ON CHLOROFORM AND OTHER ANÆSTHETICS
THEIR ACTION AND ADMINISTRATION
BY
JOHN SNOW, M.D.
Licentiate of the Royal College of Physicians
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"Case 3. On the 6th of March, 1852, I had occasion to remove the finger of a robust, healthy-looking young man, in the Royal Infirmary. He was already under the influence of chloroform when I entered the room, and as there had been some difficulty in producing complete anaesthesia, and the last of the chloroform in the bottle was already on the handkerchief, it was thought advisable by my friend in charge of its administration to keep up the inhalation, in order to produce a coma sufficiently profound to last until the completion of the operation. It was therefore left over his face, and I commenced and removed the finger, slowly disarticulating it from the metacarpal bone. I distinctly recollect hearing the man breathing quickly and shortly; and I also remember, that when just about to look for the vessels, my attention was attracted to his condition, by not any longer hearing the respiration. The handkerchief was still on his face. I took it off, and found, to my consternation, that the breathing had ceased; the face was livid; the eyes suffused; the pupils dilated; the mouth half-open. He was to all appearance dead; still the pulse could be distinguished as a small, hardly perceptible thread, beating slowly. Immediately artificial respiration was commenced. For a minute or two, his condition did not alter in any respect—then the lividity of the countenance increased, the pulse was no longer perceptible, and the sounds of the heart could not be satisfactorily heard. During the whole of this time, artificial respiration had been diligently employed, but still the air appeared to enter the chest very imperfectly. I despaired. I felt certain that the man was dead, and that no human aid could restore him; and if it had not been that those standing near me urged me to persevere, I believe I should then have deserted the case as hopeless. Just at this time it occurred to me to put my finger in the mouth and draw forward the tongue, in order to secure there being no impediment to the air entering the lungs. Retaining it in this position, we again began the artificial respiration, and found that then the chest was fully expanded by each inflation. After keeping it up for a minute or two, the gentleman, who had all along kept his hand on the pulse, exclaimed, to our delight, that he could again feel it—'It was just like a slight flutter that reached the uppermost of his four fingers,' all of them being placed over the course of the artery. It gradually became more distinct and firmer, and at the same time, the lividity of the face decidedly lessened. In another minute, the man made a slight inspiratory effort. I ceased directly the artificial respiration, and merely assisted the expiration by pressure upon the ribs. Another and another in-
spiration followed, and in a short time he breathed freely without assistance. The countenance became natural, and he appeared as if in a sound sleep. In half an hour, he spoke when roused; then he vomited, and complained of giddiness. In an hour afterwards, he had recovered sufficiently to walk home.

"Moments of intense anxiety appear much longer than they really are; but even allowing this, I am quite sure that, at the very least, five minutes elapsed from the time when the man ceased breathing before the first inspiratory effort took place, and that for not less than one minute the pulse was imperceptible, and the heart’s action almost, if not altogether, inaudible."

"Case 4. A few weeks after the occurrence just described, I was assisting Mr. Syme in removing the breast of a lady. A gentleman, my superior in the hospital, was conducting the inhalation of chloroform. Anaesthesia was complete, and the breathing good, when the operation commenced. The chloroform was allowed to remain over the face during the whole time of its performance. Before it was over, I noticed the respiration become very quick and incomplete, and suggested, in consequence, the propriety of removing the handkerchief. My remark was neglected for eight or ten seconds, and then, just as it was taken away, the breathing ceased suddenly. The face became deadly pale; the eyes vacant; the lips livid. Instant dissolution appeared inevitable (the pulse was not felt). Artificial respiration was immediately commenced, but the air not entering the lungs freely, the tongue was pulled forwards, and retained so by the artery forceps. The chest then expanded freely with each inflation, the air escaping with a cooing sound. In rather less than a minute, the respiratory movements recommenced, but at first so slowly and imperfectly that it was necessary to assist expiration. When recovery was a little more established, the operation was completed. Before the putting in of the sutures, sensation had partially returned, and in a short time the lady had perfectly recovered."

Mr. Bickersteth very properly adds: "There can be no doubt, that in the foregoing cases, a grievous error was committed by continuing the inhalation after anaesthesia was produced, and that it was in consequence of this, the accidents, so nearly fatal, occurred."

As these accidents seem to have occurred from continuing the inhalation too long, they differ entirely from nearly all those which are actually fatal, and which, as we have seen, arose from the too great concentration of the vapour, and not from any want of care in watching the patient, so as to be able to leave off at the right moment, if it were possible. I have previously stated, that after breathing vapour of the proper strength for inhalation, animals may always be readily restored by artificial respiration after the breathing has ceased, provided the heart is still beating. In the cases related by Mr. Bickersteth, the heart had ceased to beat before the patients were restored; but in the third case, there is distinct evidence that the heart continued to beat for four minutes after the breathing had ceased. It was, therefore, certainly not paralyzed by the direct action of the chloroform. The patient was nearly in the condition of a drowned person, where we know that there
is a good prospect of recovery by artificial respiration during the first few minutes after the breathing has ceased, even if the action of the heart be imperceptible. In the other three cases, also, it is probable that the breathing ceased before the action of the heart; and, at all events, this organ was not paralyzed so thoroughly as in the cases in which artificial respiration was promptly applied without effect.

