TRICHLORETHYLENE IN OBSTETRICAL ANALGESIA
AND ANAESTHESIA

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INTRODUCTION

The provision of pain relief in labour is complicated by the fact that in
this circumstance we are dealing with 2 patients, the mother and the
unborn child, and that frequently what is good for the one may be very
bad for the other. Drugs used to relieve the mother’s pain may so
depress the responses of the infant that the initiation of spontaneous
respiration after birth may prove difficult, and especially when such
depression is added to obstetrical trauma. To believe that every
failure of the infant to breathe spontaneously is the result of administra-
tion of anaesthetic drugs, as is sometimes suggested, is, of course,
absurd. In this regard reference is made to a paper by Snow on
“Resuscitation of the Stillborn,” published in the Westminster Medical
Gazette on October 16, 1845—exactly one year before Morton’s historic
demonstration of ether anaesthesia. Anaesthesia has made possible
modern obstetrical practises which have reduced the incidence of still-
birth due to trauma, but I believe that the use of heavy sedation and
depressing anaesthetic agents has had a tendency to offset this gain.

The ideal in pain relief for obstetrical patients would be provided
by agents and technics which would provide complete relief of pain for
the mother throughout labour, preserve her cooperation and the whole
reflex mechanism of “bearing-down” in the second stage, preserve
uterine contractility and uterine tone, and which moreover would have
no depressing effect on the infant. The regional anaesthetic technics
so widely advocated approach this ideal in some respects, but fall
short of it in that they abolish the straining reflex. From the practical
point of view they also present the disadvantage of requiring highly
skilled technic and supervision which makes their use difficult in the

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Research Council of Canada.
obstetrical service of a busy general hospital, and completely impracticable in the hands of the general practitioner. At the University of Toronto we commenced an investigation into the use of trichlorethylene for analgesia in labour to determine whether we would be justified in recommending its use to general practitioners. We have been so impressed with our findings that this agent, used with the techniques I shall describe, is rapidly displacing others in our obstetrical service.

Chemistry and Pharmacology

Trichlorethylene is a chlorine-substituted derivative of ethylene, having the structural formula \( \text{Cl} \quad \text{Cl} \quad \text{H} \quad \text{C} \quad \text{C} \quad \text{Cl} \). It is thus chemically akin to chloroform, and resembles chloroform in many of its physical properties. It is a clear colourless fluid with a sweet odour somewhat resembling chloroform. Specific gravity is 1.46, vapour density 65.75 and boiling point 87°C. It is noninflammable.

Chemically pure trichlorethylene is slightly unstable when exposed to sunlight and air, small quantities of phosgene and hydrochloric acid being found. The addition of 0.01 per cent thymol inhibits this decomposition. It should be stored in firmly stoppered containers which exclude light. A purified preparation containing 0.01 per cent thymol and coloured blue to distinguish it from chloroform is available for anaesthetic purposes under the trade name trilene (Imperial Chemical Industries).

The use of trichlorethylene for general analgesia and anaesthesia appears to have been suggested by Jackson (1) in 1934, who reported its use in dogs. At the same time Herzberg (2) published a report of the histologic study of tissues from dogs killed by prolonged administration of high concentrations of trichlorethylene vapour, and reported that no significant changes were found. In 1935, Striker, Goldblatt, Warm and Jackson (3) reported the clinical use of this substance to produce analgesia and anaesthesia in over 300 cases and noted particularly the absence of postoperative nausea, vomiting and depression. In spite of this promising start, no further anaesthetic use appears to have been made of this drug until Hewer (4) reported its use in 400 cases to the Royal Society of Medicine in 1942. Since that time it has received wide application in Britain and more recently in Canada for the production of analgesia and light planes of anaesthesia.

