



Chloroform Anaesthesia.

Thesis for M. D. Degree.

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The question regarding the proper mode of administering Chloroform for surgical purposes, and of the dangers to be dreaded in its administration, is one which has more or less occupied the attention of the profession ever since the introduction of this agent into general use.

Besides what we owe to individual investigations in this matter, we find that the whole subject was gone into very thoroughly by a committee appointed by the medico-surgical society of London in 1864*, and in a still more exhaustive manner by the Glasgow

*Medical Times 1864 Vol II p. 74.

Committee of the British Medical Association in 1878.¹⁾ In their report the London committee draw attention to the danger of sudden paralysis of the heart from an overdose of chloroform rapidly administered, in this endorsing the opinion previously expressed by Dr. Snow.²⁾ When the agent is pushed but in a more gradual manner death does not occur so rapidly and the respiration generally stops before the heart. The Glasgow committee whose experiments were far more elaborate than any that had been previously attempted, emphasized this tendency of chloroform to dangerously depress or even completely paralyse the heart's action, and going further declared that they had found it have this effect when the

¹⁾ British Medical Journal 1879 Vol 7 p. 921.

²⁾ On Anesthetics, Dr. Snow p. 217 et seq.

inhalation of the anaesthetic had just been commenced, and when therefore no overdose could have been administered. That sudden cardiac paralysis was a real danger in the use of this agent seemed to be established by these researches, and apparently received ample confirmation from the numerous cases in the human subject in which death was regarded as having occurred in this way.

The Hyderabad Commissions of 1888-89 however arrived at a diametrically opposite conclusion, and issued a report in which they state in a very dogmatic manner that primary cardiac syncope is altogether impossible. "The administrator," they say, "should be guided as to the effect entirely by the respiration. His only object while producing anaesthesia is to see that the respiration is not interfered with."

The Commission has no doubt whatever that if the above rule be followed, chloroform may be given in any case requiring an operation with perfect ease and absolute safety, so as to do good without the risk of evil." Naturally so categorical a statement aroused opposition on the part of those who were in the habit of attending to the pulse as well as to the respiration during the administration of the drug, and produced a considerable discussion of the subject in the medical journals and societies. Nor indeed does it seem that the conclusion at which the commission arrived can be justified even from their own experiments. In the account given of experiment No. 40,² we read that after the administration of chloroform for only a few seconds, the dog's

¹ Lancet 1890 Vol. I p. 159.

² Lancet 1790 Vol. I p. 156.

heart apparently ceased beating, and it was believed by every one present to be dead, being only brought round indeed with some difficulty by artificial respiration. The Hyderabad Commission say that the depression was the result not of continuous chloroform administration till respiration ceased, but of a long and severe fall in pressure after the removal of the drug. Surely it is in the highest degree blameworthy in the face of an experiment of this kind, to give forth to the world a statement implying that a fatality from chloroform is invariably due to a culpable ignorance or carelessness on the part of the administrator.

Before proceeding to a more detailed discussion of the subject, I should like to record my own impressions formed during a year's residence as house surgeon in

the Royal Infirmary of Glasgow. The administration of chloroform formed part of my daily duty and in all it was administered by me during this period not less than 400 times. In many cases the patient was not under the influence of the drug more than a few minutes, in other cases for several hours. The respiration was taken as the cardinal point on which attention must be fixed, but assistance was also derived from the condition of the corneal reflexes, and the state of contraction or dilatation of the pupil, and information as to the state of the circulation obtained from the colour of the lips, while in at least half of the cases a student or other competent person kept a finger on the pulse throughout.

The first ten or fifteen minutes of the inhalation have always seemed to me the time when

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a more than usual amount of care and watchfulness are necessary. During this period the patient is breathing an atmosphere of chloroform so concentrated, as to be capable of producing death in a comparatively short time, while if the inhalation be stopped for even a few moments he is apt to show signs of renewed sensibility. After some time consciousness is not so quickly restored on withdrawal of the drug, evidently owing to the existence of a considerable saturation of the blood and tissues necessarily requiring a longer period for its elimination. About the time when consciousness is lost, [whether this consist in an abrogation of function of any special part of the brain, or merely in a lowering of function over the brain generally associated with lessened or perverted nutrition,] we find the nerve centres falling into a state of unstable

equilibrium which often shows itself in violent struggling or shouting. When this condition is at all pronounced the breathing is interrupted, and the change in colour of the lips soon shows that the blood is being imperfectly aerated. It seems to me that this condition of partial asphyxia is the result rather than the cause, (as was stated by a medical man at a recent meeting of the medico-surgical,) of the trembling and struggling which accompanies it. At the same time setting aside the cases of habitual drunkards and nervous hysterical females, (in whom this condition is very liable to be induced in whatever way the chloroform be given), there can be no doubt that by a gradual and careful administration of the chloroform, we are enabled in the great majority of cases to bring the patient into a state of complete insensibility without his having

passed through any period of struggling. As regards the treatment of this condition when it does occur, the best course seems to be to continue the chloroform but with the admission of plenty of air, so as to avoid giving an overdose during the deep breaths which will follow the temporary cessation of the respiration.

