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CHLOROFORM AND ETHER:
THEIR ADVANTAGES AND DISADVANTAGES

I venture this evening to detain you for a short time upon the anaesthetics – Chloroform and Ether, their Advantages and Disadvantages. I hope also to mention some statistics, and draw your attention to a few of the remedies used to prevent poisoning by chloroform and ether.

Nearly every member of the Society, and especially those engaged in surgical and obstetrical practice, must, to a large extent, use anaesthetics; and I trust that every member will be able to give his experience upon the use of the two anaesthetics.

I may commence by saying that I have a firm and unshaken faith in chloroform, having been present at, or taken part in, its administration hundreds and hundreds of times, and will continue to use it until a more satisfactory anaesthetic is introduced to our notice. The prompt action of chloroform, and the calm sleep which it induces, its pleasant odour and taste, and the usual absence of subsequent vomiting, if care be taken in dieting the patient, would be alone sufficient to secure its general adoption were it not that so many physicians and surgeons regard it as uncertain and dangerous. With some the conviction is so decided that they advocate its entire disuse as the only radical method of avoiding the attendant risks.

I am quite cognisant of the fact that certain medical journals have denounced the use of chloroform and highly approve of the use of ether. And one recent writer went so far as to say that – "A surgeon who used chloroform in preference to ether, should a death occur in his practice, deserved to be tried for manslaughter."

The medical journals still continue to report a noticeable number of fatal cases of chloroform poisoning, and these are occasionally referred to by the editors with stringent comments. According to one statement a death occurs in every 2,723 administrations of chloroform, while a more recent writer, Mr. B. Carter, in *The Lancet*, August 7th, 1875,

gives the proportion as 1 in 2,500 patients; and Mr. Carter goes on, in the same paper, to state that ether is in all respects as available and as effectual as chloroform, and that it is absolutely safe. He says: "I do not believe that it has ever destroyed life, nor do I believe it has any tendency to destroy life." I fear Mr. Carter is a prejudiced writer; other men are as competent to form an opinion as he. Further on I shall show ether is considered unsafe by certain writers, especially so in children. In *The British Medical Journal*, 6th November, 1880, you can read a letter from Mr. Jonathan Hutchinson, advocating the use of ether in preference to chloroform, and calling upon the editor to continue his advocacy until ether is universally used in all suitable cases. You see Mr. Hutchinson uses the words "suitable cases," admitting there are some patients who take chloroform better than ether. He prefers to administer chloroform to old people and young children. With all due respect to Mr. Hutchinson's opinion, were I to give ether at all it would be to old people owing to its recognised stimulating effect upon the heart. In the same journal Mr. Hutchinson's letter is followed by one from Mr. Jacob, of Leeds, also advocating the use of ether; but

admitting that there are certain dangers attendant upon the administration of that anaesthetic. Immediately succeeding Mr. Jacob's letter is one from the administrator of anaesthetics at the Victoria Hospital for Children. He considers that in all inquiries relating to the respective merits of the two anaesthetics, chloroform has always been heavily handicapped; and submits that if ether or chloroform were given in cases of similar degree of risk, the mortality of the two would be found to be very much on a par.

Notwithstanding all the adverse opinions and writings, yet physicians and surgeons will rely upon their individual experiences. One has used chloroform in hundreds of cases without any bad results, and considers it safe and reliable; another had almost adopted the same conclusion after a long experience, when alarming symptoms or a fatal issue occurred in his own practice and shook his confidence. Still another has been alarmed by apparently dangerous phenomena resulting from ether, and has returned to chloroform with the idea that its danger has been exaggerated.

It is very odd that the first attack upon chloroform as an anaesthetic was made in America, the birthplace of ether; and all of you must have observed that in the many discussions upon the merits of the two anaesthetics nationality has entered largely into the debate – America v. England; and from the visit of Dr. Joy Jeffries, of Boston, to this country, in 1872, must we date the peculiar ether craze which has seized the minds of some men. It is very remarkable that many of the fatal cases of death from chloroform inhalation have occurred in the practice of dental surgeons, private practice, or in some small institutions – a circumstance which would seem to show that there had been some fault in the mode of administration. A writer in *The British Medical Journal*, January 1st, 1876, claims:– "That by proper care chloroform is a sufficiently manageable and safe agent for use, and that it is not the chloroform which is to blame, but the mode of administration." With this opinion I fully concur. I always feel safe during an operation when the experienced house-surgeon is looking after the anaesthetic; and I must confess when an inexperienced person is *locum-tenens* I always feel uneasy until the operation is finished. I suppose many of you have read of a death from chloroform at one of the London hospitals? Just before the administration the house-surgeon was summoned to a coroner's court and was consequently absent during the operation; death occurred. Another death from chloroform has also been reported, where the experienced chloroformist was unavoidably absent during the administration. Here you see in the one case the experienced house-surgeon absent, in the other case the chloroformist otherwise employed; the chloroform may or may not have been administered by an experienced person. Comment is unnecessary; still they are deaths from chloroform.

