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# TRICHLORETHYLENE

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Trichlorethylene is now a common drug in British anaesthetic practice, and its use is spreading in the United States of America. This is a short account of its properties and administration.

## History

Trichlorethylene was first isolated by Fischer in Germany in 1864, and anaesthesia was produced experimentally in animals in 1911. During the war of 1914-18 it was widely used in Germany as an oil solvent, and in 1915 Plessner described the syndrome of acute trichlorethylene poisoning in factory workers. This syndrome included trigeminal analgesia, and led to trichlorethylene being used mistakenly as the specific treatment of tic doloreux for 20 years afterwards. In 1935 Jackson and Striker in the United States administered the drug to 300 patients; and in 1940 it was introduced into British anaesthesia by Langton Hewer, who had been searching for a non-inflammable anaesthetic less dangerous than chloroform for use under war conditions.

## General Information

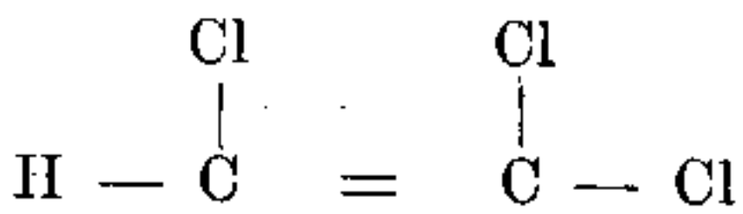
Trichlorethylene is administered in Britain as "Trilene", a trade name of Imperial Chemical Pharmaceuticals, Ltd. The composition of trilene is:

Pure trichlorethylene
Thymol 1:10,000 preservative)
Waxoline blue 1:200,000 (dye)

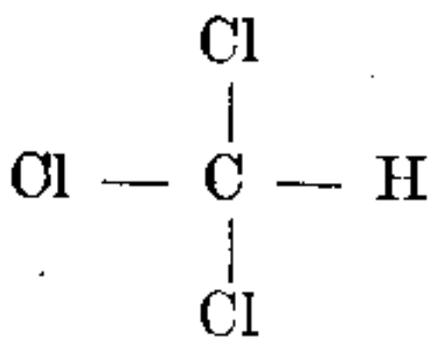
Trilene decomposes in strong sunlight, and should not be left in a plain bottle in the anaesthetic apparatus.

The formula is $C_2HCl_3$. The structural formula may be compared with that of chloroform:

1. Trichlorethylene



2. Chloroform



I would emphasize that trichlorethylene is wholly different from chloroform in its clinical effects.

It is the least volatile anaesthetic: its boiling point is 87°C, compared with 61°C for chloroform and 35°C for ether, and for this reason cannot be given by the open mask in temperate climates. It is an excellent fat solvent, and has many uses in industry, especially for degreasing metals and dry cleaning clothes.

## Metabolism

Trichlorethylene is partly excreted by the lungs and partly metabolized to trichloracetic acid ($CCl_3COOH$). Trichlorethylene itself disappears from the blood and expired air fairly quickly, but trichloracetic acid rises in the blood and urine for two days after operation, then falls slowly for another 7 to 10 days (fig. 1).

Trichloracetic acid is not a toxic substance: it was given intravenously in 1869 in an attempt to produce anaesthesia, and apparently had a slight narcotic effect. The alteration of trichlorethylene into trichloracetic acid is an unusual chemical change, and it is possible htat unkown intermediary compounds are formed.

## Effect on the liver

Trichlorethylene in correct dosage has no toxic effect on the liver. In animal experiments, histological changes in the liver have been seen only after repeated inhalation or injection of the drug. The liver is never affected in cases of poisoning with trichlorethylene in industry. Five cases of acute hepatic necrosis have been reported after trichlorethylene anaesthesia, but all except one clearly had other causes. The disturbance of liver function shown by the cephalin-cholesterol test is less than that produced by ether.