In January 1943 Waters, Orth and Gillespie (5) reported an investigation of the effects of trichlorethylene anesthesia on cardiac rhythm. This report was based on electrocardiographic observations on 7 dogs and 10 clinical patients anaesthetized with the drug, and the authors concluded that trichlorethylene produces undesirable effects on cardiac automaticity. Gordon and Shackleton (6) reached a similar conclusion on purely clinical grounds after an experience with 100 clinical patients anaesthetized with trichlorethylene and
oxygen alone. It would appear, however, that after what must be several hundreds of thousands of administrations over the past eight years trichlorethylene has achieved an almost unique record of safety; and here I must point to what I believe is a common misunderstanding on this side of the Atlantic in the reading of the British literature on trichlorethylene — namely, that when the British anaesthetist refers to trichlorethylene (or trilene) anaesthesia he refers in almost every case to trichlorethylene vapour exhibited in conjunction with nitrous oxide and oxygen. Only when this is appreciated can we stand on common ground in discussing the use of this agent. Certainly when trichlorethylene alone is pushed to the stage of surgical anaesthesia the cardiorespiratory effects may be most alarming. When the agent is used judiciously to supplement nitrous oxide-oxygen analgesia it is rare indeed that there will be cause for alarm (7–23).

Trichlorethylene should not be used in a closed rebreathing system with the carbon dioxide absorption technic. McAuley in 1943 (24) drew attention to cases of trigeminal anaesthesia following administration of the agent by this technic, and subsequent reports by Morton (25) by McClelland and Humphrey (26) and by Carden (27) demonstrated that cranial nerve palsies and in some cases death might occur as a result of the inhalation of substances produced by the degradation of trichlorethylene in contact with hot soda-lime. Such sequelae have not been reported following the use of pure trichlorethylene by technics which avoid carbon dioxide absorption by alkali. Commercial trichlorethylene must not be used since it contains impurities which will produce these same effects.

Methods Used at Toronto General Hospital for Trilene in Obstetrics

The analgesic properties of trichlorethylene recommend it particularly for use in obstetrics. The analgesia produced without loss of consciousness is more profound and more prolonged than that produced by any other presently available agent, including nitrous oxide. The poor anaesthetic qualities of the drug provide additional advantage in the obstetrical field.

We have employed trichlorethylene extensively for the provision of analgesia in obstetrical patients at the Toronto General Hospital since

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analgesia and Anesthesia Combinations Used</td>
</tr>
<tr>
<td>Group</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>I</td>
</tr>
<tr>
<td>II</td>
</tr>
<tr>
<td>III</td>
</tr>
<tr>
<td>Total patients in series</td>
</tr>
</tbody>
</table>
May 1949. The patients so treated may be classified in three groups, namely, Group I, trichlorethylene analgesia throughout labour with no other sedative or analgesic; Group II, trichlorethylene analgesia until delivery with nitrous oxide-oxygen-trilene for delivery and perineal repair, and Group III, “conventional” sedation during labour with trichlorethylene or nitrous oxide-oxygen-trilene for delivery.

TABLE 3

<table>
<thead>
<tr>
<th>Cumulative Effects and Other Sedation (161 Cases)</th>
<th>Cases</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative effect</td>
<td></td>
<td>22.9</td>
</tr>
<tr>
<td>Noted clinically or sleepiness or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>relaxation of inhibitions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time over 4 hours</td>
<td></td>
<td>29.1</td>
</tr>
<tr>
<td>Other Sedation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedative before trilene</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Sedative after trilene</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>(6 slow labours; 1 accidental haemorrhage;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 cardiac disease)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The patients in Group I were carefully followed throughout labour for evaluation of the efficiency of analgesia, the effect of the trichlorethylene on the mechanism of labour and the immediate postnatal condition of the infant. Group II and Group III are less completely documented with the exception of notes on the condition of the infant on delivery.

TABLE 4

<table>
<thead>
<tr>
<th>Effect of Trichlorethylene on Third Stage of Labour (161 Cases)</th>
<th>Cases</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third Stage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal</td>
<td>9</td>
<td>5.5</td>
</tr>
<tr>
<td>Prolonged 3rd stage</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Manual removal of placenta</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Excessive bleeding</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

In our patients in Group I (trilene alone) there were 104 patients; in Group II, 78 patients, and in Group III, 487 patients, a total of 669 patients (table 1).

