

ON ARTIFICIAL RESPIRATION.

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It has frequently occurred to me to wonder why, in performing artificial respiration for the resuscitation of patients showing signs of syncope under anæsthesia, the Sylvester method of inflating the chest by movements of the arms is so generally adopted.

On looking into the history of the method^a I find that before the year 1756 the "immediate insufflation," or mouth-to-mouth method, was employed exclusively. Of course, the cases which came under treatment at this period were almost invariably those of drowning. This method, as advocated by Dr. Fothergill early in the eighteenth century, is thus described:—

"He placed his mouth to the mouth or nostril of the patient, or, as was the more common, as well as the more desirable, practice, he made a funnel of his right hand, placed that by the outer (ulnar) part over the nostrils, and closing the mouth of the patient and putting his own mouth to the opening of the funnel formed by the thumb and forefinger, he breathed through the funnel backwards and forwards, so as to empty and fill the lungs of the patient."

In the year 1756 Joseph Black, M.D., the celebrated chemist, demonstrated the toxic action of carbonic acid

^a Asclepiad, 1890. P. 277.

gas—then called “fixed air”—and proved its presence in expired air.

The deductive reasoners of that day, startled by the discovery that a poisonous gas was exhaled by the lungs, determined that immediate insufflation was dangerous. The result was that the method, previously considered effective, fell into complete disuse—for it was argued that to pour the exhaled breath of one human being into another human being was to commit a grave physiological error, and to intensify the bad condition which was already present.

Manipulative methods of various kinds were accordingly substituted. All these seem to have had for their principle expulsion of some of the residual air by compression of the chest, a like quantity returning to the chest when the pressure was removed. This compression was either effected by direct pressure on the chest and abdomen, or indirectly by Hall's method, where the patient was rolled gently from the side to the front part of the chest and back again about fifteen times a minute.

These methods were defective enough, and when in 1857 Sylvester introduced his plan it was justly regarded as an enormous improvement on the almost futile practices then in vogue. Its underlying principle was to increase the chest capacity by raising the arms over the head so as to put the extraordinary muscles of respiration on the stretch, and then by bringing the arms down again and compressing the chest to expel not only the air which entered during the first movement, but also some of the residual air. By repetition of this process a fair amount of tidal air was made to flow and ebb, certainly much more than was possible by any of the previous manipulations.

Some idea of the unreasoning way in which artificial respiration was sometimes practised before Sylvester's

time may be obtained from one of his original letters, in which he drew attention to the futility of applying compression to the chest wall of the newly born baby, showing that since there was as yet no air in the chest to expel, compression could not alter its amount. Contemporary ideas on the mechanism of respiration must have been somewhat nebulous, when the necessity of alluding to so obvious a point existed.

Since the method of immediate insufflation was discarded a century and a half ago, no one, so far as I can find, has seriously questioned the validity of the grounds on which this important step was taken. Benjamin Ward Richardson, it is true, in order to overcome the objection to the mouth-to-mouth method, devised a special bellows for insufflation, but the suggestion is a counsel of perfection, for the apparatus is never at hand when needed.

If the above description is correct where it says the operator "breathed through the funnel backwards and forwards so as to empty and fill the lungs of the patient," it certainly was not ideal, either for the operator or the patient, and should have been modified as follows:—The operator first takes a deep breath or two, so as to purify his own lungs, and by a single puff fully inflates the patient. During this act sufficient pressure is applied to the cricoid cartilage to keep the gullet closed, and thus prevent the air from entering the stomach. Then removing his mouth from the patient's mouth or nose, the inflated air is allowed to escape, the last portion of it being expressed by moderate pressure on the chest and abdomen, the process being repeated about every five seconds. Assuming that this practice is followed, I shall endeavour to show that the method is superior to any other.

In the first place, the quantity of air introduced into the chest by blowing is very much greater than by Sylvester's

method, for, even supposing the amplitude of the chest wall movement to be no greater, the positive pressure in the thorax will cause the descent of the diaphragm, and so greatly increase the volume of air admitted.

In the resuscitation of the apparently drowned, two effects are sought—first, the starting of the heart mechanism, and, secondly, the oxygenation of the blood. In cases of poisoning by volatile drugs, such as chloroform, there is a third effect desired—viz., the elimination of the poison. As far as starting the heart mechanism is concerned anyone can prove on himself that increasing the depth of the respiration increases the force and frequency of the heart beat. It is fair, therefore, to assume that the better the chest is filled the greater will be the stimulus to the heart's action. The method, therefore, by which the largest volume of air is made to ebb and flow will, both from this point of view and that of an elimination of a volatile drug, be the best.

Now, as regards æration of the blood, this is the point on which it seems to me the theorists of the eighteenth century went entirely wrong. They allowed themselves to be frightened from a most excellent practice by the inference drawn from the fact that exhaled air makes lime water turbid. No one doubts that carbonic acid gas is poisonous, but to say that it is present in poisonous quantity in expired air is absurd. Patients breathe and re-breathe the air from the bag of an ether inhaler for a very considerable fraction of an hour at a time, with no bad effects, though the quantity of carbonic acid gas present must necessarily be very high, and the oxygen minimal.

Again, even admitting the theoretical impurity of expired air, it is safe to say that any defect in its quality is more than compensated for by the extra quantity introduced by the mouth-to-mouth method, while in addition

we must remember that by comparison with that in the lungs of a poisoned or asphyxiated patient it is purity itself.

But then there is yet another point for consideration. At the end of the operator's inspiration the column of air from the bifurcation of the trachea upwards may be regarded as entirely pure. Now this is the portion which first reaches the patient's lungs. If before inflating the patient he rapidly takes two or three deep inspirations, so as to include both supplemental and complementary air, as divers do before going under, even the theoretical objection to expired air is got rid of, for its purity is as great as if it came from a bellows.

It has fallen to my lot to have seen several cases of syncope under chloroform. I may mention four of the worst. Two did not recover, though Sylvester's method was practised. In a third, a case of sarcoma of the throat in a powerful man, aged about thirty, I had done a preliminary tracheotomy. Chloroform was given through the tracheal tube. Bleeding was at first free; later I found he was not bleeding at all. The anæsthetist simultaneously raised an alarm. The patient had ceased to breathe, the skin was pallid, the pupils dilated, the cornea anæsthetic, and the pulse absent, or at least impalpable at the wrist. I insufflated the patient through the tracheal tube. In a minute or two his colour returned, and he began again to breathe and bleed.

In another case, that of a girl aged fourteen, on whom I operated some years ago, being assisted by an anæsthetist of great experience, a similar condition of profound collapse occurred. The patient was restored after a moment or two of direct insufflation.

Of course, in any given case it is impossible to say that the patient would or would not have recovered by another

method, but it seems to me to be clear from every consideration that the mouth-to-mouth or nose method gives the patient the best chance, for, to recapitulate:—

(1) The quantity of tidal air is greater than by any indirect method, and, therefore, the stimulation of the mechanisms of circulation and respiration, the elimination of the poison, and the oxygenation of the blood are all as great as possible.

(2) The impurities, if present at all, are negligible.

(3) The method can be applied without a moment's loss of time.