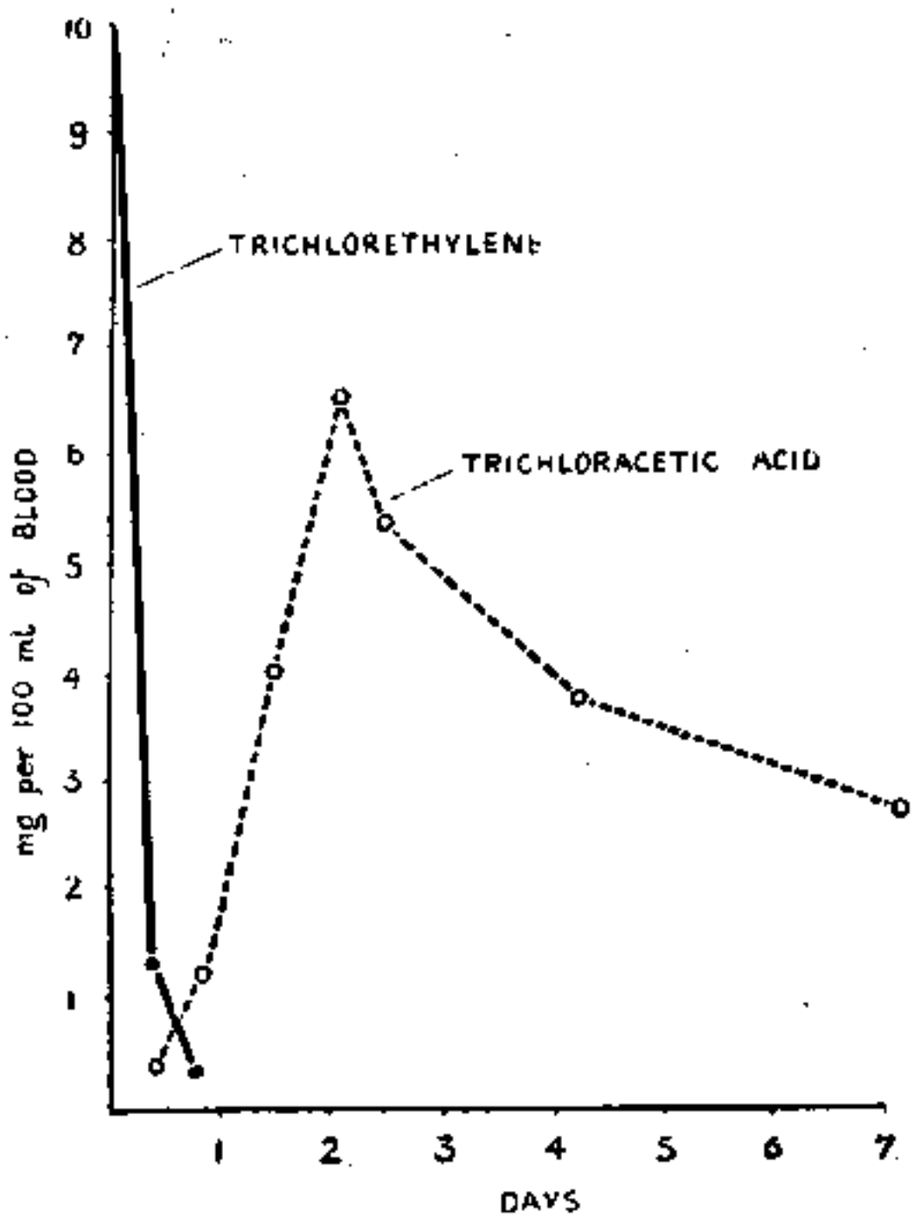



Fig. 1

## Effect on the respiration

Trichlorethylene is mildly irritant to the normal respiratory mucosa.

An overdose of other anaesthetics is shown by respiratory arrest, but an overdose of trichlorethylene by tachypnoea. This tachypnoea is probably due to the effect of the drug on the stretch receptors in the lungs — a theory which is corroborated in clinical practice by the rapidity in which tachypnoea can be abolished by withdrawal of the trichlorethylene from the anaesthetic mixture (fig. 2). Tachypnoea is the most serious disadvantage of trichlorethylene, and can be avoided only by practice in administering the drug.

## The cardiovascular system

Trichlorethylene can cause primary heart failure in the same way as chloroform, but extremely rarely: well over a million administrations have now been made in Britain, with only three cases in which death was clearly due to the drug. Transient arrhythmias occur, as in cyclopropane anaesthesia, but these should