The varying size of the pupils has been regarded by some as a point of great importance, but practically it does not seem to be of much assistance and is apt to do harm by distracting attention from more important points. The pupil is usually moderately dilated during the first stage of inhalation, strongly contracted during deep anaesthesia, and gradually dilates again as the patient is coming out. Its dilatation during deep anaesthesia is a danger signal, and indicates

that the limits of safety have not merely been reached but passed. I have however on several occasions seen the pupils dilated when the patient was to all appearance as tested by the corneal reflex quite under, and yet with nothing to show that the chloroform had been pushed too far. I have also seen cases in which the pupils did not contract, though the patient did not wince in the least under the surgeon's knife in the course of a fairly prolonged operation. The variations of the pupil due to light and shade are apt sometimes to prove deceptive. During delirium tremens the pupil is generally dilated, and this often constitutes a premonitory sign of the disease.

In a man of this class to whom chloroform was administered during a prolonged operation, the pupils were persistently large throughout, though it must also be confessed that it was exceedingly difficult to keep him

under the influence of the drug. This man took delirium tremens on the following day and died very suddenly and unexpectedly, giving another proof of the fact, now however very generally admitted, that deaths occurring during the administration of chloroform are not necessarily to be set down to that agent. [Unfortunately in this case a post mortem was not obtained, but death was apparently due to syncope.]

In more than half of the 400 administrations which form the basis of my statements, the pulse was watched carefully throughout, but in no case did it give information which was not obtainable as quickly and completely from watching the respiration and general appearance of the patient. Unfortunately however in all those cases no incident occurred to cause any alarm, while in the two cases in which danger did present itself, the pulse was not taken.

The first case was a man of fifty who was undergoing the operation of supra-pubic cystotomy. The heart and lungs were sound. Some difficulty was experienced in introducing a thick drainage tube into the bladder, on account of the rigidity of the recti muscles. To overcome this the chloroform which was administered on an ordinary flannel mask was pushed till the desired end was attained. The breathing had now become rather shallow and the mask was instantly removed, but after two or three slight breaths respiration ceased. The pulse continued. The tongue was at once drawn forward and artificial respiration commenced. It was almost immediately successful.

The second case occurred in a man of 27 years, who had quite definite signs of phthisis

in his right lung. An abscess probably spinal in origin was pointing in the left thigh. Patient took the Chloroform at first fairly well, the abscess had been opened and the pus was escaping when the breathing suddenly became shallow; the chloroform was instantly removed but only two or three breaths were taken till respiration ceased altogether. The heart was still beating strongly. The tongue was immediately drawn forward and artificial respiration commenced, while a hot sponge was pressed over the cardiac area. The patient's face had a pale livid colour. A distinct interval probably not less than half a minute elapsed before these measures had the desired effect. The respiration when it did return was at first slow and gasping in character.

The anaesthetic used in this case was not pure chloroform, but a mixture of Chloroform 1, Ether 2 parts, from

a Clover's inhaler.

These cases occurred within a fortnight of each other, and both fall within my third hundred administrations.

In both the pulse continued after the respiration ceased, (I infer this in the second case from the fact that the heart was beating strongly) which must be considered as so far supporting the conclusions of the

Hyderabad Commission. In the first case the chloroform was being pushed rather far at the time the accident occurred, and one was therefore to a certain extent prepared for it, but in the second case I was not conscious of having given any overdose, though this proved far the more alarming of the two, both from the aspect of the patient and the long time that elapsed before respiration was restored.

It may be of some interest to refer to the various anaesthetics

and apparatus that were used. Chloroform was given on a flannel mask about 200 times. By means of Junker's inhaler 126 times. The mixture of chloroform and ether in Clover's inhaler before referred to was given 54 times.

This inhaler was used once or twice, and ether alone was also administered on a few occasions. The chloroform and ether mixture in Clover's inhaler does not commend itself to me. It produces insensibility pretty rapidly but requires great caution and unflinching attention to avoid giving an overdose. This seems only what might be expected from the very different rate of evaporation of the two agents as pointed out by Dr. Snow.* The use of the flannel mask is excellent. Junker's inhaler is rather slow in putting the patient under, and in short operations the mask has probably most to commend it, but

* On Anaesthetics. Dr. Snow. p. 369.

where the operation is to last for half an hour or more I give the preference to Junker, considering the uniformity of dose which the use of this inhaler renders possible, a great advantage.

