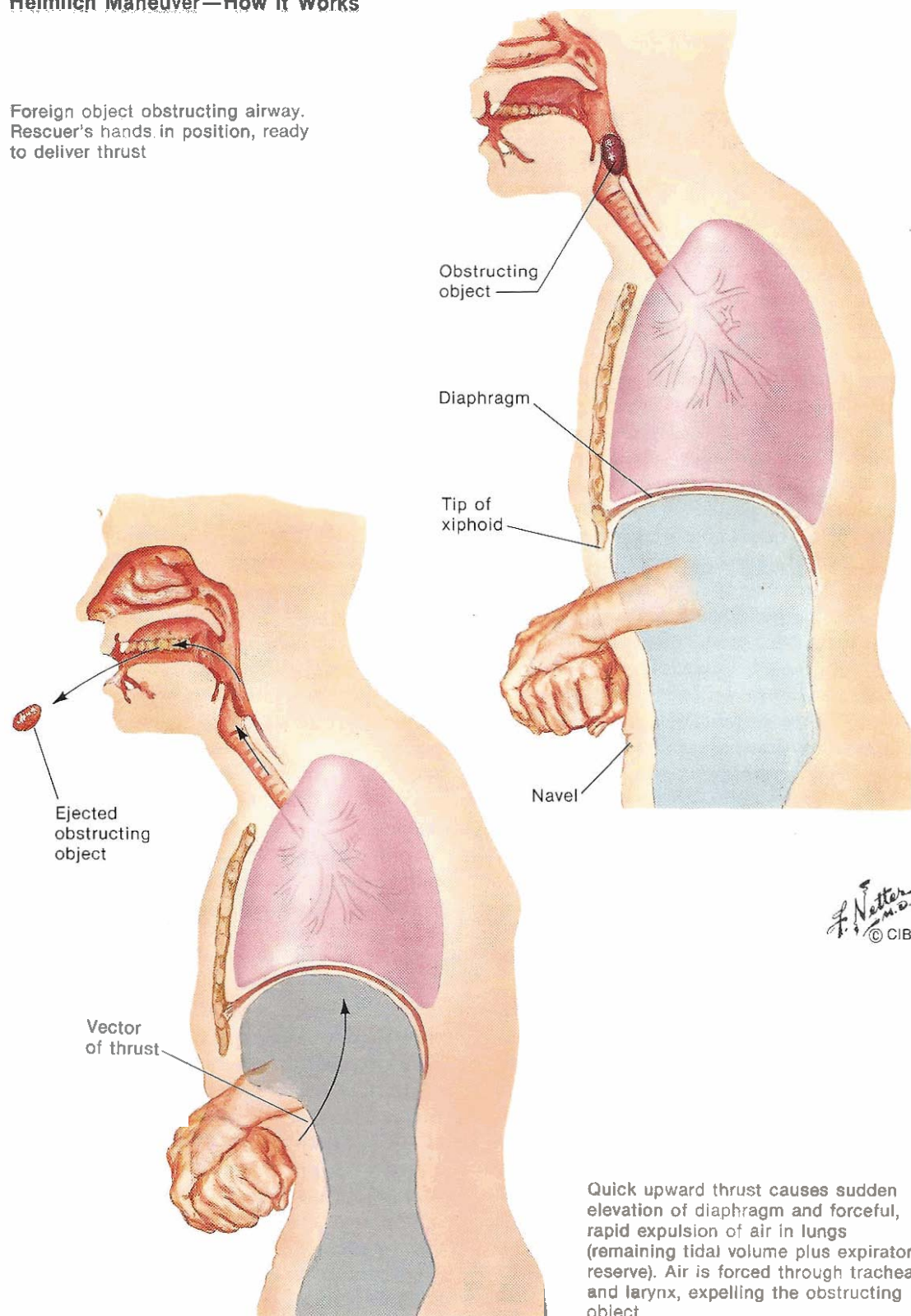
Special precautions must be taken to prevent choking in children. In addition to the safety measures listed above, a child should never be allowed to play or run with food, a lollipop or anything else in his mouth (Plate 12). Children under 3 years of age require special attention because during play they are likely to mouth toys or any other object within reach (Plate 13). Care must be taken to select toys that are too large for them to swallow or inhale. The recent death of a small child as a result of inhaling a "missile" from a toy spaceship points to the need for parents to be constantly vigilant in checking all toys they or others may purchase for their children. The house or play area must also be "child-proofed" by moving small objects such as nails, coins, beads or even an older child's toys out of the infant's reach.

