Cyclopropane induction for anaesthesia in dental surgery
A Report on 800 Cases

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Nitrous oxide continues to be the basis of anaesthesia for dental surgery. Despite the hazards associated with its use, there is scarce a dental surgery in the land wherein anaesthesia is not obtained by the use of nitrous oxide. It is the purpose of this paper to describe a technique which, it is thought, removes some of those hazards without contributing new ones.

The hazards are essentially those associated with anoxia, and, since anoxia in some degree is an essential concomitant of the production of anaesthesia by nitrous oxide (Macintosh, 1943; Clement, 1939), to avoid it means the use of an agent more powerful than nitrous oxide. There are many such agents; almost any other anaesthetic substance will provide anaesthesia in the presence of full oxygenation. But the dentist’s requirements must be met, and these being quick induction, quick recovery and adequate anaesthesia, the words of Sir Robert Macintosh (1952) come to mind: “It is virtually impossible to fulfil those requirements with any anaesthetic. There is one condition, however, which gives rise to sudden unconsciousness, leads rapidly to a state approaching death and yet can be reversed almost equally rapidly—I refer to acute anoxia.” Clement (1939): said: “The essentials for success are a minimum of oxygen during induction, time and a disregard for cyanosis.”

The difficulties of nitrous oxide anaesthesia and the production of anoxia start with the induction. During induction it is the object of the anaesthetist so to reduce the oxygen supply to the brain that consciousness is lost. While achieving this the oxygen reservoir in the lungs and blood is diminished, and so obstruction, should it occur, produces a state of extreme anoxia almost at once. Also during induction difficulty may arise if the classical stage of delirium manifests itself too strongly, as it may in the apprehensive, the alcoholic and the physically strong. Breath holding may also occur and result in spastic movements. Induction in children may necessitate a very nice degree of judgment to obtain that state of fine oxygen balance which holds the patient between consciousness and circulatory failure. During induction there is a moment when the anoxic drive on the carotid body may cause the patient to take a great gasp of air by the mouth, thus wrecking a well planned anaesthetic. There is also a period during induction when “banging in the ears” may be experienced and may cause the patient to
gasp air or try to snatch off the mask. Some patients, too, become aware of the heart's beating and may, from fright, attempt to get out of the chair or otherwise interrupt the induction. Anaesthesia having been obtained, it may be found that masseter spasm exists in such degree that it is not possible to open the mouth with a gag without doing damage, and in some cases increasing the oxygen percentage to overcome this spasm produces instability in anaesthesia.

Clement (1939) writes: "The induction is usually the most difficult part of any anaesthesia." The induction of anaesthesia for dentistry can be just as difficult for one tooth as for twenty, and the degree of anoxia required to obtain surgical anaesthesia even for a short case may be extreme. Cyanosis develops after seven to twelve breaths of nitrous oxide, but the number of breaths before the patient is fit for surgery is a much more variable figure, and cases have been noted when as many as thirty breaths were required before the dentist could proceed. Using the technique to be described, the dentist can usually begin extracting after the tenth breath and, if the case be a small one, it may be completed without cyanosis having developed. It is an axiom that a smooth induction tends to produce smooth anaesthesia. Such an induction can be obtained with nitrous oxide in some cases if relatively large quantities of the gas are allowed to pour over the face. This does not remove the unpleasant sensations associated with increasing anoxia, however, though it does tend to diminish them, and the induction is slow. Clement (1939) advocates fast induction with pure nitrous oxide as a routine measure and states that by so doing the occurrence of excitement is diminished. The use of cyclopropane makes induction yet faster.

Cyclopropane is a powerful, nonirritating agent which can produce anaesthesia in a few breaths. It has been used by several workers to provide anaesthesia for dental surgery (Pinson, 1944; Gillies, 1948; Bourne, 1952; Marston, 1945; Clement, 1939). Save for Bourne, however, who is using it currently by a single dose technique, it seems to have fallen into disuse. One reason for this may be that if used as the principal anaesthetic agent it carries a high sickness rate: Bourne (1952) mentions vomiting as occurring in 21 per cent and nausea in 12 per cent of his series of 1,000 cases. Pinson (1944) also speaks of sickness being a disadvantage. Another reason is that delayed recovery may occur and one of the dentist's requirements is quick recovery. Yet a third reason is salivation and, fourthly, it is costly.

The technique to be described uses cyclopropane for induction only; maintenance being by nitrous oxide-oxygen, with or without trichlorethylene.

It has been found that with this technique the desiderata of safe and comfortable anaesthesia can be provided, viz.:

1. Induction is so rapid that delirium does not occur.
2. Breathing tends to be nasal because anaesthesia is established.
3. Oxygen 8 per cent can be used for maintenance in the first instance.
4. The masseters are relaxed and the mouth opens easily.
5. The dentist's requirements are fulfilled.
The disadvantages of cyclopropane anaesthesia have not been seen, viz.:

1. No vomiting or nausea.
2. No salivation.
3. No delayed recovery.

APPARATUS

Nitrous oxide being the basic anaesthetic agent, some form of pressure machine with intermittent flow is desirable. To this is added a cyclopropane flowmeter (fig. 1). The corrugated rubber breathing tube is replaced by a tube of 300 ml capacity and is suitably obtained by a tube of 2 cm inner diameter and 95 cm length. This tube permits of free respiration. The large rubber bag of the Magill rebreathing attachment is replaced by one of 500 ml capacity having a stopcock at its lower end. The cyclopropane flowmeter and the stopcock are connected by a rubber tube. A watch or other timing device is required to measure one minute.

