Soon after the introduction of chloroform I administered it to a gentleman, aged about 55, whilst a fatty tumour was removed from the nape of the neck. It did not turn out as fatty tumours usually do, but required to be dissected out. The patient had taken a meal before the operation, and vomited freely afterwards. On his visit the next morning, the surgeon thought his patient going on well. Vomiting returned, however, and the patient became affected with partial stupor and delirium, which his friends attributed to the chloroform. He became covered with an eruption of erysipelas over a great part of the body, had a very rapid pulse with great depression, and died on the fifth day. An examination after death showed that there had been diffuse cellular inflammation around the seat of the operation. A surgeon who assisted at the operation on the above patient, and also at the post mortem examination, removed an encysted tumour from the scalp of an old lady the day following the latter event. This operation was performed without chloroform, but the patient was attacked with erysipelas and diffuse cellular information, and died in three or four days.

Faintness and Depression. Although chloroform acts as a stimulant to the circulation, increasing the force and frequency of the pulse whilst it is being inhaled, it is occasionally followed by a feeling of faintness, especially if the patient remains in the sitting posture. At one period in the history of medical opinion, it would have been said that the depression was a consequence of the previous excitement. The facts, however, would not agree with such a doctrine. The subjects who are most stimulated by chloroform are the strong and robust, and they do not suffer from depression afterwards; whilst the feeble and debilitated, who are most liable to subsequent depression, are but little stimulated by it at the time of inhaling. Some amount of faintness and depression usually accompanies the sickness caused by chloroform, and is in fact a consequence of it, being, like the sickness, most frequent after a full meal. This depression is usually relieved by vomiting. I have met with a few cases in which there has been more decided faintness, and once or twice absolute syncope after chloroform, which was not attributable to loss of blood. In these cases, however, the patients were in the sitting posture, and they recovered from the syncope immediately, on being placed horizontally. The patients most subject to faintness after chloroform are those who are subject to
this affection at other times, being often persons in a state of anæmia, or having the symptoms of fatty degeneration of the heart. Faintness is, however, very much more rare after operations with chloroform than without it. The only cases in which I have seen it follow the use of chloroform in the horizontal position, and where there was no considerable loss of blood, have been two or three of operations on the rectum, performed before breakfast, and after a brisk purgative had been taken the previous night. It might be advisable, where persons in a state of debility have taken a purgative, to make an exception to the usual rule of prohibiting the breakfast, and to risk the inconvenience of vomiting rather than the more formidable symptoms of faintness from inanition.

The faintness which now and then follows an operation under chloroform should be treated on ordinary principles, as the horizontal posture, the application of the vapour of ammonia to the nostrils, and the exhibition of brandy or wine, if the other measures do not suffice. I never give ammonia internally where a patient is sick or faint, but the spirit of sal volatile, when at hand, serves very well to pour on the corner of a towel and apply to the nostrils.

**Hysteria.** I have already stated (p. 43) that chloroform occasionally excites hysteria in those who are subject to that complaint; and that, in a few cases, the hysteria, which has been subdued by the chloroform, reappears as the effects of the vapour subside. It is nearly always in the female sex that one meets with these phenomena although I have two or three times seen hysterical symptoms in the male for half an hour or so after the inhalation. The hysteria commonly takes the form of laughing or crying, but the patient sometimes remains quiet, and simply in an unconscious state. The hysterical symptoms usually pass off spontaneously, in half an hour or less, without any remedies; if they last longer, the ordinary remedies for hysteria may be applied. I am not aware that the hysteria has lasted longer than three or four hours in any of the cases in which I have administered chloroform, but it may have done so without my being informed of the circumstance. I was informed of the case of a young woman in King's College Hospital, who remained unconscious, or at least apparently so, for three days after chloroform had been administered for an operation, the nature of which I have forgotten. She recovered without ill effects. When the patient does not wake spontaneously, and cannot be roused to the waking state, within twenty minutes or half an hour after the inhalation of chloroform has been left off, we may rest assured that the patient is affected with hysteria—at least this has been the case in every instance with which I have become acquainted. The physical properties of this agent do not permit it to remain long in the system, if the circulation and respiration are going on properly, and this circumstance ought to prevent unnecessary alarm, in the absence of other symptoms except the state of unconsciousness. I have, however, known great alarm to exist where the properties of chloroform were not well understood. Soon after its introduction, a medical man administered it to a young woman in domestic service, for the extraction of a tooth. He became
alarmed, in the first instance, from the impression that he had given an overdose. In a few minutes, however, the patient burst out in a loud fit of laughter, but again became unconscious, and various measures were used to restore her, including even artificial respiration, in the idea that she was still under the influence of chloroform. I was sent for thirty-six hours after the inhalation, and found the patient apparently in a profound state of insensibility, and breathing very feebly. Guided by the considerations mentioned above, I concluded that she was only labouring under hysteria, and that the anxiety of those about her tended very much to keep up the complaint. The anxious attendance on her was discontinued, she took some medicine containing valerian, and became quite conscious in a few hours. I was told, however, that she did not seem quite well for some time.

