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Trichloroethylene anesthetic and analgesic and its use in labor

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TRICHLORETHYLENE ANESTHETIC AND ANALGESIC AND ITS USE IN LABOR

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INTRODUCTION

It is odd, but it seems that somewhere along the line in Medical School, this author missed any reference to Trichlorethylene pertaining to its use as an anesthetic or analgesic or to its use in labor. Yet, he found that it is used especially in labor. Not having any source of textbook information to fall back on, the author became curious as to some of the facts about Trichlorethylene. Thus, we have this paper.

In a subject like this, one thinks at first sight that it must be something new if there is nothing about it in the textbooks. Yet, a brief review of the history of Trichlorethylene will be presented in which one finds it is not a new agent at all.

Some of the pharmacologic facts of importance will be presented and the agent described as to its physical properties. The effect on respiration and the cardio vascular system are important and should be understood by anyone who uses Trichlorethylene so that he will know when a patient is receiving an overdosage. These facts will be brought out.

Then, what of the after-effects? Is recovery slow or rapid? If used in obstetrics, should one worry about depressed infant respiration and sleepy babies? These

are all fairly important questions, but before the author started his search of the literature, he could not answer them.

As for the use of Trichlorethylene in obstetrics, since that is probably where the student first comes in contact with it, why is it used? Does it give good analgesia and can it be used for the anesthetic for delivery? What are the patient reactions to Trichlorethylene? What are its disadvantages? These questions are important for a more intelligent and effective type of analgesia and/or anesthesia in labor patients.

Thus the author has searched the literature for a fairly exhaustive review, and has spent some time checking patients, as they used Trichlorethylene for the analgesia it produces while in labor. The author has spent some time questioning patients after delivery for their reactions to it.

The findings will thus be presented, in the hope they may help others in their intelligent use of the drug, Trichlorethylene, as they have helped and will help the author.

Trichlorethylene has uses other than in labor. There are reports written on its use in dentistry, in plastic surgery, in neurosurgery, and in the changing of painful dressings, ecetera. However, this paper

except for mentioning that there are other uses, will stick mainly to the use of the drug in labor, and will use material from articles written on its other uses only when they lead to a concise history or a more clear understanding of the pharmacology of the drug.

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HISTORY

The history of Trichlorethylene is rather a long one. It was first described by a German chemist, Fischer (1) in 1864. In 1911, another German, K. B. Lehmann (2) wrote a paper describing the anesthetizing of eight cats using Trichlorethylene. He also noted the decomposition of Trichlorethylene to dichloracetylene in the presence of alkali at temperatures near 100 degrees C. W. Plessner (3), another German in 1915 presented four cases of poisoning by Trichlorethylene in industry. He described vertigo, nausea and vomiting, swelling of the optic discs and analgesia in the area of distribution of the trigeminal nerve. Oppenheim (4) on hearing of Plessner's work, decided to try Trichlorethylene on cases of trigeminal neuralgia, for which treatment at that time was quite unsatisfactory. His report on the treatment of trigeminal neuralgia with the inhalation of small amounts of Trichlorethylene appeared also in 1915. This proved to be a popular form of treatment and was used for several years. Usually it consisted of placing twenty to twenty-five drops of Trichlorethylene on a wisp of cotton on a handkerchief and inhaling this until all traces of the Trichlorethylene were gone. This was repeated four times per day. As late as 1931, a report came out in

the Journal of the American Medical Association by Glosser (5) on the treatment of trigeminal neuralgia with trichlorethylene. Glosser, however, noted such drowsiness with the administration of the drug that he recommended the recumbent position to take the inhalations.

In 1934, Jackson (6) declared that the benefits from Trichlorethylene in trigenimal neuralgia and the side effect of drowsiness were due to its anesthetic properties. He suggested that it would be a good general anesthetic, rating its potency at about the same level as ethylene. Herzberg (7) reported on the histology of tissues taken from animals killed by prolonged exposure to the concentrated vapors of Trichlorethylene. He concluded that Trichlorethylene had little effect on the tissues studied. Since the liver was among the tissues, it was his opinion that Trichlorethylene was not the hepatotoxic agent that chloroform was. Soon after this, Striker and others (8) reported on the use of Trichlorethylene as a general anesthetic in over 300 cases. Most of these were dental procedures and dilatations, ecetera carried on in a venereal disease clinic. They commented on the absence of postoperative effects and suggested that nausea and vomiting and injurious affects attributed to the drug in industry

were due to toxic products in an impure drug and that with a pure drug, these untoward reactions could be minimized. However, the Council on Pharmacy and Chemistry of the American Medical Association (9) put a damper on further research into the subject in this country by rather a sour preliminary report on the use of Trichlorethylene for general anesthesia, when they stated that available evidence did not justify its use as a general anesthetic. It suggested waiting for further investigation into its potential toxicity and for further clinical evidence of its effectiveness. This put an end to the use of Trichlorethylene as a general anesthetic for several years, except for one experiment on dogs in 1939 by Rubenstein and others (10).