LOOKING TO THE FUTURE

Yet another recent death—that of an heiress who choked on a piece of steak at a New Year's Eve party in London—underscores the major challenge ahead: widespread dissemination of information about the Heimlich Maneuver. In the United States many states have already passed laws requiring the posting of instructions for the Maneuver in eating establishments. In some communities, public

Heimlich Maneuver—How it Works

Foreign object obstructing airway.
Rescuer's hands in position, ready
to deliver thrust



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health officials have conducted active instruction programs and have reported a subsequent decline in choking deaths (Gibbons, 1975). A much greater effort—in the schools, in news-

papers and on television—is necessary, however, to reach the millions of people who do not know how to recognize a choking emergency or how to save a choking victim.

Historical Review of the Literature on Choking

SEVENTEENTH CENTURY OBSERVATIONS

The first written description in the English language of a foreign body in the air passages is contained in a letter from Mr. James Young of Plymouth addressed to Robert Hooke, then Principal Secretary to the Royal Society of London. The letter, which Hooke read before the Society in 1677, is an account of a Mr. Anthony Williamson of Liscard, Cornwall, "who in an attempt to cure himself of colic, swallowed two musket balls." A few days later, on April 12, 1674, he repeated the therapy, and "attempted to swallow three pistol shots; but they almost choked him." One of the shots became lodged in a bronchus and initially produced a severe respiratory reaction. The symptoms apparently then subsided but were followed by intermittent relapses in ensuing months. Almost two years later, the patient underwent treatment "to induce expulsive coughing" and thus expectoration of the foreign body. He was suspended head downward while inhaling "fumes of Storax, Benjamin, etc....together with concussions of the body...but to no avail." Some time later the patient succumbed to pulmonary complications caused by the continuing presence of the foreign body (R. Frank, 1978: personal communication).

Hooke's presentation of the letter to the Fellows of the Society provoked a comment from Sir Christopher Wren, who mentioned "that a relation of the Lord Wenman, upon swallowing a bullet down into his lungs, had been freed from the same not long after by a person, who turned him with his heels upwards, and shook him, and thereby making him cough occasioned the bullet to fall back into his epiglottis, and from thence by the cough to be thrown out with great violence, and so he had no further mischief thereby" (Birch, 1757).

It is rather remarkable that even in the seventeenth century the "logic" of inversion and pounding the victim on the back was exercised, a technique elaborated upon in much greater detail 200 years later. Of the two victims alluded to above, each suffering from aspiration of a similar foreign body, one survived after expelling the bullet by coughing, and the other died of inflammatory and destructive changes following lodgment of the bullet in a distal bronchial tube.

THE WORK OF GROSS

Almost two centuries after these first recorded comments, a volume by a most remarkable and perceptive American surgeon, Samuel D. Gross, appeared. Gross's book, *A Practical Treatise on Foreign Bodies in the Air-Passages*, published in 1854, marked a new era in the awareness of the problem of airway obstruction, and it has become a classic reference on the subject.

The book is based on a personal analysis of 200 cases collected from the world literature or known personally to Gross. Prior to its publication, no such comprehensive analysis had ever been undertaken. As Gross himself states in his preface to the volume:

"I found the whole subject in a state of chaos. No attempt had ever been made, at least in modern times, to systematize it or to present it in a clear, tangible and connected form.

"No complete and elaborate monograph has ever appeared, in any language, on foreign bodies in the air-passages. The only approach to such an attempt, so far as my information extends, was the 'Memoir on Bronchotomy' by Mons. Louis read before the Royal Academy of Surgery at Paris, in 1759, and published soon after in its *Transactions*. In that paper, so celebrated in its day, this distinguished savant collected all the cases of foreign bodies then known to the profession, and pointed out, in

the most forcible and eloquent manner, the importance of a more correct diagnosis, and the indispensable necessity of an early resort to the knife."

Gross was among the first to recognize the diagnostic confusion that so often surrounds an episode of complete airway obstruction. His appreciation of the insidious nature of the problem is evident from the following statement: "How many persons have perished, perhaps in an instant and in the midst of a hearty laugh, the recital of an amusing anecdote, or the utterance of a funny joke, from the interception at the glottis of a piece of meat, a crumb of bread, a morsel of cheese, or a bit of potato without a suspicion on the part of those around, of the real nature of the case! Many a coroner's inquest has been held on the bodies of the victims of such accidents, and the verdict rendered that they had died by the visitation of God, when the actual cause of death lay quietly and unobserved at the door of the windpipe of the deceased."