I am not aware of any permanent ill effects having been produced by chloroform, although, amongst the multitudes of persons who have inhaled it, some have not failed to blame it for symptoms that have occurred afterwards.

A clergyman from the country called on me, in 1852, and the following are some notes I made when he left my room. He is 63 years of age. He said that he had inhaled chloroform about a year ago to have four teeth extracted. He felt very well for about a week afterwards, but on his pupils returning, and his beginning to apply himself to teaching, he became affected with flushings of the face and a rushing noise in his head, which lasted occasionally for a day or two, and have troubled him ever since. An eminent physician, whom he named, prescribed quinine, under the use of which he became worse. An eminent surgeon prescribed infusion of hops, etc., and he has tried other medicines without good effect. He had been recommended to travel, and had been to Switzerland; but the complaint troubled him when at leisure, as well as when applying himself mentally. He could not sleep at night, when affected with the attacks. He is rather deaf, and has been so for three or four years; he was also occasionally troubled with a rushing sound behind the ears before he inhaled the chloroform. He is rather short and rather stout, and has a florid complexion. The pulse was rather feeble. The second sound of the heart was rather louder than the first. In other respects its sounds were natural, but its impulse was not strong. In every respect, except the symptoms above named, the health of the patient was good, and he felt quite well between the attacks.

It was my opinion that the complaint of this gentleman was coming on long before he inhaled the chloroform, and that it depended on a much less transient cause. I have not heard from him since.

CAUSE AND PREVENTION OF DEATH FROM CHLOROFORM

All narcotics are capable of causing death, and the discovery of preventing pain by inhalation consists essentially in in carrying the effects of a narcotic much further than had previously been the custom; there was, therefore, every reason to apprehend that accidents might occur in the new practice, unless the effects of the medicines employed could be very effectually controlled. There are certain circumstances connected with the physiological properties of chloroform, as
ascertained in the experiments previously related, which indicate how accidents may very easily happen with this agent, if not carefully and systematically managed. It was calculated (p. 155) that 18 minims of chloroform is the average quantity in the system of an adult, when sufficiently insensible for a surgical operation, and that this amount might be absorbed by use of 36 minims, allowing one half of the quantity breathed to be exhaled again, without being absorbed; but 36 minims of chloroform make only 37.5 cubic inches of vapour, which, at the temperature of 60° Fah., may exist in combination with 257 cubic inches of air, making it expand to not quite 300 cubic inches; the whole of which might be breathed in twelve ordinary inspirations of 25 cubic inches each. If the inhalation of vapour of this strength were continued till insensibility was induced, the lungs would still contain a great quantity of unabsorbed vapour.

The amount of air usually present in the lungs is about 250 cubic inches, and if saturated with chloroform at the temperature of 60° it would contain the vapour of 30 minims. About half of this might be absorbed, the remaining half passing off in the expired air; but the addition of 15 minims to the 18 minims already absorbed would almost double the quantity of chloroform in the system, and bring the patient necessarily to the brink of death. It is true that, in the ordinary methods of inhalation, the air seldom becomes quite saturated with vapour, and usually is not more than half saturated, or accidents might be of much more frequent occurrence; but the above considerations are sufficient to show that the amount of vapour contained in the air breathed by the patient should not be left to mere accident, such as the varying temperature of the handkerchief from which the chloroform is breathed, or the greater or less extent of wetted surface over which the air passes. It should be recollected also that the patient sometimes draws a deep and sudden inspiration by which he may inspire 100 cubic inches of air, which would contain, if strongly charged with vapour, ten or twelve minims of chloroform—a large quantity to be suddenly added to that already in the circulation, when the patient is insensible, or nearly so.

It is, however, only by a knowledge of the different modes in which chloroform is capable of causing death, that the exact nature of the accidents from this agent can be understood, together with the means of preventing them, and the reason why they are usually irremediable when they happen. If animals are kept for a very long time under the deep influence of chloroform, they become ultimately exhausted, the circulation and respiration are gradually weakened, and cease nearly together. Such a mode of death from this agent is never likely to occur to the human subject, and therefore need not engage our further attention. The following experiments illustrate the different modes of dying, when death is caused more suddenly by this agent.*

* London Journal of Medicine, April 1852.