Now let us consider some of the advantages and disadvantages of ether and chloroform.

Advantages of Chloroform. – In most cases its administration is agreeable to the patient; rapid in its action; complete insensibility produced; the entire absence of excitement when the insensibility is complete; little laryngeal or bronchial irritation; the easy maintenance of the anaesthetic influence, and less liability to cause vomiting.

Disadvantage is said to be the risk attending its administration. Death from the inhalation of chloroform may result, and probably does often result, from gradual paralysis of the respiratory muscles from the effects of the chloroform upon the respiratory centres.

There is another form of death from chloroform – cardiac syncope – the heart at one moment beating well, and the next moment stops. So that you see chloroform may cause death not only by arresting respiration, but also by its depressing action on the heart – this action on the heart being, in my opinion, the greatest disadvantage of chloroform, because when the respiratory centres are affected we can watch the change of breathing from its comparatively calm state, gradually becoming more shallow and stertorous; here by following out certain rules danger can be averted. But when death takes place from cardiac syncope, here there is no warning, the time between life and death being almost absent; so that, granting this cardiac syncope to be a serious disadvantage to the use of chloroform, we must take every precaution, before commencing the administration, to limit the risk, by placing the patient in the recumbent posture, and attending to the other well-known details.

Advantages of Ether. – It is said that all records show it to be safer than chloroform – that is a matter of opinion. To my mind the greatest advantage of ether over chloroform which can be presented is, that although ether, like chloroform, may kill by arresting respiration, it does not destroy life by its depressing action on the heart – *i.e.*, it does not kill by cardiac syncope.

Disadvantages of Ether. – It is an unpleasant anaesthetic; it requires a long time to effect complete

unconsciousness. The time required to get the full effect of the ether varies to a far greater extent with different people than in the case of chloroform. As a rule, it is twice as long, the quantity requiring to be inhaled being much greater. Other disadvantages are the restless excitement that often results from its administration, very different to the extreme quiet of chloroform unconsciousness; also the danger of ether vapour catching fire should any light be placed incautiously near the patient's mouth during inhalation. Dr. Neligan mentions, as one of the disadvantages, the persistent taste and odour experienced even for days by those to whom it has been administered; and Mr. Clover has drawn attention to the fact that the flow of saliva is considerably increased during the administration of ether and occasionally gives trouble.

Is Ether really Safer than Chloroform? – If we are to believe all that has been written on the point I believe that we must come to the conclusion that ether is the safer of the two anaesthetics; but, gentlemen, it is to obtain your individual opinions that I have introduced the subject. We still find many medical men very much in favour of chloroform, notwithstanding what has been written in opposition to it. I think we must all come to the conclusion that for operations upon young children and pregnant women chloroform is to be preferred to ether.

A few years since Dr. Tripier, of Paris, read a paper before the French Association for the Advancement of Science, and related cases in which the administration of ether to young children for surgical operations was attended by an arrest of respiration, and alarming symptoms ensued. Dr. Tripier instituted experiments upon young cats with ether, and found, as in young human subjects, an arrest of respiration often occurred. Older animals were less liable to the accident. He, therefore, considers anaesthesia by ether in young subjects as dangerous, and that chloroform for them should be preferred.

My opinion is that ether does not hold so good a position in the scale of safety as it did a very few years ago. I remember some six years since nothing but ether was administered at several English and Irish hospitals I visited, and I was very much surprised to find three weeks since, whilst revisiting these hospitals, either chloroform in use or a mixture of ether and chloroform. I dare say you are aware that up to 1872 Mr. Spencer Wells used ether largely, and that he now either uses chloroform or bichloride of methylene. At the Samaritan Hospital for Women, London, I had the pleasure and advantage of seeing a few ovariotomies performed. Here the anaesthetic used was chloroform administered by Junker's inhaler; and from conversations I had with several medical men just returned from the great medical schools of the Continent, I learned chloroform is the anaesthetic chiefly used.