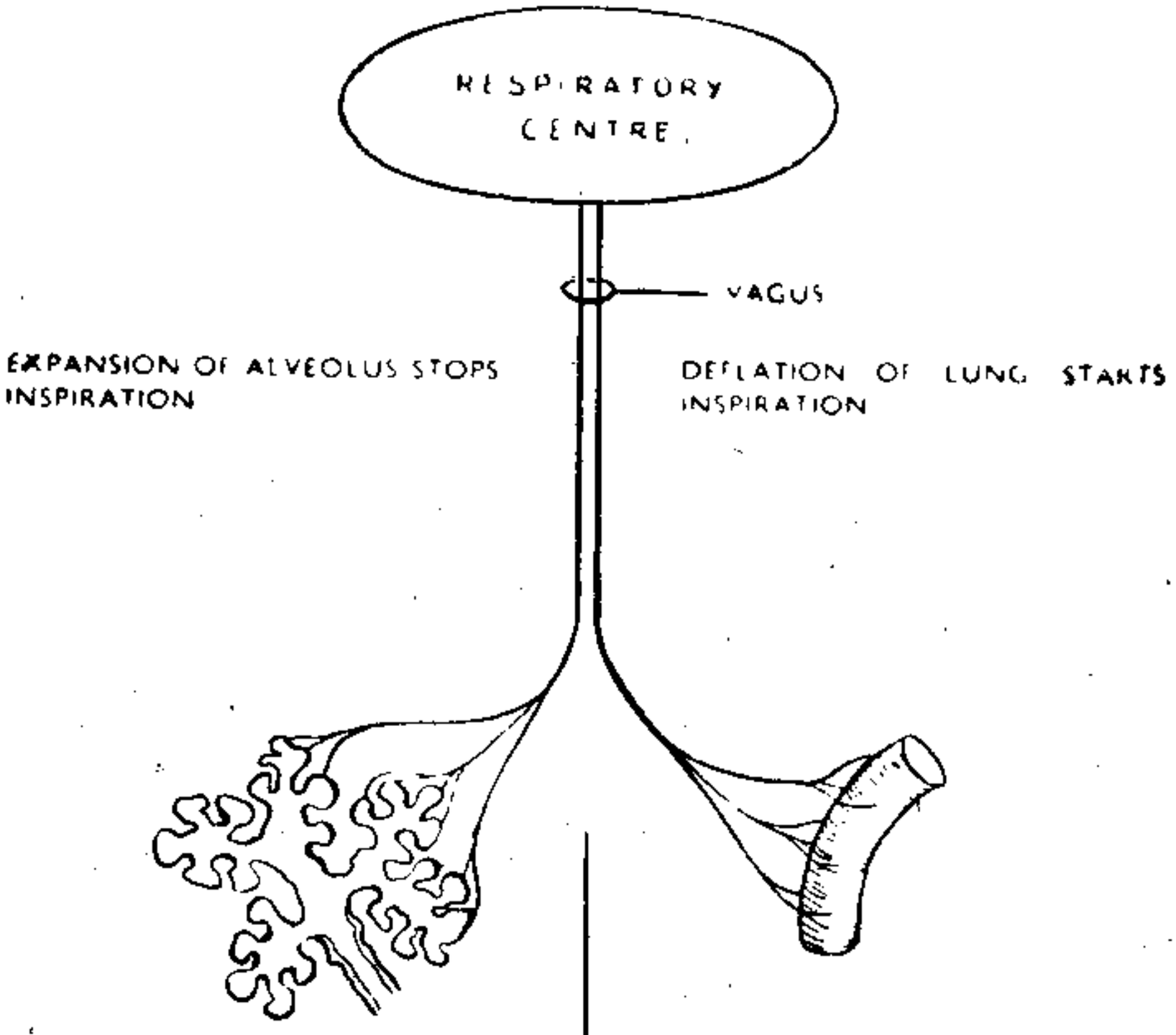



**Fig. 2**

not be encountered if the drug is given correctly (fig. 3). The blood pressure is not lowered by trichlorethylene — an advantage over chloroform. The capillaries are constricted, and bleeding is normally not increased. Although experimental work suggests that trichlorethylene shares with chloroform the danger of causing ventricular fibrillation in response to adrenalin injected during the operation, no case has been reported from clinical practice.

## Nerve palsies

Trichlorethylene should never be used in the closed-circuit apparatus with soda lime: it must be administered by the semi-open apparatus, which is more popular in Britain than in Brazil and in the United States. Trichlorethylene and soda lime forms hydrochloric acid and dichloracetylene, which may cause cranial-nerve palsy (particularly of the 5th nerve) or encephalitis. The lesions have been reported in patients anaesthetized with cyclopropane from a closed circuit in which trichlorethylene had previously been used.

## Advantages

1. Safety.

2. It is non-inflammable, and it is therefore useful as a safer substitute for chloroform when the electric cautery is used.

