Back-Pressure Arm-Lift Artificial Respiration

By HEINZ SPECHT, Ph.D.

On December 6, 1951, the Department of Defense announced the adoption of an improved method of manual artificial respiration. The new method, a back-pressure arm-lift method originally described by Holger-Neilsen, has been adopted by other organizations, including the American National Red Cross; the American Telephone and Telegraph Co.; United States Bureau of Mines; Boy Scouts of America; Camp Fire Girls, Inc.; Council on Physical Medicine and Rehabilitation, American Medical Association; Federal Civil Defense Administration; Girl Scouts of the U. S. A., Inc.; and Public Health Service, FSA.

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Opinions regarding the "best" method of manual resuscitation have never been unanimous. Until 1927, when the Public Health Service Conference on Artificial Respiration was held, a variety of methods were used. As a result of that meeting, a number of groups (*1*) representing the major interests in this country agreed that the prone-pressure method be adopted as the standard to be taught throughout the country.

Sporadic interest in the basic principles of resuscitation continued in the laboratories, but their findings rarely reached the groups teaching resuscitation methods. The general feeling that manual resuscitation was only partially successful stimulated efforts to develop mechanical aids. Some authorities still consider that the manual method is only a temporary measure to be used until mechanical means can be applied, whereas it is evident from the recent research that proper manual methods are fully adequate.

Analyses of the effectiveness of manual methods on the basis of field experience have not been reliable, for obvious reasons, and the most optimistic reports indicate that not more than 75 percent of the efforts at manual resuscitation were successful. It is apparent that an accurate estimate of the ratio of successful to unsuccessful resuscitation attempts cannot be made. Unsuccessful cases are not likely to be reported, and reports of successful attempts include persons who would have revived without application of artificial respiration.

It was the realization of this general feeling, at least among the medically and scientifically trained portion of the population, that led the Red Cross in 1946 to support specific investigations on the effectiveness of various methods of manual artificial respiration. In 1948, a conference on this subject, called by the American National Red Cross with a subcommittee of the Committee on Physical Medicine of the American Medical Association, increased the impetus to apply modern methods of quantitative research to the problem. In 1949, the medical laboratories of the Army Chemical Center took up the question in connection with chemical warfare.

The import of these discussions, especially as they bore on civil defense activities, brought the whole matter to a critical point. Rapid progress was made when, in 1950–51, the several military departments supported four decisive

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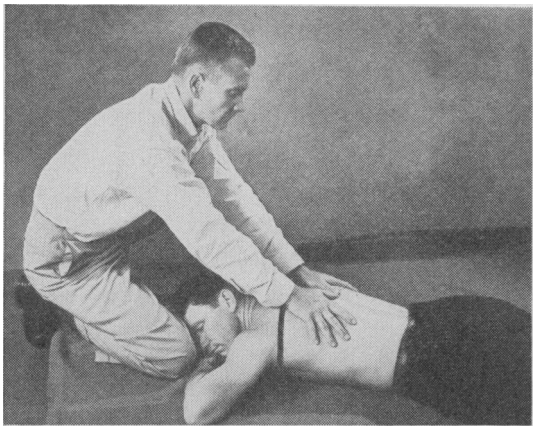
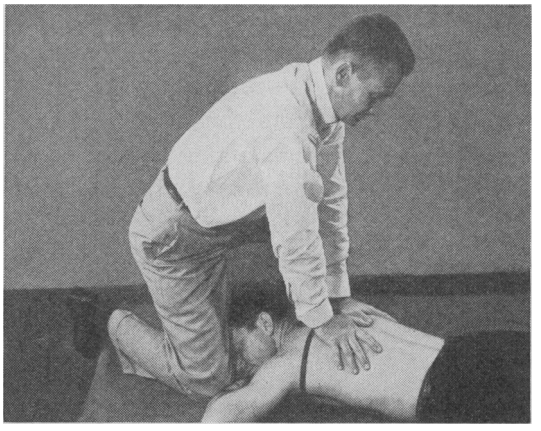
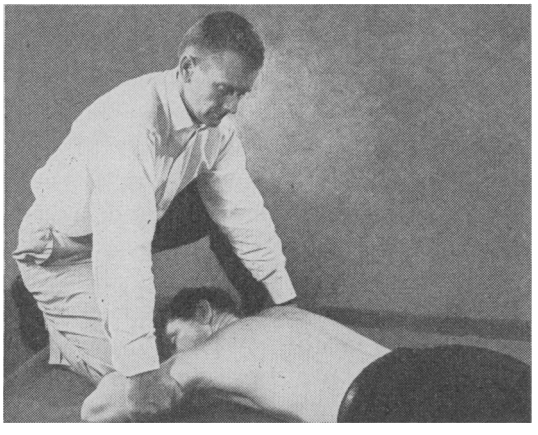
Correct positions for the back-pressure arm-lift method of artificial respiration are illustrated below. In this method the person is placed prone with the elbows bent and with one hand upon the other. The forehead is placed on the hand with the face turned slightly to one side. The operator kneels on one knee at the head of the victim.