Case Histories from Gross

The 200 cases presented in Gross's book are interesting not only because of the astute observations Gross derived from them, but also because they lend the weight of past experience to observations made by Heimlich and other modern investigators. Some examples are presented below:

□ A child, aged 1 year, aspirated a half peanut. The first treatment tried was emetics, followed by suspension of the child by the heels—to no avail. There was no success with other therapeutic efforts. Eight months after the accident, after an unusually severe paroxysm of coughing, the child ejected the peanut a distance of 5 feet.

□ A child, aged 7 years, inhaled a bean, which led to violent cough, dyspnea and distress. After awhile the symptoms subsided, and he seemed to be all right, but in stooping forward, he was attacked by the same symptoms as before, and expired from asphyxiation.

□ A boy, aged 4 years, aspirated a grain of corn. A tracheotomy was performed because of impending suffocation. During a subsequent fit of coughing, the grain was forcibly expelled, striking the ceiling of the room, which was 12 feet high.

□ A boy, aged 15 years, inhaled a pebble while running a race. He developed a severe fit of coughing and dyspnea, which shortly subsided. The boy reported that he could distinctly feel the pebble moving up and down the windpipe, particularly while he was coughing. A physician who saw him shortly after the accident kept him with his head down for some time. This experiment, which was repeated three times, did not cause the pebble to escape and always produced violent coughing and difficulty in breathing, which was relieved only when the boy was returned to the upright position. The boy coughed violently both before and after the trachea was incised, and stated that he felt the pebble move but thought it had escaped at the artificial orifice. After a tracheotomy was performed, the boy was once more placed head down and was struck forcibly on the back when he felt the stone move above the wound. While in this position, during the act of inspiration, the stone fell out through the opening in the trachea.

□ A boy, aged 4 years, aspirated a watermelon seed. There was gradual subsidence in the initial difficulty of breathing, although occasional paroxysms of cough and dyspnea continued. The physician was not permitted to perform a tracheotomy until the sixth day, after emetics and errhines (medications applied to the nasal membranes to induce sneezing) had been used, unsuccessfully. By this time, the paroxysms of cough were more frequent, and breathing had become more difficult and croupy. (Apparently there had been considerable inflammation of the larynx and glottis caused by the seed.) An opening about 3/4 inch in length was made in the trachea, and the edges of the incision were held apart. The seed was instantly expelled, and "passing over the shoulder of one of the assistants, fell upon the floor three yards from the table."

□ A 4-year-old child aspirated a leaden bullet. The day after the accident the boy was suspended by the feet and legs, with his head and shoulders down, and was given repeated strokes to the back with the hand. After a few minutes the bullet was dislodged (presumably from the bronchus) and hit with considerable force and a noise like "that of a popgun" against the undersurface of the larynx. The

child's face immediately became purple, respiration became laborious, and other symptoms of strangulation were so alarming "as to excite apprehensions of a speedy dissolution." Promptly, an incision through four or five rings of the trachea was made, and a curved probe was introduced into the incision. But as this excited cough and pain, the instrument was immediately withdrawn. All operative proceedings were stopped and the child placed on the lap of an assistant, where soon he began to breathe easier. "Believing that the bullet had passed into the stomach, the doctor ordered a dose of Calomel and in a few hours had the satisfaction of seeing the bullet in the first stool."

Gross's Observations

Drawing on his analysis of these and many other cases, Gross made numerous observations concerning the problem of airway obstruction. Some of his conclusions are presented below. They are arranged, as he arranged them in the summary to his book, "according to their respective relations, as diagnostic, pathological, therapeutic and operative."

Gross on Diagnosis. The necessity of inquiring carefully into the history of every case before making a diagnosis was emphasized by Gross (see also: Clerf, 1975). The following are summaries or quotations from Gross dealing with the cautions and definitions of symptoms:

□ The foreign body may be arrested in any portion of the air passages from the larynx to the bronchi. The site of lodging is generally determined by the size, weight and configuration of the object, as is its movement from the bronchi into the trachea at times in response to marked expulsive efforts to be rid of the foreign body. Thus, objects such as bullets, shot, coins and nails are more likely to drop into the most dependent portions of the tracheobronchial tree.

□ The object is liable to change its situation in the airway. It may be coughed upward into the trachea from one lung and be reaspirated into the other lung or ejected forcibly into the mouth and swallowed. On the other hand, it may be coughed upward and impacted against the conus elasticus (the undersurface of the

the larynx), producing asphyxiation and death.