The work that finally established Trichlorethylene as a useful general anesthetic and analgesic was done in England during World War II. A certain Mr. Chalmers of Muswell Hill London wrote to the editor of the Lancet asking about anesthetic properties of Trichlorethylene. The editor referred him to C. F. Hadfield, then Secretary of the Joint Anesthetic Committee of the Medical Research Council. At that time, the Committee was looking for a non-inflammable anesthetic which could be used as a substitute for chloroform under war conditions. Hadfield collected what little information he

could on the subject and asked C. Langton Hewer of St. Bartholomews Hospital if he would look into the matter according to Oesterle (11). Hewer published his first paper on the subject of Trichlorethylene as a general anesthetic and analgesic in 1941 (12), and soon followed this with a report in the Proceedings of the Royal Society of Medicine (13) in 1942.

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PHYSICAL PROPERTIES

Trichlorethylene is a halogen substituted derivative of ethylene with the formula $ClClCCl_2$. The structural formula is $HC{=}C\begin{matrix}Cl\\Cl\end{matrix}$. In industry, it is an important solvent for fats, resins, bitumens, rubber, sulfur and phosphorous. It has been used rather extensively in dry cleaning, and was used by the Germans in the first World War as a solvent in their war industries. From this use in industry, there have been reports of workers becoming habituated to the drug, sniffing its vapors for the same solace an alcoholic gets from alcohol.

Trichlorethylene is a clear, colorless liquid with a sweet odor somewhat like that of chloroform. It is soluble in alcohol and not soluble in water. It has a specific gravity of 1.46; a vapor density of 65.75; and

a boiling point of 87 degrees C; according to Gordon and Morton (14). It is unstable in sunlight and air where it decomposes eliminating small quantities of phosgene and hydrochloric acid. The usual anesthetic Trichlorethylene contains 0.01 per cent thymol to inhibit decomposition. It should be stored firmly stoppered in light inhibiting containers. It is non-inflammable under ordinary operating conditions, but it is not non-inflammable under all conditions as Hewer (12) stated in his first paper on the subject. Jones and Scott (15) found that below 25.5 degrees C, Trichlorethylene has not sufficient vapor pressure for inflammable mixtures in the presence of 1 atmosphere of pressure or more. However, in mixtures with oxygen, all concentrations between 10.3 per cent at the lower limit and 64.5 per cent at the upper limit are inflammable. It is inflammable in air at a temperature of 463 degrees C. which is hardly an optimal operating room or delivery room temperature. Placed on the market by Industrial Chemicals Incorporated in a pure form, it was given the trade name Trilene. Commonly called Trilene in the literature, it is usually tinted a pale blue to distinguish it in color from chloroform, which is usually tinted a pale pink.

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CNS DEPRESSANT ACTION

Trichlorethylene as an inhalation anesthetic has a direct depressant effect on the central nervous system. It is carried from the lungs to the higher centers of the brain by the blood stream. Hewer (13) gives the following stages of anesthesia: Stage I. The stage of analgesia is one of marked detachment for the patient; in stage II, he noted occasional excitement but otherwise is not remarkable; Stage III is characterized by quiet automatic respirations with a small pupil. The planes of Stage III show eye signs similar to those with ether.

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EFFECT ON RESPIRATORY AND CARDIO VASCULAR SYSTEMS

The first note of the effect of Trichlorethylene on the respiratory system was by Lehmann (2), who, in his experimental anesthetization of eight cats noted a rise in their respiratory rate. Hewer (16) in 1943 reported that Trichlorethylene was non-irritating to the respiratory system, and that with its use, there was no excessive salivation or mucous. Thus, it was possible to rapidly increase its vapor concentration in the induction

of anesthesia.