In one of the latest communications of Dr. Marshall Hall to the Lancet, he did me the honour to quote the account of the three following experiments, together with some accompanying remarks from the London Journal of Medicine, and to make the following observation respecting the pages from which he quoted. "I have no hesitation in affirming that the first three pages of this paper are amongst the most able and valuable in physiology, and I beg to be allowed to reproduce them in the pages of the Lancet." (Lancet, April 18th, 1857, p. 397.)
**Experiment 23.** A young but full-grown cat was placed in a glass jar, of the capacity of 1,600 cubic inches, and a fluid drachm of chloroform (4%) was introduced, by a portion at a time, through a tube in the cover of the jar. As twenty-five minims of chloroform produce twenty-six cubic inches of vapour, the atmosphere which the cat had to breathe contained nearly four per cent. of vapour, and the jar was moved about, to ensure the uniform mixture of the vapour with the air. In five minutes, the cat became insensible, and lay breathing naturally. In about ten minutes more, the breathing became very feeble, and it ceased altogether in about another minute, or sixteen minutes after the cat commenced to breathe the chloroform. It was immediately taken out and laid on a table, and the stethoscope was applied to the chest. The heart could be heard beating distinctly at first, but the pulsations became slower and feebler, and in about a minute they could be no longer heard. Just at this time, however, the cat took a gasping inspiration, and immediately the heart was heard to beat in a most rapid manner. The gasps were repeated, and the action of the heart became less rapid, but stronger. In a little time, both the breathing and the action of the heart became natural, the cat remaining, however, insensible for some minutes.

**Experiment 24.** A cat, about the same size as the last, was put into the same jar, and the same quantity of chloroform was introduced. It was removed at the end of four minutes, when it was so far insensible as to offer no resistance. Being laid on the table, it was made to breathe air charged with ten per cent. of vapour of chloroform from a bladder. Twenty-five minims of chloroform were put into the bladder, which held 250 cubic inches (10%) and it was filled up with the bellows. A portion of another bladder, which was attached to the stop-cock, was made to surround the head of the cat, which consequently breathed to and from the bladder. In half a minute it was quite insensible: in about half a minute more the breathing became difficult, and the sounds of the heart less distinct. The breathing became gradually slower, and ceased altogether between three and four minutes after the respiration from the bladder commenced. The sounds of the heart were rather frequent, and scarcely audible, just before the breathing ceased, and they could not be heard afterwards. The chest was opened three-quarters of an hour after death. The lungs were of a pale red colour, everywhere permeated with air, and a small quantity of fluid blood flowed from them on making an incision. The right cavities of the heart were quite full of blood, and the left cavities contained a small quantity.

**Experiment 25.** A cat was made insensible in the same manner as the two previous ones. As it made strong efforts to get out of the jar, and consequently breathed more deeply, the chloroform took effect sooner; and it was removed and laid on the table, in a passive state, at the end of two minutes and a half. The respiration and sounds of the heart were quite natural. The nose of the animal was placed in the mouth of a metal vessel, lined with bibulous paper, and used as a chloroform inhaler. The inhaler contained chloroform, and was surrounded with water of the temperature of 110°
Fahr. The stethoscope was kept applied to the chest whilst the chloroform was exhibited. After four or five inspirations from the inhaler, the heart suddenly ceased to beat, the breathing still going on. The inhaler was removed as soon as I was satisfied that the action of the heart had ceased, and there were two or three rather convulsive respirations afterwards, and then the breathing stopped; but, between one and two minutes later, there were two or three feeble inspirations, accompanied with motion of the nostrils, but no returning action of the heart could be heard. The chest was opened ten minutes after death. The lungs were quite pale throughout. There was a little clear serum in the pericardium. The heart appeared quite motionless when first observed; but, after exposure to the air for a short time, there were some slight contractions of a few fibres of the right ventricle. The right auricle and ventricle were filled with blood.

The air which this cat breathed must have contained much more than ten per cent. of vapour.

In Experiment 23 the breathing was arrested by the influence of the chloroform on the nervous centres, but the action of the heart continued, until it was stopped, or very nearly so, for want of respiration, as in asphyxia from privation of air. In experiments 24 and 25 the action of the heart was arrested by the direct effect of the chloroform; in one instance at the same moment as the respiration, and in the other instance, even before it.

The paralysing effect on the heart of large doses of chloroform was shown in the first experiments which were made with this substance, viz., those by Dr. R. M. Glover in 1842.* In animals which were killed by injecting it into the jugular vein, the irritability of the heart was found to be destroyed, whilst this organ retained its irritability in those that were killed by the injection of chloroform into the arteries, stomach, or peritoneum. I have frequently arrested the action of the heart remaining in animals which were opened immediately after death, by blowing the vapour of chloroform on it; and I ascertained by some experiments on frogs, that the motion of the heart can be arrested by an amount of chloroform somewhat greater than suffices to suspend the respiration. As absorption of chloroform vapour is continued by the skin of these animals after the respiratory movements have ceased, they can be exposed to the vapour till the action of the heart is suspended by its direct influence.


(To be continued)