□ "The immediate and invariable effect of the entrance of a foreign body into the air-passages is a violent, spasmodic and irresistible cough, with dyspnoea, and a sense of impending suffocation. The countenance is frequently livid and the patient sometimes falls down in a state of insensibility."

□ "The violence of the first symptoms continues from a few minutes to a quarter of an hour, half an hour, or even longer when it is succeeded by a calm, variable in duration, and again followed by cough and difficulty of breathing, very much as in the first instance."

□ "When the extraneous substance is arrested in the larynx, there will generally be more or less change in the voice, sometimes, indeed, total aphonia, hoarseness and croupy cough, with diminished respiratory murmur in both lungs. The latter symptom will be most conspicuous when the body is so large as to impede materially the ingress of air."

□ The initial symptoms of coughing, gagging, choking, wheezing and dyspnea may subside, to be followed by a symptom-less interval which may last anywhere from a few hours to many years. Indeed, the initial episode of foreign body inhalation may never have been witnessed or may have been forgotten.

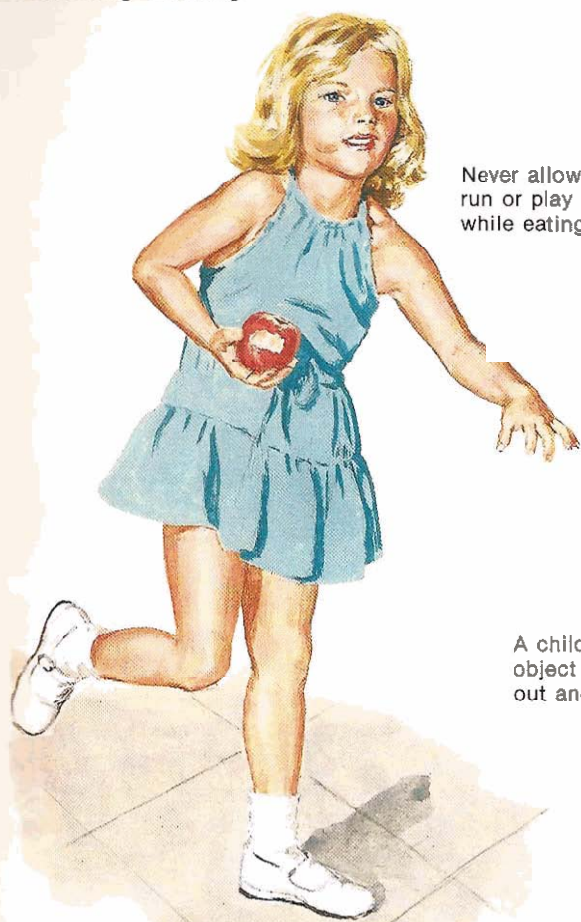
□ A foreign body in the larynx can produce all the symptoms noted above, including voice changes, but to a much more severe degree. The symptoms described may also be caused by trauma inflicted by digital efforts to remove a foreign body.

□ "When the foreign body plays up and down the windpipe, as it often does when it is light and small, it always excites violent and suffocative symptoms, very similar to those produced at the moment of its entrance."

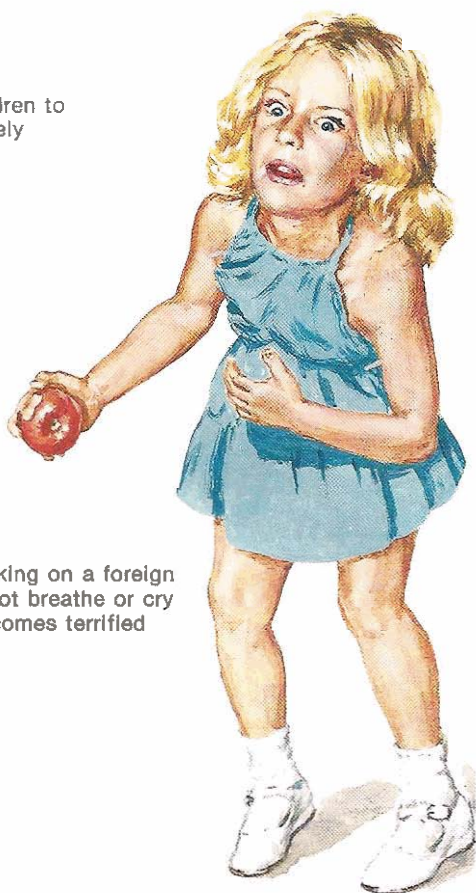
Gross on Pathologic Effects. Gross divides effects into those that are primary—take place immediately after the accident—and those that are secondary—"organic alterations induced in the respiratory apparatus in consequence of the protracted retention of the foreign body." The primary effects are of interest here; some of those observed by Gross follow:

□ Inhalation of a foreign body may cause death immediately or "at a variable period afterwards." In either case, the fatal effect may be

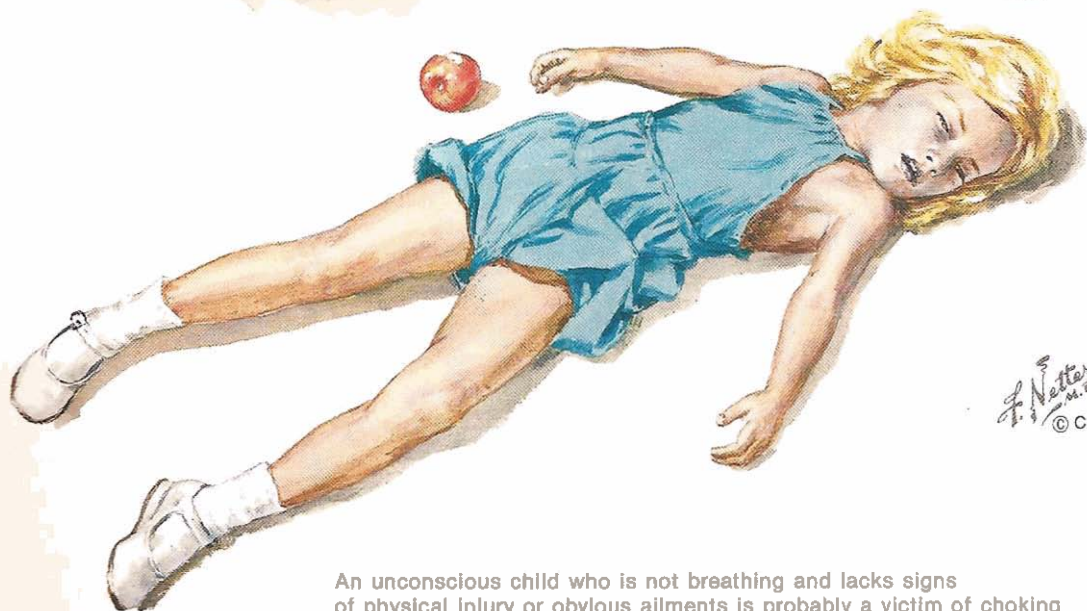
Preventing Choking



Never allow children to
run or play actively
while eating



A child choking on a foreign
object cannot breathe or cry
out and becomes terrified



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An unconscious child who is not breathing and lacks signs
of physical injury or obvious ailments is probably a victim of choking

the result of spasm of the larynx or of mechanical occlusion.

□ Spontaneous expulsion of the object can occur in a violent paroxysm of coughing directly after aspiration, or weeks, months or even years later.

□ "No patient is safe so long as the extraneous substance remains in the windpipe...inasmuch as he may perish at any moment from suffocation or, at a more or less remote period, from inflammation."

□ "The danger from suffocation when the patient escapes the first effects of the accident, is generally greatest...when the foreign body plays up and down the windpipe."

□ Nuts, nut kernels and seeds cause profound inflammatory changes of the membranes of the tracheobronchial tree at the site of contact wherever they come to lodge, while members of the bean family absorb water and swell so markedly that they may cause luminal obstruction, or laryngeal edema and death. (The obvious corollary is that the longer a foreign body remains in the respiratory passages, the more likely is the chance of serious complications.)

Gross on Misguided Attempts at Therapy.

In Gross's time—as now—medical measures were recognized as being totally ineffective. Gross notes that although foreign bodies were occasionally expelled after the use of emetics, errhines and sternutatories (substances which provoke sneezing), "the number of cases is too small to justify the practitioner, under any circumstances, in confiding in these different classes of remedies. Generally, indeed, their effect is to increase the suffering and the danger of the patient, by impelling the intruder against the larynx..." Further cautions and recommendations for treatment by Gross follow:

□ Slapping the patient on the back when the patient is in distress or experiencing respiratory symptoms, turning or holding the patient upside-down or in the head and chest down position, and holding an infant or child up by the ankles or draping it across an arm are all *seriously hazardous procedures*. The addition of *succussion* (vigorous shaking) and *percussion* (striking or beating the chest or the back of the victim) to inversion of any kind increases the danger. Each of these measures

alone or in combination may cause the foreign body either to impact on the underside of the larynx (causing asphyxiation) or to become dislodged and then settle in an upper bronchus (making the removal procedure much more difficult). Laryngeal edema or spasm causing asphyxiation may also result.