Several other cases have been related in the medical journals in which patients have been restored by artificial respiration, after animation had been suspended, more or less completely, by chloroform; but the above remarks would, I believe, be applicable to all these cases.

Where patients have recovered under the use of other measures, without artificial respiration, it is probable that animation was not completely suspended, and that the recovery was spontaneous.

M. Delarue related a case of accident from chloroform to the Academy of Medicine, on August 20th, 1850, which was apparently of this nature. After administering the vapour, and when he was about to divide some sinuses in the thigh, he found that his patient (a woman) was in a state of collapse, and the breathing and pulse, "pour ainsi dire", insensible. The face was injected, and there was a bloody froth at the mouth. The uvula was titilated, and there was immediate movement of the eyelids, which was soon followed by copious vomiting, and the patient recovered.*

Such measures as dashing cold water on the patient, and applying ammonia to the nostrils, can hardly be expected to have any effect on a patient who is suffering from an overdose of chloroform; for they would have no effect whatever on one who has inhaled it in the usual manner, and is merely ready for a surgical operation, but in no danger. I have applied the strongest ammonia to the nostrils of animals that were narcotized by chloroform to the third or fourth degree, and it did not affect the breathing in the least. They recovered just as if nothing had been done. It is difficult to suppose a case in which the breathing should be arrested by the effects of chloroform whilst the skin remained sensible, yet it is only in such a case that the dashing of cold water on the patient could be of use. There is, however, no harm in the application of this and such like means, provided they do not usurp the time which ought to be occupied in artificial respiration; for this measure should be resorted to the moment the natural breathing has entirely ceased.

I have seen only two cases in which the patients seemed in imminent danger from the direct effects of chloroform. One of these occurred in 1853. It was the case of a child, aged six years, but small and rickety, which had the greater part of the eyeball removed on account of melanotic disease. The usual inhaler was employed, and when the child seemed sufficiently insensible, it was withdrawn. The operation was commenced by introducing a large curved needle, armed with a thick ligature, through the globe of the eye, in order to draw it forward. As the needle was introduced, the child cried out a very little, and thinking the parents, who were in the adjoining room, would be alarmed, I poured some undiluted chloroform hastily on a rather large sponge, and placed it over the nostrils and mouth. The

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* L'Union Médicale, 1850, p. 411.
sponge became pressed by the surgeon’s hand closer on the nose than I intended, but it was removed after the child had taken a few inspirations. The operation was quickly concluded without any further sign of sensation than that mentioned above. At the end of the operation, the breathing was natural, but the face was pale, and the lips blue, and the limbs were also relaxed. I tried to feel the pulse at the wrist, but did not discover any. The chloroform had at this time been left off half a minute at least. The pallor and blueness continued, and in a little time the breathing became slow and embarrassed, and appeared about to cease altogether, the pulse being still absent. The windows were opened, and cold water dashed freely on the face. The child made gasping inspirations now and then, but they did not follow immediately, or seem connected with each application of the water. The gasps became more frequent, till the breathing was thoroughly reestablished, when the colour returned to the lips, and the pulse was again felt at the wrist. In a minute afterwards, the child was red in the face, and crying violently from pain, which was relieved by a little more chloroform. It appeared to be a minute or a half from the time when the sponge with chloroform was removed, till the breathing became of a gasping character. There is no doubt that in this case the heart was paralyzed, or nearly so, by the chloroform, and that its action was restored by the spontaneous gasping inspirations of the child. The accident could have been prevented by having the chloroform, which was put on the sponge, diluted with spirit.

The other case occurred in the latter part of 1852. I have no notes of it, as it took place at the beginning of an illness, which prevented me from writing for some time; but I recollect the chief particulars of it sufficiently well. The patient was a lady rather more than sixty years of age, rather tall and thin. She required to have a polypus removed from the nose. Mr. Fergusson, who was about to operate, was nearly an hour after the appointed time, and during this interval she was pacing up and down the room, apparently in a great fright. She was placed in an easy chair for the operation, and the pulse was small and feeble when she began to inhale. Nothing particular occurred during the inhalation, but just at the time when the patient was becoming insensible, the breathing ceased, and the pulse could not be felt. She appeared to have fainted, and was immediately placed on a bed which was in the room. I applied my ear to the chest, but could hear no sound whatever. Mr. Fergusson applied his mouth to that of the patient, and with a very strong expiration, inflated her lungs, so as to expand the chest very freely. I immediately heard the heart’s action recommence with very rapid and feeble strokes, as I had so often heard it recommence in animals. The patient soon began to make distant gasping inspirations, and the natural breathing and pulse were soon reestablished. Mr. Fergusson made only one or two inflations of the lungs after the first one, which of itself was the means of restoring the patient. It was about twenty minutes, however, before she became conscious; and during the greater part of this time there were spasmodic twitchings of the features and limbs on one side. In about an hour, she was pretty well; and on the following
day the operation was performed without chloroform.