"In Germany chloroform has a less disputed sway than in any other country, and is now, according to Dr. Kappeler, of Germany, so far as he knows, exclusively used. In Austria the course pursued by Billroth is an index of the lack of full satisfaction with either ether or chloroform."[1] He is an advocate of, and constantly uses, a mixture consisting of three parts of chloroform, one part of ether, and one part of alcohol. This is the mixture which was so strongly recommended by the Committee of the Medico-Chirurgical Society.

Even in certain parts of America – the birthplace of ether – and notably in the Southern States, chloroform is preferred to ether. A paper bearing out this statement has lately appeared, written by Dr. Chisholm, of Baltimore.[2]FN This confidence in chloroform seems to be based upon the experience of surgeons with it in the Confederate Army, and in the Northern States the warmest advocates are surgeons who have had large experience during the American War. According to Sedillot and Mal- gaigne, ether has never succeeded in supplanting chloroform in France. Gross, of Philadelphia, prefers chloroform.

Why, gentlemen, have such men as Spencer Wells, Bantock, Billroth, Gross, and others, given up the use of ether, and adopted either chloroform or a mixture of chloroform and ether? In Scotland, as we should naturally expect, chloroform is the anaesthetic in common use, and has a strong advocate in Professor M'Leod, of the Glasgow University. Dr. M'Leod, in *The British Medical Journal*, January 1st, 1876, lays down some excellent rules regarding the administration of chloroform, and goes on to state:– "He believes a good many of the deaths under chloroform have apparently been due to patients, suffering from heart disease, not being completely insensible when the operation was performed, and the shock killing them. Here,"he says, "the chloroform is blamed, whereas what was really wrong was that it was not sufficiently pushed." He also states he never measures the amount of chloroform poured on the sponge or towel, simply watching the effects, and considers more deaths are due to too little than to

1 American Journal of Medical Sciences. July, 1880.

2 American (Journal of Medical Sciences.

too much chloroform being given. In his paper he alludes to a very important point – namely, always to administer the chloroform in the recumbent posture. With this opinion I think we must all agree, as you are aware a large proportion of the deaths from chloroform have occurred in the practice of dentistry, and chloroform is generally administered by dentists when the patient is in the sitting posture.

Bearing out Dr. M'Leod's opinion regarding the shock killing the patient, not the chloroform, a letter has just appeared in *The British Medical Journal* by an Edinburgh professor. When speaking of the sudden arrest of the heart's action from reflex irritation during an operation, he says:– "The treatment of the sudden arrest of the heart's action from reflex irritation should consist in boldly pushing the administration of the chloroform, in the hope that relaxation of the spasmodic contraction of the heart will speedily occur." My idea is that chloroform is perfectly safe when administered with the precautions advocated by the Chloroform Committee of the Medico-Chirurgical Society in 1864, and, in addition, carefully adhering to the rule always to administer the anaesthetic in the recumbent posture. The relative advantages of ether and chloroform were carefully investigated by the Committee on Chloroform appointed by the Medico-Chirurgical Society (*Lancet*, July, 1868). In their Report they state that ether is slow and uncertain in its action, though it is capable of producing the requisite insensibility, and less dangerous in its action than chloroform. In many respects the action of ether is the same as dilute chloroform,. The primary stimulating effect of ether on the heart's action is greater and of longer duration, and the subsequent depression of the heart's action is not so great as that produced at the same degree of insensibility by chloroform. On the whole, however, the Committee concur in the general opinion which in Great Britain has led to the disuse of ether as an inconvenient anaesthetic. The Committee found a mixture of ether and chloroform to be as effective as pure chloroform. This Report was written in 1868, and it was in 1872, subsequent to the visit of Dr. Jeffries to this country, that ether suddenly came into vogue. The Committee suggested for use a mixture composed of chloroform two parts, ether three parts, and alcohol one part, on the ground that ether and chloroform blend uniformly when combined with alcohol, and the constituents escape equally in vapour. The mixture of ether and chloroform I have lately seen used with good effect; the mixture is now used at the London Ophthalmic Hospital – not ether alone.