□ Finger-probing of the hypopharynx may force a foreign body into an impacted position in the larynx or convert a partial into a complete obstruction. Probing may also force a foreign body into the esophagus (where it may compress the trachea against the sternum causing asphyxiation, *especially in infants and children*) or through the larynx into the trachea.

Gross's Conclusions. In the 19th century, as until quite recently, operative intervention—tracheotomy—was the only answer to the dilemma of the inhaled foreign body.

□ "The proper practice, therefore, is, in all cases without exception, to perform bronchotomy as soon as possible after the occurrence of the accident." The artificial aperture thus created effectively prevented spasm of the muscles of the larynx, enabled the patient to breathe with greater freedom and prevented the possibility of suffocation caused by lodgment of the foreign body against the larynx.

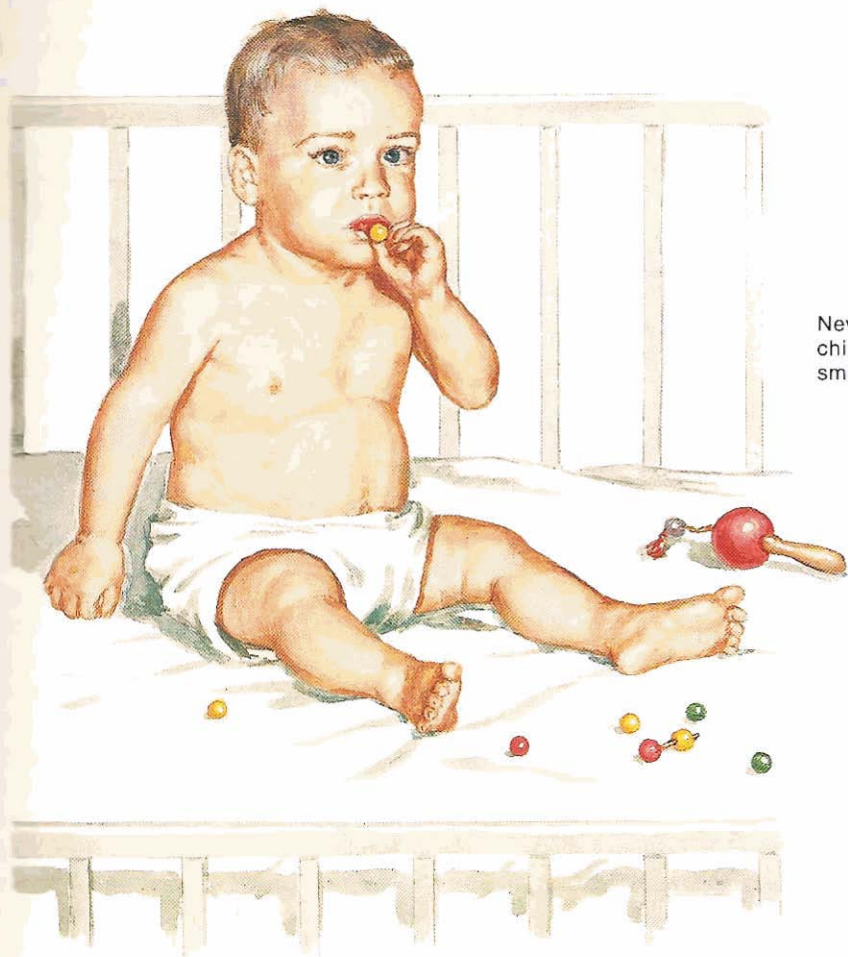
□ "In many cases, however, the foreign substance is expelled as soon as the windpipe has been properly opened, being often projected to a considerable distance from the patient's body. In general, it escapes at the artificial orifice, but sometimes it passes through the glottis, and is either expelled by the mouth, or it descends into the stomach."

It is interesting to note that more than 100 years ago, Gross warned of the dangers of inversion of the victim, blows to the back and chest, and finger-probing of the throat.