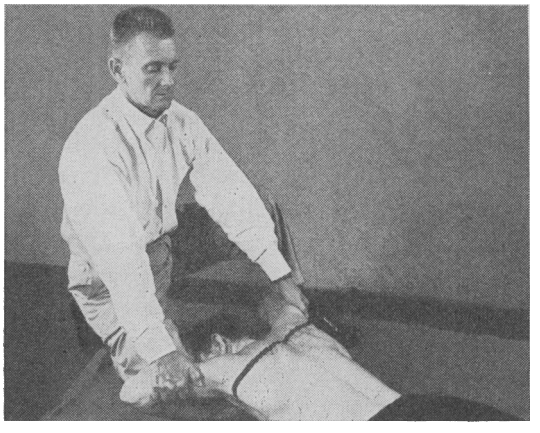
1 To start the cycle the operator places his hands on the victim's back so that the thumbs just touch and the heels of the hands are just below a line between the armpits.



2 He then rocks forward slowly, keeping the elbows straight, until his arms are approximately vertical, exerting steady pressure upon the back.



3 Then he rocks backward, slowly sliding his hands to the victim's arms just above the elbows.



4 Continuing to rock backward he raises the arms to lift the chest weight from the floor and expand the chest.

investigations in response to the need for conclusive data to support the most effective method for inclusion in the pending revisions of the military first-aid manuals. On October 1–2, 1951, the National Research Council's ad hoc committee on artificial respiration recommended that the Holger-Neilsen method be adopted as the standard method of manual artificial respiration. This recommendation was based on a series of investigations (*2–7*) which should be understood by all public health workers. Although many national organizations teach resuscitation, and it is the direct function of the American National Red Cross to teach the newly selected standard method for the civil defense program, the dissemination of the reasons for the change from the Schafer prone-pressure method should be undertaken by every person in a position to use, teach, or recommend resuscitation procedures.

The several investigations (*2–7*) form the most significant assay of manual artificial respiration that has been attempted.

Resuscitation Methods

Actually, many variations of several basic methods were applied, but in general it was found useful to categorize the methods functionally as to what is done to the subject and to observe the most effective technique for each of a selected group. These are briefly defined as follows:

Prone Pressure (Schafer). Subject on belly, head on hands, mouth to side, bimanual pressure applied to lumbar back.

Supine Chest-Pressure Arm-Lift (Silvester). Subject on back, mouth up or to side, operator folds forearms over chest applying pressure, unfolds arms and extends them over subject's head, either partly or completely horizontal.

Prone Back-Pressure Arm-Lift (Holger-Nielsen). Subject on belly, head on hands, mouth to side, operator applies bimanual pressure below shoulder blades, then lifts arms at elbows to expand rib cage and partially lift chest.