Garland (17) reporting a case of convulsion under Trilene anesthesia suggested that the hyperpnea or tachypnea from the Trilene induced a low alveolar carbon dioxide tension thus, leading to convulsions. Hunter (18) remarked on the tachypnea associated with Trilene and suggested it was due to excitation of the Hering Breuer reflex. He said it could result in anoxemia and suggested a high oxygen concentration of inspired air to eliminate a secondary increase in respiratory rate from the anoxemia. Enderby (19) and Hewer (20) agree that tachypnea with Trichlorethylene administration is a sign of overdosage.

Whitteridge and Bulbring (21) in a nice bit of research with animals found changes in the Hering Breuer reflexes under Trilene anesthesia. There were able to separate the inspiratory and expiratory reflexes by cooling the vagus. They concluded that the rapid, shallow breating found with Trilene anesthesia was due to stimulation of both the inspiratory and expiratory reflexes. Trilene compared with ether in this respect, continued to stimulate the deflation reflex, while ether at first stimulated it, then depressed it.

Dundee (22) in a recent study found tachypnea about one-third more common under Trichlorethylene

administration to the very young and the aged, and showed that bronchodilator drugs did not abolish the tachypnea tending to disprove the theory that the tachypnea is due to broncho constriction, and suggests sensibly that tachypnea is a sign of over dosage and is best prevented by using a minimal dose of the anesthetic.

Because of the structural and physical similarities between Trichlorethylene and chloroform, Trichlorethylene was early suspected of being potentially dangerous to the heart. Hewer took no note of this in his first paper on the subject say that cardio vascular effects were mild and transient in most cases. Marquardt and others (23) said Trilene produced no permanent injury to the heart unless given in large quantities or repeatedly. Herzburg (7) found no permanent injury to the heart in dogs killed by prolonged exposure to Trichlorethylene. Waters, Orth and Gillespie (24) worked with dogs and a small number of humans. They found that in dogs, cardiac arrest and respiratory arrest occurred at about the same time. They followed the anesthesia in a few cases with continuous electrocardiograms in humans, and noticed numerous cardiac irregularities, only one multiple focal ventricular extrosystoles did they consider as a serious irregularity. In only one of their human patients did they find a normal rhythm throughout.

Haworth and Duff (25) in 1943 reported the only cardiac death that this author could find in the literature. They attributed this death to vagal inhibition of the heart. Griffith (26) recorded that the blood pressure remains steady or rises slightly when using Trilene.

The most common cardiac irregularity with Trichlorethylene according to Hunter (18) is bradycardia leading to extrosystoles. Ewing and Brittain (27) also point this out. Hunter decided the extrosystoles begin when the SA node is inhibited to such an extent that another focus can originate the rhythm.

Barnes and Ives (28) did possibly the most complete study of the effect of Trilene on the cardiac rhythm. They checked forty patients with a visible record of cardiac activity at short intervals, and took a permanent electrocardiographic record of any untoward activity. They found that most of the irregularities were transient and occurred in the first ten to twelve minutes of anesthesia, and concluded that most of them were due to increased vagal tone. In seven of their forty patients, they found no abnormalities at all in the cardiac rhythm, but in four of them, they found multifocal ventricular tachycardia and considered this as possibly the most serious irregularity since in proceeds ventricular

fibrillation when using chloroform anesthesia. However, they could find only one report of a cardiac death after approximately 500,000 Trichlorethylene administrations, so they state Trilene must be considered no where near as dangerous as chloroform.

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MISCELLANEOUS EFFECTS AND AFTER EFFECTS

Hewer (13) at first reported that Trichlorethylene had little effect on the urine but later had to amend this in another paper (14) when he found that acetonuria was common following Trichlorethylene administration. He attributed this partially to a high number of children having received the anesthetic for acetonuria is more common with children. However, he emphatically stated that no ketosis resulted from the drug. In two of his papers, he reported little to no effect on the blood sugar during the course of or following Trichlorethylene Anesthesia.

Trichlorethylene is not suitable for producing muscular relaxation when used alone with no other agent. However, it has little to no effect on uterine contractions and thus, has a good place in obstetrical procedures according to Freedman (29). Browne and others (30) report

that it may slow uterine contractions if used over long periods of time or if used in high concentrations.