I now wish to introduce a few words relative to the statistics of the administration of the two anaesthetics. Some deaths have, no doubt, occurred at Guy's Hospital, London, during the administration of chloroform, but here it was given 12,000 times before any serious accident occurred. In the Crimean War it was given 25,000 times without a death, and during the American War 7 deaths occurred with 120,000 administrations. Professor Andrews, of Chicago, in 1870, collected from the different American and European hospitals the statistics of 117,078 cases in which chloroform was used, with 43 deaths. Of 92,815 cases of etherisation 4 died, and a mixture of chloroform and ether was employed in 11,176 cases with 2 deaths. Professor Gross, of Philadelphia, has given it upwards of 8,000 times without a death. Syme gave it about 6,000 times without any serious occurrence, and Professor Simpson is said to have met with but one death in all his immense experience. Professor Nussbaum, of Bavaria, in upwards of 15,000 administrations, never lost a patient; Billroth has given it successfully upon 12,500 occasions. It is calculated it has been administered in Belfast, including hospital and private practice, upwards of 7,000 times; and up to the present, I am happy to say, no death has occurred. Long may we have this story to tell.

It is extremely odd that no writer has made any attempt to present the total number of deaths which have occurred under ether. This death-rate is a very important matter when chloroform is under consideration, but of no consequence in regard to ether. Still, Turnbull in America, Kappeler in Germany, Perrin and Lallemand in France, have reported not a few deaths resulting from the inhalation of ether (see *American Journal of Medical Science*, July, 1880). Kappeler gives a class of deaths occurring after the administration of the ether is over, and refers to the investigations of Lallemand, Perrin, and Duroy, showing that ether is retained a longer time in the organism, and has therefore a decidedly more prolonged operation. As regards the deaths from ether Dr. Kappeler says[1]:– "We are as little prepared to state in figures the dangers of ether as those of chloroform, since neither the number of deaths from it nor the number of administrations are known, and the attempts made to state the proportion of deaths to administrations are mostly the product of the bitter contest – ether *versus* chloroform."

From these favourable reports and statistics, which I have just read, I think we may conclude that

[1] American Journal of Medical Science. July, 1880.

the time has not yet come when chloroform will be laid aside; and I believe its use will continue so long as there is the existing diversity of opinions regarding its merits. Hence it must be now, as it has been, the earnest wish of surgeons and physicians to diminish the attendant danger; and this leads me to speak of a few of the more prominent remedial measures and preventions to nullify ether and chloroform poisoning.

In threatened death from chloroform the means which we most frequently rely upon are – (1) Drawing forwards the tongue with tongue-forceps; this method was first introduced by Mr. Lister, but it is now considered you gain more by drawing forwards the inferior maxilla; by so doing the muscles which connect the lower jaw with the larynx and os hyoides are drawn upon and open the larynx; it is said you gain a freer opening of the larynx by this method; at the same time as you draw forward the tongue or lower jaw it is recommended to place the patient upon his left side. (2) Nélaton's plan.[1] – Inverting the patient so as to lower the head and determine a flow of blood to the brain. (3) Artificial respiration, by Sylvester's, Marshall Hall's, or Howard's methods. – When practising artificial respiration you can place a sponge saturated with hot water over the heart. This is recommended by Dr. M'Leod, of Glasgow.

In threatened collapse from chloroform, and when the heart's action flags, ether has been injected hypodermically with marked success. Lately Dr. Moinet, of Edinburgh, has spoken highly of the subcutaneous injection of digitaline as a cardiac stimulant in conjunction with artificial respiration.

The galvanic battery is also occasionally used to avert impending danger; but those of you who have been reading *The British Medical Journal* lately must have noticed a letter from Professor Schafer, of University College, on the action of the galvanic current when applied to the cardiac region. He says:– "The effect of direct stimulation of the heart is so opposite, according to the part which happens to be brought under the direct influence of the excitation, that it is no exaggeration to say that the treatment is at least as likely to arrest a beating heart as to set an inhibited one in activity."So that, taking into account this celebrated physiologist's experiments, I consider we must not rely too much on galvanism. In this recent letter you will also observe that Professor Schafer speaks very highly of a hypodermic injection of atropine in all cases in which chloroform is about to be administered. He states that it is well known that atropine paralyses the cardiac inhibitory apparatus, and since it is probable that death in these and similar cases results from a stimulation of this apparatus, either directly by the drug, or it may be, in some instances, in a reflex manner, by the stimulation of abnormally excitable afferent nerves during the actual performance of the operation, there seems good reason for the employment of atropine. He has also performed a number of unpublished experiments to prove the value of atropine as an antidote to the cardio-inhibitory effects of chloroform; and he is of the opinion that atropine should be injected subcutaneously in all cases of anaesthesia by chloroform as a preventive. As regards the previous subcutaneous injection, a letter has just appeared in *The British Medical Journal*, written by Dr. Muro, of Manchester, speaking of the beneficial effects of the atropine injection in chloroform inhalation. He has also performed a number of experiments, which he states he forwarded to the Committee of the British Medical Association, but they did not publish the results of his experiments for reasons best known to themselves.

