TRICHLORETHYLENE ANAESTHESIA IN
PLASTIC SURGERY

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Striker *et al.* in 1935, and more recently Hewer (1942), have reported very favourably on the use of trichlorethylene as an agent for general anaesthesia. From these reports it appeared that this drug would have definite advantages when employed for anaesthesia in plastic surgery. These advantages were: (1) adequate analgesia in light planes of anaesthesia; (2) no increase in bleeding due to the anaesthetic agent; (3) minimal irritation of the respiratory tract; (4) freedom from post-anaesthetic vomiting; and (5) freedom from explosion hazard. We decided to test the drug on a series of 200 cases. Our experience led us to abandon its use after 100 cases.

Age and Type of Patients

The average age of the patients in this series was 29 years. The youngest was 10 years old, the oldest 65; 50 were between 19 and 40; 4 were under 19, and 46 were over 40. With 13 exceptions these patients were Class A anaesthetic risks. These 13 were considered fair risks, and the majority of them were not regarded as Class A risks only because of the presence of blood in the airway due to recent facial injuries.

Premedication.—Each patient received omnopon gr. 1/3 and scopolamine gr. 1/150 before operation. This premedication was ordered for three-quarters of an hour or one hour before the time scheduled for operation. In 9 cases it was actually given at periods up to two hours before induction, owing to alterations or delays in the operation schedule.

Induction

All patients but one were induced by the intravenous administration of sodium pentothal in 5% solution (Table I).

TABLE I.—Induction and Maintenance

Agents Used	No. of Cases
Pentothal, N ₂ O, and trilene	33
Pentothal, cyclopropane, and trilene	1
Pentothal, trilene, and O ₂	65
Trilene and oxygen	1

The average dose given was slightly under 0.5 g. Thirty-three patients had nitrous oxide and oxygen, with trichlorethylene added. One had cyclopropane added during the induction. One patient was induced and maintained throughout with trichlorethylene and oxygen alone. The remainder had trichlorethylene and oxygen only, after the pentothal induction. The average amount of trichlorethylene used was 5.5 c.cm. per hour of anaesthesia and 7.4 c.cm. per patient. The preparation employed was that marketed under the name "trilene" and packed in glass-stoppered amber bottles for use in anaesthesia.

With two exceptions the nitrous oxide-trichlorethylene inductions were smooth, but somewhat more prolonged than we usually expect with ether, using a similar technique. Owing to the effect of the drug on respiration we found it difficult to evaluate the level of anaesthesia. Induction with trichlorethylene and oxygen alone, following pentothal, is prolonged, and often the robust patient recovered from his dose of pentothal rapidly enough to provide some excitement in the second stage. The one patient induced with trichlorethylene and oxygen without previous pentothal had profuse salivation and a very violent second stage.

In all instances we used closed-system anaesthesia of the circle type, with carbon dioxide absorption. In 97 cases the trichlorethylene was administered from a vaporizing bottle containing a wick and placed in the rebreathing circuit. In three a drip vaporizer outside the circuit was used. This last method proved unsatisfactory because of the low volatility of the agent. In 76 cases the anaesthetic was administered through a Magill endotracheal tube.

Effects on Respiration

The respiratory rate was increased in all but 16 patients (Table II). With the increase in rate there was in all cases

TABLE II.—Respiratory Rate

Rate per Minute	No. of Patients
18 to 25	16
26 to 46	78
60 to 80	5
Respiratory arrest	1

a decrease in respiratory excursion. Five patients achieved respiratory rates of over 60 a minute at a stage of anaesthesia corresponding to the second plane of the third stage (Guedel). One of these patients had a respiratory rate of 80 a minute at this plane, and one robust subject had respiratory arrest. In the remainder the respiratory rate varied between 26 and 46 a minute. Except in the cases with extreme increase of respiratory rate no cyanosis was seen.

Cardiovascular Effects

The most constant effect on the cardiovascular system was the development of bradycardia (Table III). Forty-four patients

TABLE III.—Pulse Rate

Peripheral Pulse	No. of Patients
Normal rate and rhythm	36
Irregularities	19
Bradycardia	44
Irregular during recovery	1

had pulse rates under 60 a minute, 10 of these rates being between 40 and 50. Twenty-five had rates of between 60 and 70. The pulse rate in most cases varied inversely with the depth of anaesthesia, decreasing as the plane of anaesthesia was deepened. This decrease in pulse rate was associated with increase in respiratory rate. In several cases the respiratory rate equalled or exceeded the pulse rate.