The most ready and effectual mode of performing artificial respiration is undoubtedly the postural method, introduced by Dr. Marshall Hall a little time before his death. It consists in placing the patient on the face and making pressure on the back; removing the pressure, and turning the patient on his side and a little beyond; then turning him back on the face and making pressure on the back again; these measures being repeated in about the time of natural respiration.

Whether the artificial breathing is successful or not must depend chiefly on the extent to which the heart has been paralyzed by the chloroform, as was previously observed. The fact of the breathing continuing after the action of the heart has ceased, in some of the fatal cases, shows that the heart may be so paralyzed as not to be readily restored by the breathing. It is probable that in all cases in which artificial respiration can restore the patient, its action would be very prompt; still it is desirable to persevere with this measure for a good while.

As already stated, there is every reason to conclude that the right cavities of the heart are distended with blood, in all cases of suspended animation by chloroform, and therefore it would be desirable to open one of the jugular veins if the artificial respiration does not immediately restore the patient. In opening animals, just after death from this agent, I have observed the contractions of the heart to return, to a certain extent, when the distension of its right cavities was diminished by the division of the vessels about the root of the neck. Opening the jugular veins has been resorted to in a few of the cases of accident from chloroform, but hitherto without success.

I have not succeeded in restoring an animal from an overdose of chloroform, by means of electricity, in any case where I felt satisfied that it would not recover spontaneously; and I have not heard of any patient being restored by its means. For keeping up respiration, mechanical means, such as the postural method, are better; as they cause air to enter the lungs without exhausting the remaining sensibility. If electricity be used, it should be directed towards restoring the action of the heart. It is probable that the electric current would not reach the heart without the help of the acupuncture needle; but it would be justifiable to use this in a desperate case, when other measures had failed. The needles should be coated with wax, or some other non-conductor of electricity, except near the points.

In the fatal cases Nos. 40 and 48, previously related, the action of the heart partially returned during the efforts that were made for the restoration of the patient, but did not become thoroughly re-established. It is probable that the circulation through the coronary vessels of the heart was not restored in those cases, or else the blood which must have been freed from chloroform, in its passage through the lungs, would most likely have enabled the heart to recover completely. Dr. Cockle has expressed the opinion, which is very probable, that the blood enters the coronary arteries in a retrograde manner, during the diastole of the ventricles, when the aorta and other great arteries are contracting on their contents; if so, with a very feeble circulation, the
elasticity of the aorta, perhaps, cannot sufficiently act to cause a backward current; and perhaps, also, the over-narcotism of the heart is itself an obstacle to the coronary circulation, on account of the congestion of the capillaries which always attends on narcotism.

The knowledge how seldom anything effectual can be done for a person who has inhaled a dose of chloroform from which he would not spontaneously recover, ought to impress the rule very strongly on every one, to use the greatest care in its administration.

**EFFECT OF CHLOROFORM ON THE RESULT OF OPERATIONS**

Besides the great benefit conferred by chloroform in the prevention of pain, it probably confers still greater advantages by the extension which it gives to the practice of surgery. Many operations take place in children which could not be performed in the waking state; excisions of joints and tedious operations for the removal of necrosed bone are often performed on persons who would be altogether unable to go through them except in a state of anaesthesia; and the moving of stiff joints by force is an operation now frequently performed, although it would probably not have been thought of if narcotism by inhalation had not been discovered. The surgeon also obtains the ready assent of his patient to a number of other operations, where it would either not be obtained at all, or not at the most favourable time, if the patient had to suffer the pain of them.

The effect of chloroform cannot fail to be favourable, to a certain extent, in large operations. The patient is in a more tranquil and cheerful condition after the operation, than he would be in if he had suffered the pain of it. His pulse is usually of the natural frequency; and after an amputation, there is generally an entire absence of the starting of the stump, which was formerly so distressing. After all the minor operations in which chloroform is used, and which according to my experience comprise at least one-half of the cases, there is never a death; and the only inconvenience is a troublesome sickness of stomach in a very few instances. Moreover, when patients die after the more formidable operations, they succumb to causes which are well known, and were in operation before the practice of anaesthesia. I only know of a very few instances where there has been a reasonable doubt on the mind of the surgeon, whether the chloroform may not have had some share in preventing the recovery of the patient, after a severe operation. These were cases in which the sickness, which occasionally follows chloroform, continued for three or four days, indeed till the death of the patient. This is a point which it would be difficult to decide, for the latter part of the sickness might depend on the sinking state of the patient, and might have come on if chloroform had not been used. Moreover, as sickness is seldom very prolonged after chloroform in minor operations, except in persons who are not in a good state of health, it is most probable, that the patients who died after a great operation with continued sickness, would not have done well if no chloroform had been used.

*(To be continued)*