TECHNIQUE

The small rubber bag having been charged with 500 ml of cyclopropane it is
then closed. For children under the age of ten years, 350 ml of the gas are used. Induction is started with nitrous oxide at low pressure. In the average adult five breaths of nitrous oxide are permitted, the expiratory valve being open. On the sixth inspiration the bag is opened and remains so for two breaths. If the first breath does not empty the bag owing to small tidal air, it should be emptied manually during the second breath and then closed. Within a few seconds the patient becomes unconscious as shown by the onset of automatic breathing and relaxation of the muscles, and the oxygen percentage can be immediately turned up to 8 per cent. If it is to be a long case, trichlorethylene can be added if desired. It will be found that the jaw is pleasantly relaxed. Thereafter anaesthesia is maintained according to one's custom. Recovery is rapid. Some of the unpleasantness of recovery from an anoxic interlude is avoided; it is said in one clinic, where young children are seen in large numbers and cared for by professional nurses, that there is less crying in the recovery room when this technique has been used. Patients who have experienced both forms of induction have expressed a preference for that using cyclopropane. Sickness has occurred in two cases in this series, both patients having had food shortly before presenting themselves. Salivation has not been noted.

The types of cases in this series are representative of most practices. The ages vary from three years to eighty years, the number of teeth to be extracted at one visit, from one to thirty, and the type of patient from those met with in a West End practice to those seen in Dockland.

**DISCUSSION**

The successful employment of this technique depends upon the capacity of the bag and breathing tube. If the tube or bag is too big, insufficient cyclopropane reaches the patient in one breath and too great a quantity of the gas is expelled via the expiratory valve on the subsequent expiration. The capacities of the bag and tube, 500 ml and 300 ml respectively, are not arbitrary figures, but bear a relationship to the tidal air. The average adult tends to increase his tidal air during nitrous oxide induction and 800 ml to 1,000 ml is a not unusual amount. That being so, on the sixth inspiration there is inhaled 1,000 ml of a 50 per cent mixture of cyclopropane and nitrous oxide. This is below the concentration necessary to make it irritating or to produce laryngeal spasm (Lee, 1953), and it follows the advice of Waters (1945), who advocates the rapid addition of cyclopropane to the inhaled gases. The concentration of cyclopropane in the lungs if full inspiration occurs will be about 8 per cent after the sixth breath. Absorption and dilution by subsequent breaths will reduce the concentration until, by the twelfth exhalation the amount of cyclopropane in the exhaled gas is about 1.5 per cent which is below the explosive limit (Lee, 1953), and it is at this point that the dentist usually commences his work.

This technique has been used for patients of all ages, and except for those under ten, no modification in the amount of cyclopropane is made. It is thought that by ensuring that the expiratory valve is open, the quantity of cyclopropane inhaled is limited by the tidal air: if the tidal air is large, 500 ml of cyclopropane are
received. If it is small, a correspondingly smaller quantity is inhaled and each expiration ejects some fresh gas from the tube and reduces the total amount received. The continued flow of nitrous oxide under low pressure also assists in this.

It is interesting to observe that despite the expense of cyclopropane, the cost per case is a penny or two less than when nitrous oxide alone is used. This is explained by the diminished consumption of nitrous oxide, which is reduced by half. When used alone, 100 gallons of nitrous oxide sufficed for seven cases; used with cyclopropane induction, fourteen cases is the average figure. The great saving in nitrous oxide occurs during induction.

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REFERENCES
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BOOK REVIEW

Dr. Sylvan M. Shane has written Anesthesia—Thief of Pain to dispel the fear and apprehension often associated with anaesthesia. The morbidly curious and some stoics may like this book, but individuals vary and the effect may well be the reverse from what is intended.

The patient who is to have a spinal anaesthetic and learns that he will see surgical instruments for use on himself is going to flinch, but even the staunchest is likely to quail if he thinks he may get a mirror view of the operation in progress. Surely this is not the way to conduct spinal anaesthesia.

The graphic account of a woman crying out piteously in labour is hardly calculated to inspire confidence, and readers will have some misgivings when they find the anaesthetist appeared indifferent, dismissing the situation thus: “Actually, the patient is often not experiencing the pain she complains of, since she has been given sedatives and is quite amnesic.” The italics are mine. The meaning of the word amnesic can be inferred later. There is no index.

The description of sensations perceived during the induction of inhalational anaesthesia culminating with a “bang” may cause some patients to eschew this method.

Clearly his Doctor Payneless is unfamiliar with routine relaxant practice, or is it that the author thinks this information should not be divulged?

There is no doubt that patients should be informed about what they are to expect, but the knowledge gained from reading this book will make some want to be in at the kill; this may be embarrassing.

Though parts of the book are excellent and it makes amusing reading, I should not recommend it to patients as a whole; they have to face something which cannot be laughed aside, and if they really want to know, the truth can be explained to them individually, more palatably, and without causing anxiety to others. Herein lies a part of the skill our art requires.

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