Dr. Muro is of the opinion that atropine administered previously to the giving of chloroform is a powerful heart protector, making it impossible for the latter to kill, even when administered with that intention.

The modification of the ordinary course of chloroform anaesthesia by the preliminary injection of morphia deserves attention. This is known by the name of the "mixed narcosis," and was first resorted to by Professor Nussbaum, of Bavaria. It is claimed for the "mixed narcosis" that it is especially adapted to prolonged operations, rendering a far less quantity of chloroform necessary – the anaesthesia being continued with far less repetition of inhalation; that the stage of excitement is lessened, and that thereby the dangers of anaesthesia are diminished. It is recommended to make the hypodermic injection of one quarter grain of morphia twenty minutes before administering the anaesthetic, because if made immediately preceding the use of the anaesthetic the stage of excitement is increased.

In The *Lancet* of December, 1877, you can see papers upon the "mixed narcosis method," and details of operations performed by Mr. Marshall and Dr. Sidney Kinger.

Mr friend, Dr. J. F. Wales, informs me that this method is frequently resorted to at the Leeds Infirmary. It appears that none of the advantages of chloroform-morphia attach to ether-morphia

[1] The late Mr. S. M. Bradley, of Manchester, has reported cases treated successfully by this plan.

narcosis.

Dr. Kappeler[1] gives his experience with twenty-five cases, and states that the combination of these two agents is rather injurious than beneficial.

The medicinal agent which seems to promise most as an antidote to chloroform and ether poisoning is the nitrite of amyl, since physiological experiments have developed an antagonism between the effects of nitrite of amyl and chloroform. While chloroform impairs reflex excitability and produces contraction of the cerebral vessels, nitrite of amyl restores this excitability and causes their dilatation. Into the enlarged vessels the blood freely enters, and a rapid circulation follows.

Mr. Bader, Ophthalmic Surgeon to Guy's Hospital, in *The Lancet*, May, 1875, gives the results of his experience with the nitrite of amyl. He says:– "In three or four minutes after taking three drops of nitrite on sugar the blood-vessels of the retina, especially the veins, become enormously dilated and gorged with blood, leaving no doubt as to the simultaneously existing cerebral hyperaemia with increased circulation of blood."

He further says:– "The most striking effects of the nitrite were the quick restoration of breathing, a good colour, and the rapid appearance of sickness."

As to the essential mechanism of this, Dr. Robert Pick (*British Medical Journal*, February 26, 1870) considers that the following conclusions are established by recent experience:–

1. Amyl nitrite produces a direct paralysis of the vascular wall.

2. The effect of the drug must be peripheral; but whether the smooth muscles themselves, or the terminal ends of nerves in these, or, finally, certain hypothetical peripheral ganglionic cells, are the points of attack, is unknown.

Dr. William Dabney, in the "Transactions of the Medical Society of Virginia, America," reports a series of experiments upon cats and dogs, showing the value of nitrite of amyl in cases of threatened death from chloroform and ether.

Dr. M. Schüler has written in *The Berlin Clinical Journal* a series of experiments performed with the nitrite upon rabbits. He removed a small portion of the skull, leaving the dura mater intact. He found, when chloroform was inhaled for a short time, a diminution of size of the arteries of the pia mater, then of the veins, took place. This is accompanied by a corresponding decrease in the pulsations. Soon follows an increasing relaxation of arteries and veins, and at last marked venous stasis. As a result of the venous condition of the blood, the arteries become speedily of a darker hue. The inhalation of the nitrite of amyl promptly removes the effects of chloroform on the vessels of the pia mater. The arteries dilate and become of a bright colour, the veins become of a clearer hue, and the respiration which had been embarrassed grows easier and more frequent. He also states that the reflex excitability which has been destroyed by chloroform narcosis is soon fully re-established under the influence of the nitrite of amyl.

I think these experiments show that in nitrite of amyl we have an agent which will prove of great service when disagreeable symptoms show themselves during the administration of chloroform and ether.

I have thus, gentlemen, in a feeble manner endeavoured to put before you a few practical observations regarding two very important anaesthetics. I had originally intended taking up the subject of anaesthetics in general, and introducing to your notice bichloride of methylene and the two new agents – dichloride of ethidene and bromide of ethyl; but I feared the paper would be too long, and I feel certain your patience is already exhausted.

[1] American Journal of Medical Sciences.