THE MODERN ERA

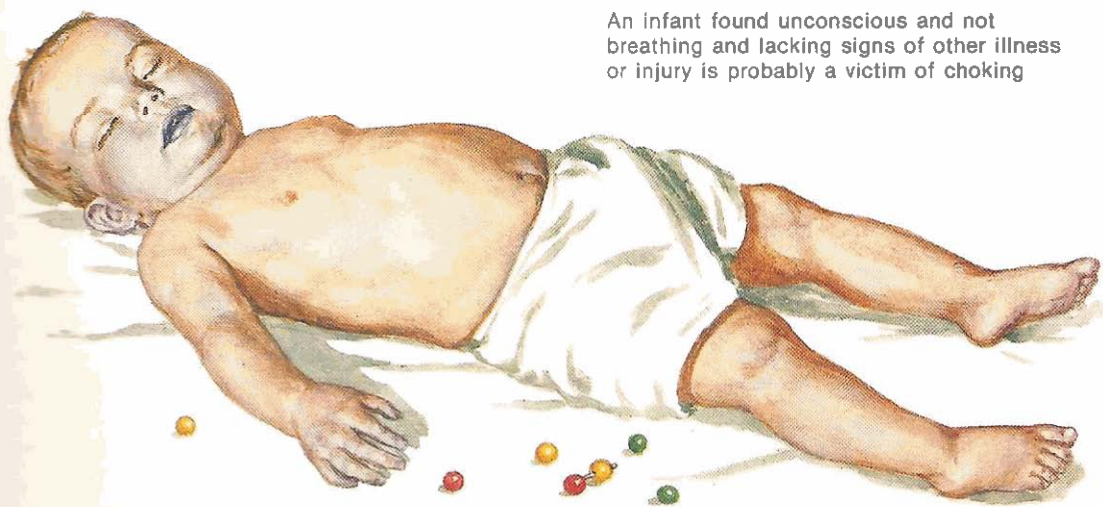
In the final years of the 19th and the first two decades of the 20th century, modes of treatment of airway obstruction became considerably more sophisticated than were the limited techniques available to Gross. Endoscopic examination and x-ray study of the esophagus, larynx and tracheobronchial tree permitted more precise diagnosis and treatment. The bronchotomy (cricothyrotomy)

Preventing Choking



Never allow young children to play with small toys or objects

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An infant found unconscious and not breathing and lacking signs of other illness or injury is probably a victim of choking

technique advocated by Gross was, with rare exceptions, no longer needed. However, the remainder of Gross's conclusions continue to be valid; they have been reaffirmed time and again by later investigators, among them practitioners in two new specialist fields which began to emerge at the turn of the century, otolaryngology and peroral endoscopy.

One of the better known studies on the subject is that from the renowned Chevalier Jackson Clinic in Philadelphia. Beginning with a series of 612 cases in 1917, the Clinic has recorded nearly 6000 patient studies from that time to the present (Jackson, 1973). The observations and cautionary comments offered by Chevalier Jackson and others (Tucker, *et al.*, 1972; Passy and McMaster, 1977; Clerf, 1975; L.H. Clerf 1977 and 1978: personal communications) are remarkably similar to each other as well as to the conclusions drawn by Gross. All of these authorities conclude that only in a situation in which a patient is *in extremis* should such measures as probing in the pharynx with the fingers, turning the patient upside down, or pounding between the shoulder blades be employed. They further add that it is extremely difficult to estimate from death statistics how many choking fatalities are the result of a truly significant initial obstruction and how many are actually the consequence of ill-advised attempts at first aid.

The "Café Coronary"

About 100 years after Gross made his insightful comments about the prevalence of misdiagnosis in airway obstruction fatalities, Haugen (1963) coined the term "café coronary" to describe nine cases of sudden death in restaurants. At first the deaths had all been attributed to heart attacks, but later, at post-mortem study, they were shown to be the result of obstruction of the airway caused by food impaction. Haugen expressed complete revulsion at the size of the fatal morsels: "...the portion of obstructing food was atrocious in all, and abominable in one." (This latter victim was found to have asphyxiated on a piece of filet mignon measuring 3-3/4 by 3 by 1 inch.) Haugen also noted an association between food choking and excessive intake of alcohol, and further pointed out that victims commonly had ill-fitting or painful dentures,

or were edentulous, circumstances which led to poor mastication of food or attempts to swallow large, unchewed portions whole.

These original observations became the basis for a study which was conducted over the following 10 years. Eller and Haugen (1973) reported their autopsy findings in 56 cases of sudden death which had occurred while the victims were eating. The startling findings were that 55 of the 56 had died of airway obstruction caused by food, while only 1 death was caused by occlusive coronary artery disease.