Striker and co-workers (8) were the first to notice the apparent absence of after effects with Trichlorethylene. They stated that after using it a few times, they felt no concern over their patients if shortly after their anesthetic, they would ride home on the city streetcar. Rubenstein, Painter, and Horne (10) working with dogs noticed the rapid recovery and short-lived effect of Trichlorethylene and that the dogs were nausea-free following the anesthetic. The freedom from after-effects caused such patient demand for Trichlorethylene, that Webb (31) persisted in its use although he himself was not convinced of its effectiveness. Hewer (13) in 1942 reported a quick recovery and freedom from after-effects in most of his patients. Scales and Ohlke (32) using Trilene with labor patients and delivery found an incidence of nausea and vomiting only 1 per cent. Gordon and Morton (14) using it for obstetrical analgesia and anesthesia had no vomiting in 73.3 per cent of patients and 21.7 per cent of the patients vomited but once on the delivery table.

Durrans (33) reported three cases of delayed recovery from Trichlorethylene anesthesia in which the recovery period was 36 hours or longer. He decided

this was due to the low volatility and high lipoidal solubility of Trilene, and states that the rate of recovery from anesthesia is proportional directly to the relative volatility of the agent used and indirectly to the lipoidal solubility. However, no other such reports were found since 1943 and one wonders if other factors were not present in his cases.

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ELIMINATION AND METABOLISM

Working with human subjects, Powell (34) found detectable amounts of Trichlorethylene in the blood and expireal air 24 hours after anesthesia. Butler (35) in rather an exhaustive study of this subject found that some of the Trichlorethylene retained in the body after anesthesia is metabolised slowly to chloral hydrate which then is rapidly converted to Trichlorethanol and/or to Trichloracetic acid. Trichlorethanol is then conjugated with glucuronic acid. This conjugation product is found in the urine of dogs. Considerable amounts of Trichlorethylene are retained in the body after the pharmacologic effects of it have disappeared. Butler suggests this could be a simple physical solution in fat. Barratt, Cunningham and Johnson detected trilene in the

fat muscle and heart of a dog 66 hours after exposure to its anesthetic vapors with the highest concentration in fat, according to Butler.

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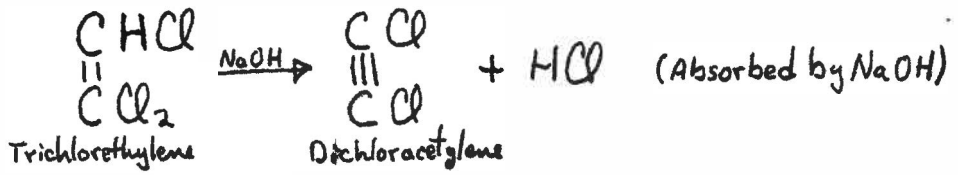
REACTIONS AND PRECAUTIONS

This is a catch-all subtitle under which to report those untoward reactions not heretofor reported in this paper. Condon (36) reported convulsions in a young man while using Trilene for anesthesia. He gave no comments as to cause but probably this could be similar to the mechanism in the convulsions reported under respiratory effects in this paper. Goldsmidt (37) reported another case of convulsions and suggested an effect of Trilene on the heart or respiratory system as the basis. He also reported an acute ecyematoid skin rash during the course of Trilene anesthesia which disappeared with deepened anesthesia. Hardman (38) reported a death from acute yellow necrosis of the liver eleven days after a prolonged Trilene anesthesia. However, this patient received his injury in the nature of burns several months before this anesthesia and had been in two hospitals prior to the one in which death occurred. Quite probably, he received plasma or transfusions so

that his death could possibly be attributed to virus hepatitis rather than to the effect of Trilene on the liver alone.

In 1943, reports by Morton (39) and McAuley (40) appeared in the literature in which they had cranial nerve palsies following Trichlorethylene anesthesia. This caused a great stir due to Trichlorethylene's early use in trigeminal neuralgia. Humphrey and McClelland (41) reported 13 cases of cranial nerve palsies following general anesthesia, but Trilene was not used for all these anesthesias. They speculated that some Trilene may have remained in the anesthetic machines as contaminants and may have undergone some decomposition or chemical change, then reached the patient with the next administration with that machine. McClelland followed this up with a paper (42) in which he proposed a reaction with soda lime producing dichloracetylene which can decompose to war gas phosgene. The reaction with soda lime was probably speeded by heat generated in the soda lime especially in the more hygroscopic brands of soda lime, Corden (43) pointed out. Firth and Stuckey (44) stated that one of the best ways to prepare dichloracetylene is to pass Trichlorethylene over heated alkali at a temperature of 130 degrees C. This results in the following chemical

reactions:



One wonders if these gentlemen were unfamiliar with the work of Lehmann who, in 1911, pointed out that at temperatures near 100 degrees C. Trichlorethylene decomposed to form dichloracetylene. Firth and Stuckey, Corden and McClelland all recommended that Trichlorethylene no longer be used in closed circuit anesthesia in the presence of soda lime.

