

INHALATION ANALGESIA IN CHILDBIRTH

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INTRODUCTION

It is important that midwives should understand not only the process of childbirth with its possible complications, but also the methods employed for the alleviation of pain in labour. Indeed, it is on the midwife, with her intimate contact with the patient, that we must rely to a large extent for the *proper* application of whatever method of pain relief is chosen. Thus, she must be fully conversant with the drugs and apparatus which are at her disposal, together with their advantages and limitations.

Usually, during the ante-natal period, the patient is prepared both psychologically and in the understanding of the mechanics of childbirth. Also, she is taught to use the simple apparatus by which, during labour, she can administer inhalation analgesia to herself.

When labour has begun, pain relief is usually achieved by a combination of drugs administered in different ways. Drugs of one group are commonly injected, and being continuous in their action relieve the general level of pain. Those of another group are gaseous in form and, when inhaled intermittently, alleviate the peaks of pain associated with the rhythmical contractions of the uterus. This method of achieving analgesia can be most effective and safe: and its scope has been greatly enhanced by the development of Trilene apparatus which is acceptable to the Central Midwives Board as being suitable for use by midwives.

It is the purpose of this booklet to stress the factors which are essential for good results, and we hope that it may be useful not only to midwives, for whom it is primarily intended, but to all who are concerned with the practice or teaching of analgesia. The material is presented in the form of a practical manual or handbook rather than a textbook, though it is realized that brevity inevitably incurs the risk of inaccuracy and dog-

matism. We have normal midwifery in mind, and have laid particular emphasis on self-administered analgesia. We have omitted the elaborate techniques of conduction analgesia (which already have an extensive literature of their own) as we believe that the simple methods in common use in this country give excellent pain relief *if properly applied*. Furthermore, they have the essential quality of being safe in use in whatever circumstances a confinement takes place, e.g. they are equally applicable in a cottage in the country or in a well-equipped institution.

The opinion is occasionally expressed that we lag behind other parts of the world where more elaborate methods of pain relief are used. It is worth noting that in a recent survey of all types of pain relief,¹ including caudal and spinal analgesia, and the use of many different drugs, all methods were found to be unsatisfactory for at least 10% of the patients. Self-administered inhalation analgesia can produce results as good as any other method, but only if scrupulous attention is paid to detail.

The trade name 'Trilene' (the chemically pure form of trichlorethylene manufactured by Imperial Chemical Industries Ltd.) has been used throughout this book since it does, in fact, imply the preparation administered for anaesthetic purposes.

We wish to express our indebtedness to Miss Marjorie Beck, who prepared all the drawings and diagrams; to Dr. H. G. Epstein for technical advice; Mr. R. Salt for assistance in the preparation of the section on nitrous oxide apparatus; Mr. E. Childerhouse, of Medical & Industrial Equipment Co. Ltd., and Mr. E. G. Moore, of Cyprane Ltd., for their willing co-operation in matters relating to the Trilene inhalers. To the secretaries of the Nuffield Department of Anaesthetics, and those friends who gave up much time to proof reading, we tender our grateful thanks.

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CHAPTER I

THE PAIN OF LABOUR

THE pain of labour follows a rhythmical pattern but the character of the pain varies according to the stage of labour.

First Stage

In late pregnancy the uterus undergoes rhythmical contractions of which the mother is unaware, but which can be detected by palpation of the abdomen. Labour is said to begin when these uterine contractions become regular and are accompanied by effacement and dilatation of the cervix. The contractions of early labour are felt as a sensation of tightening in the lower part of the back and lower abdomen. As labour progresses, contractions increase in strength and occur more frequently. They usually become painful when the cervix is about half dilated in a primipara, or about three-quarters dilated in a multipara. From then on, the sensations from the uterus have become sufficiently strong to reach the 'pain threshold' (the level of awareness at which any sensation becomes painful) which varies from person to person and is influenced by many factors including fear and nervousness.

During each contraction a dull ache is felt in the lower abdomen, the back, and the upper part of the thighs. The ache increases to a severe griping pain at the height of each contraction. Towards the end of the first stage, the pain is often felt more in the back than elsewhere. This is usually intermittent, but in some cases, especially when the occiput is posterior, backache may be continuous.

The pain that is felt in the first stage of labour is transmitted by the autonomic nervous system (which is concerned with the subconscious and 'non-voluntary control of visceral structures') and arises from the contracting uterus and dilating cervix. This visceral type of pain may be likened to the discomfort caused by

severe dysmenorrhoea or by the rough handling of the contents of the abdominal cavity under inadequate local analgesia. The autonomic nerve pathways involved are believed to enter the spinal cord at the level of the 11th and 12th thoracic segments.

It has been suggested that the pain is caused by a lack of co-ordination between longitudinal muscle fibres, mainly in the body of the uterus, and circular muscle fibres in the cervix. The longitudinal fibres are said to be controlled by the parasympathetic part of the autonomic nervous system, and the circular fibres by the sympathetic part. Usually the influence of these two components is complementary, but if there is excessive sympathetic activity then the balance is upset. The circular fibres do not relax when the longitudinal ones contract in drawing up the lower uterine segment, and in this way an excessive tension develops during each uterine contraction. The suggestion is that this lack of co-ordination arises from a 'disharmony' within the autonomic nervous system. This may develop from a state of psychological tension due to nervousness and fear, which causes over-action of the sympathetic component. If this were true, it could account for the value of psychological preparation and relaxation in reducing the pain of labour.