I may refer here briefly to a few experiments which I performed on cats. Six cats in all were used, the chloroform being administered continuously on a towel till respiration ceased. After a short interval artificial respiration was commenced and continued till the natural breathing returned, or until it was evidently useless to persevere any longer. When artificial respiration was commenced within a minute it was invariably successful, if delayed longer the risk of failure became very considerable. In one case it restored the animal though breathing had ceased for one minute thirty five seconds, and in the case of one cat in which artificial respiration was carried on

with oxygen gas it proved successful even after the lapse of two minutes. The combination of asphyxia and chloroform did not prove very deadly. In one cat thoroughly under the influence of the drug the trachea was kept closed for ninety seconds, yet breathing was spontaneously resumed half a minute after the obstruction was removed. It was found in all the cases that if natural breathing did not become reestablished during the first three minutes of artificial respiration, there was almost no chance of preserving the life of the animal. Even in a few cases in which an occasional gasp was given during this period, it was found impossible to prevent death. It is a well known fact that cats resist the action of chloroform more than many other animals as for instance dogs, and this was strikingly brought out in one of the animals experimented on, respiration being on several

occasions spontaneously restored after having been in abeyance for more than a minute. It was always found that the heart continued to beat strongly after the respiration ceased, and in one case this movement as indicated by a needle thrust through the chest wall continued for fully fifteen minutes. On the whole there does not seem to be much advantage in performing artificial respiration with oxygen in preference to the ordinary atmospheric air.

Let us now turn again to the subject which has been so much debated of late, i.e. the liability to sudden cardiac paralysis. The Hyderabad Commission as has been said deny the possibility of this. They state that during the administration there is a steady and continuous fall of blood pressure, more or less rapid according as the chloroform is pushed or not, but never sudden so long as care

is taken to keep the respiration regular and free. The tracings of the Glasgow Committee are ascribed to asphyxia plus chloroform. The Glasgow Committee in their reply "point out that a fall of blood pressure only commences half a minute or so after the asphyxia has begun while the collapse represented in their tracings was immediate. On the whole it seems to me that the Hyderabad Commission are wrong in summarily dismissing cardiac paralysis as a thing impossible when we have on the other side evidence which commands respect to show that in a considerable number of cases in man death has been due to this cause. The observations of Professor McWilliam of Aberdeen⁽²⁾ regarding the condition of the heart muscle which he calls fibrillary contraction or delirium cordis have also an important bearing on the point.

⁽¹⁾ British Medical Journal. June 14th 1890.

⁽²⁾ British Medical Journal 1889 Vol 7 p. 348 et seq.

It seems in a high degree probable as he points out, that this cardiac spasm has been the real cause of death in many of the cases where the heart is described as having suddenly stopped.

A new and it must be said rather plausible theory has been advanced by Drⁿ Kirk of Glasgow,* to account for the liability to this danger. He says that just after the inhalation has been commenced the proportion of chloroform in the pulmonary circulation is very considerable, while that which has yet had time to pass into the systemic circulation is infinitesimal.

It is known that the effect of the drug is to produce increased resistance in the pulmonary circulation, (See Glasgow Committee Researches) and when the drug is withdrawn at an early stage, the chloroform in the lungs is rapidly eliminated with a result as though a tourniquet

*A new theory of chloroform syncope. (1890.)

had suddenly been removed from the pulmonary circulation. It is highly probable that such an occurrence would have some disturbing influence on the circulation, but I should say that it can only be in extremely rare cases that it can have much practical significance. The removal of the drug from the pulmonary circulation cannot well be described as sudden, as it is known that three respirations are required after its withdrawal before the odour of chloroform ceases to be perceptible in the expired air.* But there is one fact which seems to tell against the theory more than any other, i. e. that in midwifery practice chloroform is administered on the very principles so strongly condemned by Dr. Kirk, and yet we find a death to be an exceedingly rare and almost unknown occurrence.

The very different views
 * On Anaesthetics. Dr. Snow p. 98.

held regarding chloroform, and the considerable mortality of not less than thirty per annum which has for some years past attended its use in the United Kingdom, have caused many to adopt ether in preference. There can I think be no doubt in the mind of any unprejudiced person, statistics show it abundantly, that ether is the safer anaesthetic during the actual conduct of the operation. There is of course the question as to whether ether does not prejudicially affect the patient afterwards. A question which from the nature of the case must be very difficult to settle, and which is as strenuously denied by one party as it is asserted by the other. This uncertainty along with the fact that chloroform can be efficiently administered without an apparatus, that it is pleasanter to take, and ensures perhaps a greater quietude on the part of the

patient, will probably continue to
render it the favourite anaesthetic.