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USE OF TRICHLORETHYLENE IN OBSTETRICS

The first mention of Trichlorethylene in any obstetrical procedure was by Hewer in his first paper on Trichlorethylene (12). During Cesarian section in which Trichlorethylene was the main anesthetic used, the surgeon remarked to Hewer about the way the anesthetic interferred none at all with the contraction of the uterus after the infant and placenta were removed. In 1942 Elam (45) proposed the idea that Trichlorethylene should have a definite place in obstetrics since it afforded such excellent analgesia. Haworth and Duff used it in two obstetrical cases and were favorably impressed.

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ANALGESIA

The first to use the analgesic effect of Trichlorethylene in childbirth and report a sizable series of cases was Freedman (29). He used it for analgesia ranging from 30 minutes to seven hours on 190 patients, finding it quite satisfactory. Hill (46) introduced the idea of auto analgesia with Trilene. In 62 clinical cases, 27 had no pain; 27 had some discom-

fort but not pain, 8 claimed they received no benefit although they exhibited no signs of pain at the time. Twenty-one of his patients had total amnesia. Thirty-three had partial amnesia, and eight had a lucid memory of what was done. Barratt and Platts (47) were well pleased with the degree of analgesia produced and the amount of amnesia . Then, in 1947, Hayward-Butt (48) reported satisfactory analgesia in 86.5 per cent of 671 patients, with the analgesia rated as excellent by 66 per cent and 75 per cent of two groups of women who had used it.

Scales and Ohlke (32) reporting in the Canadian Medical Journal in 1951 summarized 900 cases in which they used Trichlorethylene as the analgesic and anesthetic agent. There method was to present the inhaler to the patient when she was 7 centimeters dilated if a primipara and when she was 5 centimeters dilated if a multipara. Once this was started, no further morphine demoral or other drugs were given. Patients were instructed in the use of the inhaler and watched closely through the first few contractions after receiving it to make sure they were using it only with the contractions and that they were using it correctly. They found that for the most part, patients liked it, and many of them used their contractions to better

advantage with the aid of the Trichlorethylene analgesia.

The analgesia afforded was excellent for 46.5 per cent of a series of cases reported by Bordon and Morton (14) and was adequate in 90.7 per cent of the cases. They also noted an incidence of amnesia in 18.6 per cent of their cases. Brown, McCormick, and Whyte had a series of 1,390 labor patients who used Trichlorethylene or nitrous oxide and oxygen. They found that the analgesia produced by Trichlorethylene was comparable to that of nitrous oxide and oxygen, but that Trichlorethylene was simpler to use and much cheaper than the nitrous oxide and oxygen.

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EFFECT ON UTERINE MUSCULATURE

Besides Hewer's brief comment on the effect of Trichlorethylene on the uterus, heretofor mentioned, there are other findings to bring into focus. Brown et al (30) reported that when used in high concentrations or over a prolonged period of time, Trichlorethylene might reduce the rate and effectiveness of uterine contractions. Freedman (29) in his 190 cases noted an effect on the contractions in only one case. Seward(50)

suggests a slightly lower concentration of Trilene in prolonged intermittant administration with uterine contractions, when used over six hours, and suggests the use of morphine or demoral with this lower concentration. For at the slightly higher concentration, the patient may become drowsy and uncooperative. Yet, even if the higher concentration is used (Seward gives the figure of 0.5 per cent in air) the uterine activity is not interferred with even after the mother gets drowsy.

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EFFECT ON CHILD

Any anesthetic used in labor must come under investigation for its possible effect on the infant and, particularly, on the infant's respiration. Noble and Cattanach (49) in their report on the use of Trilene in 137 cases of uncomplicated labor, from February to May of 1949, reported no concern with depressed infant respiration. In their 900 cases, Scales and Ohlke (32) had three infants who needed resuscitation, none of which they could attribute to Trilene. Seward (50) suggests that Trilene could lead to sleepy babies if the mother has received it in concentrated form over a prolonged period of time. However, in his experience

this happened only when the mother had received Trichlorethylene and some other analgetic or depressant drug. Gordon and Morton had seven infants out of 669 who required resuscitation and their mothers had received Trichlorethylene. However, of these seven infants; one was a premature; two were cases with obstetrical complications; and, four needed aspiration of the trachea.