Prone Hip-Lift (Thompson, Emerson-Ivy). Subject on belly, head on hands, mouth to side, operator raises hips 4 to 6 inches. (May be combined with back pressure.)

Prone Hip-Roll (Emerson-Ivy). Subject on belly, head on hands, mouth to side, operator raises one hip 4 to 6 inches. (May be combined with back pressure.)

The principal difference between the prone-pressure method and the others listed is that the latter include an active inspiratory maneuver either by manipulation of the arms or by raising the hips. This action affords not only greater tidal exchange but also, perhaps, a larger surface for gaseous exchange.

One of the more important advances in methods of study of manual artificial respiration lies in the use of curarized and anesthetized volunteers (*2*) whose flaccid condition simulates the deep asphyxial condition of the more serious apneic cases. In addition to this, large numbers of acapnic apneic volunteers, some traumatic apneics, and large numbers of fresh cadavers were also subjected to the various artificial respiration methods. The various approaches gave essentially similar results (*2–7*) which will be briefly paraphrased here.

Results of Studies

The studies on air-flow patterns and pulmonary ventilation (*2*) show that the two-phase methods as a group are about twice as effective as the prone-pressure method. Pneumotachographic analysis shows that a rate of 10–12 complete cycles per minute in these cases permits completion of each cycle.

Pulmonary ventilation studies on nonapneic subjects (*3*) gave results similar to those on apneic subjects, indicating an equivalence of the various two-phase methods and a twofold superiority over the prone-pressure method.

Studies on the mechanics of breathing during artificial respiration by the various methods (*6*) showed that the two-phase techniques were superior to the prone-pressure method in clinical traumatic apneics and that air-flow measurements indicated a better utilization of the respiratory cycle for ventilation in the two-phase techniques than in the prone-pressure method. A similar experience regarding the efficacy of the various methods (*7*) was reported from another group of clinical apneics in which

higher rates of respiration were found to be more effective.

Circulatory studies (*2*) showed that the prone-pressure method could not maintain adequate blood oxygen levels in three of nine cases and that it gave the lowest blood oxygen levels of any method used. All the two-phase methods gave adequate blood oxygen values, although none produced normal saturations. Hyperventilation was not found to be deleterious in these subjects.

The energy expended by the operator in carrying out the various maneuvers was assessed in terms of oxygen consumed per unit time (*2*, *4*). It was apparent that the prone-pressure maneuver was least taxing, the hip-lift method most taxing, and the others intermediate.

The "teachability" of the previously nonstandard methods (*5*) was assessed on a large group of operators (667 male and 214 female). Both objective and subjective reports indicated that a 10-minute instruction period was sufficient to adequately teach the various back-pressure hip-lift maneuvers. The back-pressure arm-lift method was found to be more readily learned than the hip-lift maneuvers. The principal difficulty leading to variation in learning and execution lies in the difference in size between the operator and the subject.

Together with the background of earlier work these data indicate that the prone-pressure method (*a*) produces the least pulmonary air exchange of the major methods that have been proposed; (*b*) that in some individuals the air exchange is no greater than the volume of air in the respiratory passages; and (*c*) that it is less effective in flaccid individuals, that is, as occurs in deep asphyxia.

Although nearly all methods in the hands of unskilled or unthinking operators may produce trauma, especially where damage exists, there are no such reports from countries where the back-pressure arm-lift method is practiced generally. On the other hand, the prone-pressure method has been reported to have caused occasional trauma principally in the hands of large operators on slight or immature victims. Obviously, discretion must be used when traumatic accident cases are handled. For this reason alternative methods should be available. From the several two-phase methods, such a choice can readily be made without serious loss of ventilating efficiency.

It is apparent that the back-pressure arm-lift (Holger-Nielsen) maneuver is the choice for a standard manual artificial respiration method, on the basis of efficiency, ease of teaching, and feasibility.

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