The results in these patients have been evaluated in varying degrees in respect to effect on mother and child. A series of 161 cases falling in
Group I (trilene alone) and Group II (trilene and trilene-nitrous oxide-oxygen) was anaesthetized and studied by one of us (M.V.M.). Details of this series are given in tables 2 to 7. Table 2 shows the degree of pain relief obtained using intermittent trichlorethylene inhalation without sedation, based on clinical observation and the opinion of the patient obtained on the day following confinement.

**TABLE 5**

| Incidence of Vomiting After Trichlorethylene Analgesia (161 Cases) |
|-----------------------------|------------------|------------------|
| Vomiting                    | Cases            | Per Cent         |
| None                        | 118              | 73.3             |
| Once on table               | 35               | 21.7             |
| Oftener                     | 8*               |                  |

* In 3 of these patients ether was added during anaesthesia for perineal repair.

Some patients had a cumulative effect from intermittent inhalation of trichlorethylene for analgesia over a period of hours. This effect was apparent clinically in drowsiness or relaxation of inhibitions and was seen in 22.9 per cent of 161 cases.

This drug may be safely used intermittently for several hours, as demonstrated by the fact that 29.1 per cent of 161 patients had such administration over a period exceeding four hours. The longest period was ten hours.

**TABLE 6**

| Effect of Trichlorethylene on Respiration of Infants (132) |
|----------------------------------------------------------|------------------|------------------|
|                                                          | Cases            | Per Cent         |
| Immediate respiration                                    | 66               | 54               |
| Spontaneous respiration (less than 2 minutes)            | 56               | 46               |

Of the 182 patients in Groups I and II, 10 had some sedative before trichlorethylene analgesia was commenced, and 8 patients required some further sedation during the course of labour, for the reasons shown in table 3.

Abnormality in the third stage occurred in 9 of 161 cases or 5.5 per cent. These are analyzed in table 4. Vomiting was not significant. Incidence of vomiting is shown in table 5.

**TABLE 7**

| Cardiovascular Effects with Trichlorethylene Analgesia |
|-------------------------------------------------------|------------------|------------------|
| Cardiovascular Effects                                 | No effect        |
| Intermittent analgesia                                 |                  |
| Trilene-nitrous oxide-oxygen anaesthesia               | Per Cent         |
| Extra systoles                                         | 40.7             |
| Bradycardia (less than 68 per minute)                  | 23.4             |
| Tachycardia                                            | 1.5              |
The influence of trilene analgesia on the respiration of the infants after birth is shown in table 6. This is based on 132 full term infants born of normal mothers after normal labour without sedation (that is, trichlorethylene analgesia alone).

The cardiovascular effects noted are shown in table 7. In no case was any effect noted during the period of intermittent analgesia. Extra systoles occurred during nitrous oxide-oxygen-trilene anaesthesia in 40.7 per cent of these patients, bradycardia in 23.4 per cent, and tachycardia in 1.5 per cent. In no case was there any cause for alarm, nor did we believe that these arrhythmias were more serious than those ordinarily encountered during cyclopropane anaesthesia. We have no record of any cardiovascular disturbance in the infant.

**TABLE 8**

<table>
<thead>
<tr>
<th>Resuscitation of Infants—Trilene Series Toronto General Hospital</th>
<th>Cases</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate respiration</td>
<td>695</td>
<td>90.4</td>
</tr>
<tr>
<td>Spontaneous respiration (less than 2 minutes)</td>
<td>57</td>
<td>8.5</td>
</tr>
<tr>
<td>Resuscitation necessary</td>
<td>7</td>
<td>1.1</td>
</tr>
<tr>
<td>(intubation; aspiration of secretions from trachea; insufflation with oxygen)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>669</td>
<td>100</td>
</tr>
</tbody>
</table>

Only 7 of 669 infants required resuscitation of any kind (table 8). In no case do we believe that the anaesthetic played any significant part in the infant’s distress. Of the 7 requiring resuscitation, one was small and premature and 2 others represent serious obstetrical complications (table 9).