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USE AS ANESTHETIC FOR DELIVERY AND USE WITH OBSTETRICAL COMPLICATIONS

Those who have reported on Trichlorethylene as an anesthetic for the delivery of a child are not so numerous as those who report on its use as an analgetic. Perhaps this is summed up fairly well by Barratt and Platts (46), who were enthusiastic over Trichlorethylene as an analgetic but not convinced of its effectiveness for anesthesia in all cases, although they felt it was useful in some of them. Noble and Cattanach used Trilene alone in most of their 137 deliveries, though not all of them. Gordon and Morton used Trilene alone in 104 deliveries. Scales and Ohlke used Trilene in air with atropine gr 1/150 in 510 deliveries, and none of

these investigators reported any serious difficulties or drawbacks to its use for the anesthetic as well as for analgesia. Seward (49) reported two disadvantages. First, the mother may have a dry mouth from mouth breathing while using the inhaler, and, second, during the course of labor and delivery, Trilene may not relieve the backache which is continuous and sometimes more distressing to the patient than the labor contractions themselves.

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OBSTETRICAL COMPLICATIONS

There are no particular obstetrical complications which contraindicate the use of Trichlorethylene in labor. Freedman (29) reported on using it with patients with toxemia of pregnancy, rheumatic heart disease and breech delivery, with no difficulty. Calvert (51) in his 80 cases reported on its use for nine pre-eclamptics, three of which were inductions, four breech deliveries and four deliveries in which forceps were used. Barratt and Platts, however, feel that the anesthesia produced by Trichlorethylene is not sufficient for use of forceps.

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AFTER EFFECTS AND PATIENT REACTION

One patient had the following comment to Calvert (51) after using nitrous oxide for a previous delivery and Trilene for the next. Of the nitrous oxide, "It were no good" and of the Trilene, "This were grand". The 510 patients of Scales and Ohlke were generally in favor of Trilene because of the rapid recovery and absence of nausea and vomiting. Gordon and Morton (14) noted a cumulative effect of drowsiness and relaxation of inhibitions, yet 29 per cent of their patients used the Trilene for 4 hours or longer before the delivery. Brown et al (30) reported their patients favorable over all although some objected to the odor of the Trichlorethylene.

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AUTHOR'S EXPERIENCE

In a small community hospital in Nebraska, there were 31 deliveries for the first three months of this year and the author collected some figures on those deliveries in which Trichlorethylene was used. The technique of administration was similar to that used in several of the local Omaha hospitals. The inhaler was given to the mother when it was determined that she was making definite progress in labor, and when she was becoming quite uncomfortable. Its use was explained, and in most every case, there was someone sitting with her throughout her labor. Occasionally, the mothers objected to the odor of the Trichlorethylene, however, usually if the first few breaths of it were not too concentrated, the mothers would soon cease their objections. In only one case did the mother refuse its use entirely on the basis of the odor. The inhaler strapped to the wrist of the mother was used intermittantly with the contractions until delivery time at which time, open drop ether was used as the anesthetic for delivery.

Of the 31 deliveries, 27 of the mothers used Trilene, the other 5 entered the hospital just in time for delivery or else had so little discomfort with their labor, that no analgesia was used. Out of the 27 using Trilene, 22

found the analgesia satisfactory. Six of these thought it was excellent. Fifteen thought it was good. In some cases where the mothers had had previous deliveries using different means of analgesia, they thought Trilene was as good or better.

There were few reactions noted to the analgesia, in most cases, any reactions noticed were transient. One mother got some flush and had quite a profuse diaphoresis for about the first ten times she used the inhaler with her contractions. Then this disappeared. No bradycardia was noticed. In four cases, there was noticed some hyperpnea, whether this was due to the drug, or whether it was an attempt on the part of the mother to alleviate the pain from an especially severe contraction, could not be determined. In no case, did the hyperpnea last beyond the length of time the patient used the mask with the contraction.

Of the 22 patients who were generally in favor of the Trilene analgesia, three recalled spontaneously after delivery that they did not like the odor and four remembered it did not help their backache. Of the five who did not like the Trilene, one objected most to the odor. Three said it did not help their backache. One said she got no relief at all from anything. Of these five patients, three were rather hard to care for and

labeled chronic complainers by the nurses.