Similar observations were made by Gelperin (1974), who reported three cases of sudden death in hospitalized elderly patients attributed to myocardial infarction, which at postmortem examination were found to have resulted from asphyxiation caused by food in the airway. Brady (1976), the Chief Medical Examiner of the State of Oregon, autopsied and analyzed 50 choking victim cases, 31 of whom had unexpectedly collapsed and died at a dining table. He noted that most deaths occurred at the table (two-thirds), but that many victims were away from the dining area, and the true diagnosis was not suspected until autopsy. Brady also discovered that, in eight cases, death had occurred immediately after the *very first bite of steak*. Witnesses had thus erroneously concluded that death was caused from a heart attack because "his whole steak was in front of him." In 23 of the 50 cases, arteriosclerotic heart disease was present and might easily have been listed as the cause of death had the neck organs not been removed and examined. Irwin and his colleagues (1977) also described deaths from food asphyxiation which were mistakenly attributed to "acute myocardial infarction" until postmortem examination revealed food asphyxiation.

From the preceding studies, it is reasonable to conclude that the death rate from airway obstruction in adults is significantly higher than has previously been suspected.

Airway Obstruction and CPR

In May, 1973, several decades of investigative effort culminated in the National Conference on Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC) cosponsored by the American Heart

Association and the National Academy of Sciences—National Research Council (NAS-NRC). The recommendations of the conference were published as a supplement to the *Journal of the American Medical Association* in 1974, and an issue of *CIBA Clinical Symposia* on the subject (Volume 26, Number 5) also appeared that year. Since two of three steps of the proposed "ABC's of Basic Life Support"—"A" (airway) and "B" (breathing)—were concerned with establishing and maintaining ventilation, airway obstruction became a matter of prime interest.

The problem of an obstructed airway during a heart attack had earlier been addressed by the Ad Hoc Committee on CPR of the NAS-NRC (1966). This committee had recommended a sequence of procedures for clearing the airway in a cardiac victim, and the standards published in 1974 were essentially similar. As the recommended CPR procedure predated the first report of Heimlich's work, the subdiaphragmatic thrust was not included as one of the steps at this time, although subsequent recommendations by various national organizations have incorporated the thrust as a rescue technique to be used on victims with obstructed airways.

The Work of Heimlich

Four months after the release of definitive CPR standards in 1974, Heimlich published in *Emergency Medicine* the first description of his technique. Gordon (1977) summed up Heimlich's impact on the field of emergency treatment of the choking victim as follows:

"The work of Heimlich deserves recognition for its impact in re-awakening interest in

food-choking and foreign body obstruction of the airways and for redirecting attention to this important problem as well as the need for immediate action. His contributions include: 1, detailing the signs for early recognition; 2, emphasizing a universal sign for food-choking; 3, recommending immediate instead of delayed action; 4, demonstrating the specific manual maneuvers which could be life-saving; 5, providing wide dissemination of explicit instructions for those simple maneuvers."

CONCLUSIONS

The emergency of acute airway obstruction has distressed mankind throughout the centuries, and has been addressed by numerous investigators. Authors such as Gross made significant contributions which unfortunately often went unrecognized, or were forgotten. Indeed, this story is yet another instance of the truth of the statement that "those who can not remember the past are condemned to repeat it." Contemporary authors, such as Haugen and Gelperin, sought to define the problem, especially with reference to accurate differential diagnosis. More recently, the wide recognition of CPR as a life-sustaining technique has created a renewed focus on the problem of acute airway obstruction. We have now become aware that an obstructed airway is of itself a life-threatening event, which has been misdiagnosed in many cases of sudden death, and that it is a readily reversible condition if recognized promptly and treated appropriately. The introduction of the Heimlich Maneuver thus represents the latest, and most promising, addition to the body of knowledge on acute airway obstruction.

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In June, 1977, while completing the final plates for Volume 7 of the CIBA Collection of Medical Illustrations—"Respiratory System"—Dr. Frank Netter invited Dr. Milton Uhley to collaborate with him in the preparation of some material on the Heimlich Maneuver. Working with Dr. Uhley, Dr. Netter developed illustrations and legends depicting the rescue procedure, several of which were published in "Respiratory System." In preparing the material for the CIBA Collection, Dr. Uhley undertook an extensive historical review of the literature on airway obstruction and the various rescue methods that have been proposed in the past. The highlights of his research are presented here, along with a full description of the Heimlich Maneuver by Dr. Henry Heimlich himself.