**TABLE 9**

<table>
<thead>
<tr>
<th>Infants Requiring Resuscitation</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prematurity (weight 1½ pounds)</td>
<td>1</td>
</tr>
<tr>
<td>Obstetrical complications</td>
<td>2</td>
</tr>
<tr>
<td>-1 rotation with mid-forceps extraction</td>
<td></td>
</tr>
<tr>
<td>-1 tearing of veins in mediastinum due to traction</td>
<td></td>
</tr>
<tr>
<td>- on head for delivery of shoulders</td>
<td></td>
</tr>
<tr>
<td>Obstruction of trachea by fluid requiring aspiration</td>
<td>4</td>
</tr>
</tbody>
</table>

**Apparatus**

Trichlorethylene during the first stage of labour and up to the point of delivery has been self administered by the patient through an inhaler. A number of inhalers for this purpose have been developed by British manufacturers primarily for obstetrical use. In basic principles all are similar, consisting of a vaporizer through which air is drawn by the patient’s respiration, an expiratory check valve and blow-off valve, and a by-pass by which the proportion of air drawn through the trilene vaporizer may be adjusted. In all inhalers de-
signed primarily for obstetrical use a locking device is provided on the
ing by-pass, to insure that the concentration cannot be increased by
the patient herself. Some of these inhalers are so small that the
whole apparatus may be held in the patient’s hand. Others may be
clamp to the bed or a convenient table, the patient being supplied
with a rubber face-piece which is connected to the vaporizer unit by a
length of corrugated tubing. Recently the question of permitting
registered midwives in the British Isles to use trilene inhalers has been
considered by a committee of experts, and specifications have been
made up which, it is believed, would provide an instrument safe enough
for this purpose. These specifications provide for a safe maximal
concentration, and the maintenance within narrow limits of a constant
concentration of trichlorethylene vapour over a considerable tem-
perature range. Some inhalers are, of course, constructed for use
by the anaesthetist and these may usually be employed alone with air,
or attached to a gas machine, as in Marrat’s apparatus or the recently
designed “McGill” vaporizer. It must be emphasized that these in-
halers designed for production of obstetrical analgesia will not be
useful for surgical anaesthesia.

In the administration of nitrous oxide-oxygen-trichlorethylene we
have used the McKesson Nargraf nitrous oxide apparatus, placing the
trichlorethylene in the ether vaporizing bottle. This has proved
very satisfactory. Ordinarily a 50:50 mixture of nitrous oxide and
oxygen is employed with the trichlorethylene. If tachypnoea develops
this may usually be controlled by increasing the nitrous oxide to 75
per cent and reducing the concentration of the trichlorethylene. A
“circle” apparatus such as the Foregger or Heidbrink may also be
used, with a high flow of nitrous oxide and oxygen (8 liters) and with
the carbon dioxide absorption canister shut off from the circuit.

Summary

Trichlorethylene has been found to be a satisfactory agent for the
production of analgesia in obstetrics, providing adequate analgesia
both when used intermittently throughout labour and when used in
combination with nitrous oxide and oxygen for delivery. It has proved
less depressing to the infant than other inhalational anaesthetic agents,
especially when analgesia is required over a prolonged period of time.
It is pleasant to the mother and produces a minimum of postpartum
depression and vomiting. It is satisfactory for all obstetrical ma-
nipulations except versions (in which relaxation of the uterus is
required).

REFERENCES

1. Jackson, D. E.: Study of Analgesia and Anesthesia with Special Reference to such
   Substances as Trichlorethylene & Vinethene (Divinyl Ether) Together with Apparatus
2. Herzberg, M.: Histology of Tissues Taken from Animals Killed by Prolonged Administra-
   tion Concentrated Vapour of Trichlorethylene, Anesth. & Analg. 13: 293–294 (Sept.–
   Oct.) 1934.