3. It is pleasant to inhale, only mildly irritant, and less likely to cause coughing during induction than ether.

4. It is effective in small amounts, and causes little post-operative disturbance.

5. It is cheap.

## Disadvantages

1. Muscular relaxation is poor, and trichlorethylene cannot be used alone for abdominal surgery. This has become a negligible disadvantage since the relaxants took over this function from the general anaesthetics.

2. Tachypnoea can be produced easily if care is not taken.

3. Cardiac arrhythmias occasionally occur, but they seem to have no ill effect on the patient.

4. The drug cannot be used in the closed-circuit apparatus.

5. Recovery may be slow of too much of the drug is given.

6. It is unsuitable for children, who develop tachypnoea readily.

## Technique of administration

Trichlorethylene is a fairly simple drug to administer, but success depends on observing carefully these points:

1. As little as possible must be given — a concentration of 1-2.5 % trichlorethylene (by volume) is sufficient to maintain narcosis, and is roughly represented by a faint smell of trichlorethylene in the delivery tube of the apparatus.

2. Anaesthesia must be established with another agent such as thiopentone, and trichlorethylene given with nitrous-oxide — oxygen in the semi-open circuit to maintain it. The use of trichlorethylene allows 20 % oxygen to be given in the mixture, which will avoid anoxia; and it makes repeated injections of thiopentone or demerol unnecessary, which will avoid post-operative depression.