Nineteen patients had irregularities of the peripheral pulse during anaesthesia. With two exceptions these irregularities occurred with normal or accelerated pulse rates, and disappeared with the onset of bradycardia. In these two cases the peripheral pulse rate was irregular at slow rates, and a count of the rate at the cardiac apex showed a pulse deficit of about 30 beats, the apex beat also being irregular. These irregularities appear to be due to the occurrence of extrasystoles. One patient had an irregular pulse rate for 30 minutes during the post-anaesthetic recovery period.

One patient apparently had 3:1 heart-block shortly after induction, the pulse rate increasing suddenly from 40 to 120 a minute. Cyclopropane had been used during the induction of anaesthesia in this case.

During one operation the surgeon applied to a raw area a large pack soaked in 1:1,000 adrenaline solution. The pulse rate rapidly increased from 60 to 120, and became weak and "thready" in quality. It was at this point that inquiry by the anaesthetist revealed the presence of adrenaline in the pack. The pulse improved rapidly after its removal.

Blood pressure usually remained within normal limits. There was a general tendency for some increase in the systolic and pulse pressures in patients with bradycardia or normal pulse rates. In those with tachycardia or irregularities the blood pressure was very labile, and in one case it varied from 104/70 to 150/70 to 120/76 in a period of ten minutes. One young patient, aged 29, whose blood pressure before operation was 124/80, had a range from 160/100 to 240/160 during an anaesthesia lasting 65 minutes; throughout this time his pulse rate remained regular at 56 a minute.

Recovery

All patients recovered consciousness within a reasonable time after cessation of the anaesthetic, the average for the group being 35 minutes, and the longest two hours. Recovery time was roughly proportional to the duration of anaesthesia. With one exception there was no post-anaesthetic depression: this case was the one in which anaesthesia was induced and maintained by trichlorethylene-oxygen alone. The patient recovered consciousness in 90 minutes, but remained drowsy for 24 hours. Peripheral pulse, blood pressure, and respiration, however, were normal.

Complications

Vomiting.—Sixteen patients in this series vomited post-operatively. Of these, 10 vomited a small amount once only during the recovery period; 3 vomited once shortly after recovery; 1 vomited several times during the first 12 hours, and another during the first 36 hours; and the remaining patient vomited once 10 hours after the operation. There were no cases of persistent vomiting. Only one patient had recently taken food, and in this case there was no vomiting. Patients who did not vomit made no complaint of nausea after the anaesthetic.

Respiratory.—Seven patients had a history of recent respiratory infection. One of these had a post-anaesthetic pulmonary atelectasis, and another, with a history of chronic bronchitis, suffered an exacerbation of his complaint. These were the only subjects who showed any respiratory complication.

Discussion

We feel that, on the whole, the advantages of trichlorethylene as an anaesthetic agent for plastic surgery are far outweighed by its disadvantages. The only advantages of the use of the drug as an agent for surgical anaesthesia would seem to be freedom from explosion hazard, minimal irritation of the respiratory tract, and small cost. The disadvantages lie chiefly in its action on the cardiovascular and respiratory mechanisms, and its low volatility.

Although no facilities existed for electrocardiographic examination of this series of patients, it would appear from clinical observation that the drug has a definite action on the conducting mechanism of the heart, as well as a direct irritant or sensitizing effect on the myocardium. The relation of the bradycardia to the increase in respiratory rate and decrease in respiratory excursion suggests to us that part, at least, of the effect on the cardiovascular mechanism may have origin in the central nervous system. We consider that these cardio-respiratory effects require further elucidation before trichlorethylene is accepted as an anaesthetic agent for general use.

Summary

A series of 100 administrations of trichlorethylene for general anaesthesia in plastic surgery is reported.

The respiratory rate is greatly increased by the drug, and the respiratory excursion decreased. This result is associated with slowing of the cardiac rate as deeper planes of anaesthesia are attained. There is some instability of the systemic blood pressure. One case of heart-block occurred—after cyclopropane induction. Extrasystoles are frequent.

Post-anaesthetic recovery was good, and the only respiratory complications occurred in two patients who had a history of recent respiratory infection. Sixteen patients vomited after operation.