No effects were noted on the babies that could be attributed to Trilene. Only one baby needed resuscitation. It was a premature and later died of an aspiration pneumonia. There was one stillbirth. Had any after-effects been noticed with the babies, it would be difficult to say if it were due to the Trichlorethylene or to the ether or, in some cases, to the demoral which was used on the mother.

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SUMMARY

The history of Trichlorethylene as an anesthetic and analgesic agent is traced from its discovery through its use in trigeminal neuralgia and its first use on humans in 1934. Then to its rediscovery by Hewer in 1941. Important physical properties were reviewed. It is non-inflammable under ordinary operating or delivery room temperatures. It should be kept tightly stoppered in light inhibiting containers as it decomposes in the presence of sunlight and air to eliminate small quantities of phosgene and hydrochloric acid.

Several important pharmacologic aspects of Trichlorethylene as an anesthetic have been brought out. Important among these especially in this paper is the excellent analgesia afforded in the first stage of anesthesia. The effect on the respiratory system that is most important is the tachypnea resulting from changes in the pulmonary receptors of the Hering Breuer reflexes. This may result in either anoxia or low carbon-dioxide alveolar tension leading to convulsions. Tachypnea thus must be considered a sign of overdosage.

Many cardiac arrhythmias have been noted with Trichlorethylene as with many of the inhalation

anesthetics. However, most of these are not serious for only one cardiac death could be found in the literature that was attributed to the use of Trichlorethylene. Bradycardia due to vagal inhibition, can be considered another sign of overdosage of Trichlorethylene if severe and persistent. It may, however, be transient, and in some cases can be corrected by either reducing the amount of Trichlorethylene in inspired air or by increasing the oxygen content.

After effects from Trichlorethylene are minor. Nausea and vomiting are rare and recovery is usually rapid. Some patients object to the odor of Trilene.

Miscellaneous effects are acetonuria, particularly in children; little to no effect on the blood pressure, and little to no effect on the blood sugar. Trichlorethylene alone is not suitable for producing good muscular relaxation, but it has little to no effect on uterine activity. Thus it is quite a suitable agent for obstetrical anesthesia and particularly for obstetrical analgesia.

The idea of auto analgesia in obstetrics using Trichlorethylene was introduced in 1944, and has slowly gained favor. A small inhaler was devised that the patient could hold in her hand and have strapped to wrist so it would not be dropped and broken when the

mother's hand dropped away from her face as she reached an anesthetized state. Many authors have reported favorably on the analgesia produced with Trichlorethylene, and the mothers have rated the analgesia as satisfactory in 75 to 85 per cent of cases.

Of those who reported on effects on the infant, most agreed that there was little need to worry about depressed infant respiration when Trichlorethylene is used intermittantly over a period of hours for analgesia.

Results from a series of 27 deliveries were recorded by the author in which Trichlorethylene was used for analgesia alone during labor, and ether used for anesthesia at delivery time. Analgesia was satisfactory in 85 per cent of these cases. Only transient effects were noted on the mothers' respirations and then in only a few cases. No cardiac difficulty was encountered though only the pulse was checked and then only early in the administration. Several patients did not like the odor of Trilene and the other objection to it was that it did not help the backache which continued between contractions and thus, between the times the Trilene was used. No effects on infants that could be attributed to Trichlorethylene were found.

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CONCLUSIONS

1. Trichlorethylene can be used as a general anesthetic, although alone, it will not give complete muscular relaxation.

2. Important signs of overdosage of Trichlorethylene are tachypnea and bradycardia.

3. Trichlorethylene in sub-anesthetic concentrations is an excellent agent for analgesia in labor and can easily be used by the patient herself as a means of auto analgesia. When used this way, it is quite safe for both the mother and infant.

4. Trichlorethylene auto analgesia may be objected to by some mothers due to the odor. Usually this objection can be overcome by starting slowly.

5. Trichlorethylene does not in intermittant inhalations relieve the backache common in many labor patients. This backache is continuous and may require the use of another agent such as demoral in conjunction with the Trichlorethylene.

6. Trichlorethylene can be used in some cases for the anesthesia during actual delivery of the child. However, perhaps this use is best reserved for those patients with which an easy delivery without forceps or episiotomy is expected. For the depth of anesthesia reached with Trichlorethylene alone is relatively light.

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