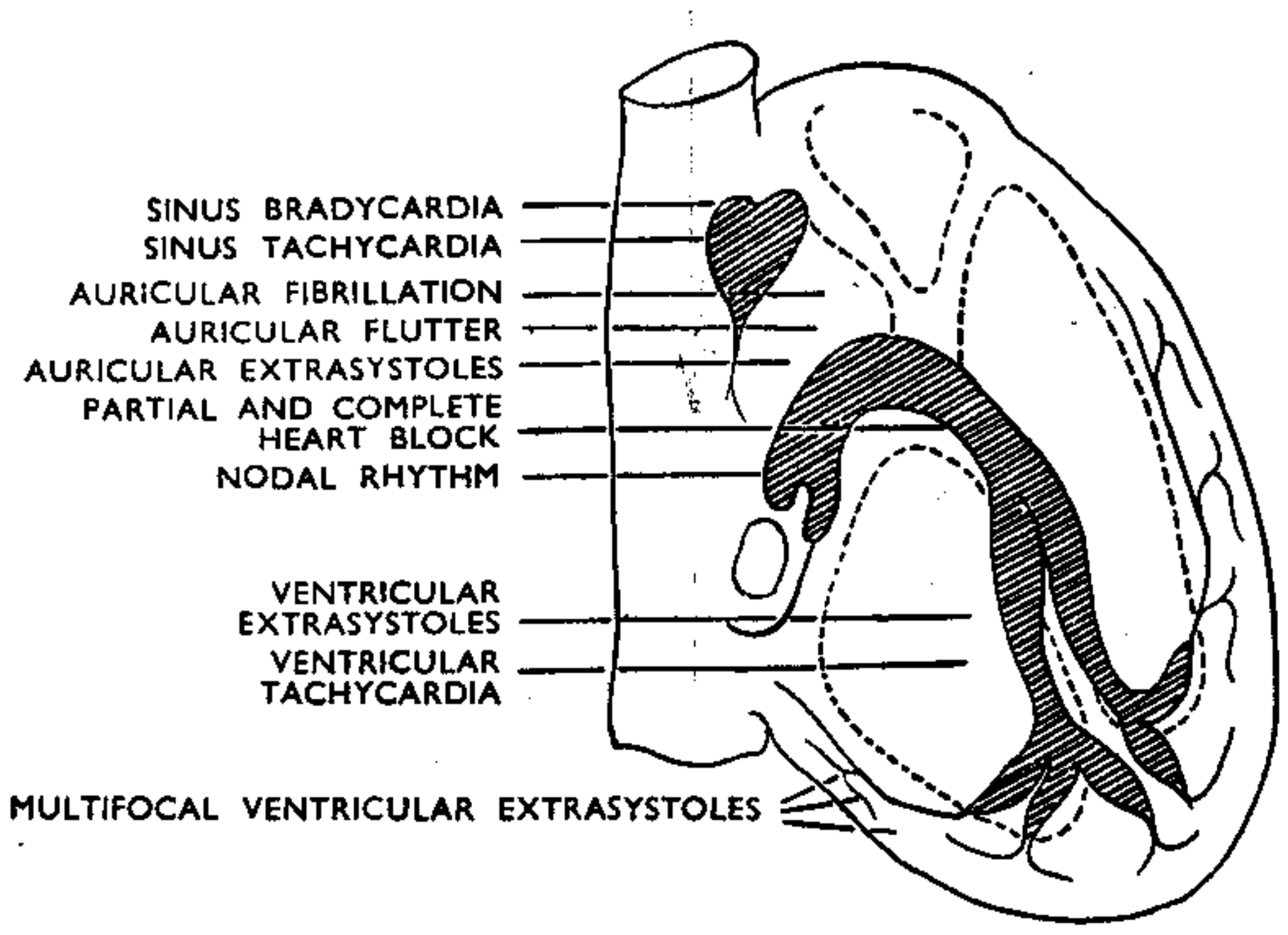



Fig. 3

3. Trichlorethylene must never be used to achieve muscular relaxation.

4. During induction trichlorethylene may be used as a "buffer" between thiopentone and the pungent vapour of ether, and stronger concentrations may be given for this short period.

5. Trichlorethylene should be withdrawn from the anaesthetic mixture abouth half-way through the operation; it is excreted slowly, and anaesthesia will be maintained by the amount already inhaled.

6. If tachypnoea should occur, trichlorethylene must de withdrawn and the anaesthetic continued with another agent.

## Trichlorethylene in analgesia and obstetrics

Trichlorethylene inhaled in low concentrations has the useful property of producing effective analgesia without unconsciousness or excitement. It has been used as an analgesic for dentistry, painful dressings, minor operations, and midwifery. In Britain 75 % of births are conducted by a midwife only, and it is important that some safe and simple form of analgesia should be provided for her to use without the supervision of a doctor. Nitrous oxide and air given by the Minnitt apparatus has been used for this purpose, but is likely to be superseded by trichlorethylene in a concentration of 0.35 - 0.5 %, administered by a specially designed inhaler.

Trichlorethylene has no effect on the uterine muscle unless an overdose is given, and depression of the baby's respiration is seen only when an overdose of trichlorethylene is combined with the effect of another respiratory-depressant drug. Foetal blood absorbs more trichlorethylene vapour than maternal blood, probably because of the greather affinity of the foetal corpuscles for the drug. Its excretion by the foetal and maternal blood follows the same pattern as that described for the adult. Trichlorethylene has no effect on the rate or rhythm of the foetal pulse.


## Summary

1. Trichlorethylene is a non-inflammable anaesthetic with a pleasant smell, which in small concentrations produces effective analgesia, and is useful for the maintenance of light narcosis. It causes little post-operative disturbance, and has no toxic effect on the liver. Cardiac arrythmias may occur if an overdose is given. It is decomposed by soda lime to form dichloracetylene and other products, which may cause trigeminal nerve palsy. In the body it is metabolized to trichloracetic acid, which is excreted over a period of several days. There is a small risk of its causing primary heart failure.

2. Trichlorethylene must be given in concentrations of 0.5-2 % (by volume) and withdrawn well before the end of the operation; otherwise tachypnoea may follow rapidly and the recovery period may be prolonged.

3. Trichlorethylene effectively produces analgesia, and is particularly useful in labour.



## Sumário

1) Triclorotileno é um anestésico não inflamável de cheiro agradável, o qual, em concentrações pequenas produz analgesia real e é útil para a manutenção de narcose superficial. Produz muito ligeiras perturbações pós-opera-

tórias e não possui efeito tóxico sôbre o fígado. Arritmias cardíacas podem ocorrer no caso de overdose. E' decomposto pela cal-sodada, formando dicloroacetileno e outros produtos, os quais podem causar paralisia do trigêmeo. No organismo é metabolizado em ácido tricloroacético que é excretado num período de diversos dias. O risco de parada cardíaca primária é pequeno.

2) Tricloroetileno deve ser administrado em concentrações de 0,5-2 % (por volume) e descontinuado bem antes do término da operação; de outra maneira a instalação de taquipnéia pode ocorrer ràpidamente, acorretando um período de recuperação prolongado.

3) Tricloroetileno produz realmente analgesia e é particularmente útil no trabalho de parto.

## Bibliography

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"Recent Advances in Anaesthesia and Analgesia", 7th edition, by *C. Langton Hewer* (J. and A. Churchill, London, 1953).


**para**

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**ANESTESIA DE BASE**

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**Vantagens do componente**

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**em relação à morfina:**

1. **Intensa ação analgésica.**
2. **Efeito rápido.**
3. **Boa tolerância.**
4. **Quase nenhuma influência sôbre o peristaltismo.**

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