It is felt that the cardio-respiratory effects of trichlorethylene require further elucidation before this drug is accepted as an agent for general anaesthesia.

BIBLIOGRAPHY

- Herzberg, M. (1934). *Anesth. & Analges.*, **13**, 203.
Hewer, C. L. (1942). *Proc. roy. Soc. Med.*, **35**, 463.
Jackson, D. E. (1934). *Anesth. & Analges.*, **13**, 198.
Striker, C., Goldblatt, S., Warm, I. S., and Jackson, D. E. (1935). *Ibid.*, **14**, 68.

Speaking at a conference on venereal disease called by the Scottish Committee of the British Social Hygiene Council and held at Edinburgh on March 5, Mr. Thomas Johnston, Secretary of State, said that in Scotland last year there were nearly 5,000 recorded cases of fresh infection, apart from cases among Service personnel. In one Scottish town known infections had risen from 36 to 419. Existing treatment facilities were adequate for the increased number of cases, but it was most desirable that persons infected should come forward promptly and, what was no less important, should continue treatment until they were told by their doctors that it was safe to stop. About 40% of the patients who left centres did so before they were pronounced cured, and over 20% left before even completing a course of treatment. The Scottish Medical Advisory Committee had considered the increase in venereal disease at its first meeting and had advocated better sex education of young people, in which parents, school staffs, and family doctors could help. These diseases were more than a medical matter, and were, in fact, closely bound up with behaviour and with the ethical standards from which behaviour springs.

A NOTE ON TRICHLORETHYLENE ANAESTHESIA

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Since Hewer's (1941) suggestion that trichlorethylene might be a useful general anaesthetic a number of communications have appeared dealing with individual cases and difficulties, but we have seen only one report of a general investigation—that of Elam (1942). We venture, therefore, to offer the following observations. We have used the drug in the form of trilene in 306 cases, and have investigated such various points as could conveniently be done in ordinary hospital practice.

Technique of Administration

We have used the open mask and the machines of Shipway, Marrett, and the standard Boyle-Magill. We ultimately adopted the Boyle-Magill, and found that anaesthesia was well maintained with a flow of 3 to 4 litres of nitrous oxide and $1\frac{1}{2}$ to 2 litres of oxygen per minute, the surface of the trilene in the chloroform bottle being faintly ruffled. There was partial rebreathing but no tension on the spring of the outlet valve. Using this method, surgical anaesthesia was induced in 7 to 11 minutes and maintained on a consumption of 1 drachm of trilene in 5 minutes during short anaesthetics or 1 oz. an hour for prolonged administrations.

Type of Anaesthesia

Induction.—In 22 of 143 cases (15%) there was a little struggling during the second stage. The patients who struggled were nervous women rather than plethoric men.

Relaxation.—This was much less than with chloroform, ether, or gas-ether anaesthesia. In 15 of 53 abdominal cases (28%) anaesthesia could not be pushed beyond plane 1 of stage 3, and resort was had to ether. This figure does not include a number of cases in which our colleagues bore with less relaxation than is generally considered desirable, and we take this opportunity of gratefully acknowledging their forbearance.

Cumulative Effect.—This is reflected in the relatively smaller quantity required in long administrations, already referred to.

Mode of Action

The drug appears to act by virtue of its solution in the blood and action on the central nervous system. We noticed that physical measures designed to increase the amount taken up by the body, over and above that obtained by the technique already described, had no influence whatever on the rate of induction or on the depth of anaesthesia obtained. These measures included heating the trilene with the water-bath designed for ether, bubbling the oxygen through the fluid instead of blowing across the surface, and increasing the tension on the outlet valve. The sole results were that anoxaemia was produced and that trilene was wasted.

We conclude, therefore, that overdosage from presenting too high a concentration of vapour is not the danger it is with chloroform, and that an ordinary skilled anaesthetist will produce the deepest anaesthesia possible in about 10 minutes, after which further efforts at securing relaxation are useless.

Effects of Trilene Administration

Respiratory System.—No salivation or irritation was noticed. Tachypnoea was troublesome in many cases. In 79 of 104 cases the respiration rate was over 40 after the patient had settled down. Rates of 60 a minute and over were often recorded.

Circulatory System.—Blood-pressure observations showed practically no change in the first half-hour and a slight fall thereafter. In a few of the longer administrations (one hour or more) the systolic pressure became irregular, varying up to 10 mm. Hg between beats.