Second Stage

When the cervix is fully dilated, the patient is said to pass into the second stage of labour, and for a short period her discomfort is less. There is a constant feeling of distension which increases to actual pain during each contraction. This pain is caused by the stretching of the vagina and perineum with the presenting part of the foetus as it advances. The character of the pain differs from that in the first stage of labour and is transmitted by the somatic sensory nerves (which control the conscious and voluntary functions of the body) supplying that part of the body. In addition, there is still some pain arising from the contractions of the uterus.

Delivery

The pain of the second stage of labour reaches a climax as the

head is crowned, although delivery of the shoulders, especially when the baby is large, may be almost as painful as delivery of the head. The pain of a normal labour may be represented by the following diagram (Fig. 1):

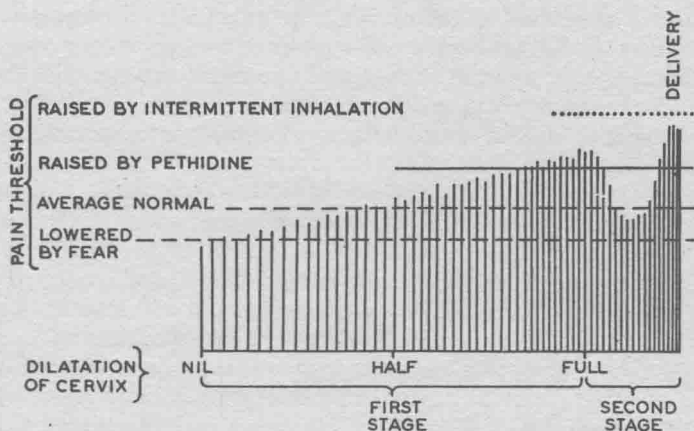


Fig. 1. PATTERN OF PAIN IN NORMAL LABOUR

Each vertical line represents the stimulus of a uterine contraction. Those which reach or exceed the line labelled 'pain threshold' cause pain, and the pain threshold varies from person to person. Pain is usually felt first when the cervix is about half dilated in a primipara and three-quarters dilated in a multipara. It becomes worse towards the end of the first stage, but is not so severe in the second stage until delivery is imminent. Pain relief is another way of saying that the pain threshold has been raised (e.g. by pethidine, and later by inhalation).

This broad picture of the pain of labour is subject to individual variation. In cases of persistent occipito-posterior position, premature rupture of the membranes with a high head, and obstructed or precipitate labours, pain may be more severe and of a different character. But even in the 'normal' case there are other causes of discomfort in labour which must be mentioned: stretching of the ligaments of the lumbar vertebrae and of the

pelvis; pressure on the ureters which dam back urine and in effect produce a temporary hydronephrosis; and finally, lying for long periods in an unaccustomed position on a bed which may not be too comfortable.

Self-administered analgesia will play only a small part in the relief of these discomforts. It is the attendant with her kindness and nursing skill who must deal with these troubles as they arise. Such simple procedures as changes of position, massage of back and limbs, the application of local heat to the back, and the regular emptying of bladder and rectum, go a long way towards making the mother more comfortable.

CHAPTER 2

THE BASIS OF PAIN RELIEF

IN midwifery, the aim is to provide analgesia, i.e. freedom from pain without loss of consciousness, so that if everything goes well the patient is alert and co-operative throughout. Analgesia is different from twilight sleep, which is a state of amnesia in which the pain is felt at the time, but is immediately forgotten because memory is dulled by drugs such as hyoscine; but a patient in this twilight state is often restless, cannot take care of herself, and needs constant supervision. Analgesia is different from anaesthesia, which means absence of all sensations or, in other words, loss of consciousness.

Obstetric analgesia is essentially a compromise in which the maximum possible relief of pain for the mother must be balanced with the claims for survival of the child. Drugs administered to relieve the mother's pain can be expected to pass through the placenta into the baby's circulation, and may interfere with the establishment of respiration at birth. It would be easy to relieve maternal suffering completely by giving large doses of powerful drugs, but the baby would suffer in consequence. Self-administered inhalation analgesia has been developed in this country in order to achieve an efficient compromise.

Analgesia may be (1) CONTINUOUS or (2) INTERMITTENT:

(1) *Continuous*, where it is produced by drugs whose effect is exerted both during and between contraction, e.g. morphine, pethidine, and heroin. These drugs may have unfortunate side effects on the mother—nausea and vomiting, and respiratory depression. Since they also tend to depress the respiration of the baby, they should be used with discretion during the 3-4 hours preceding delivery. Pethidine causes less respiratory depression than morphine, and has proved particularly suitable in labour. Although it can inhibit or even abolish the weak contractions

of early labour, pethidine may actually hasten the progress of established labour.

Nevertheless, there is no doubt that pethidine depresses respiration, although it is easy for the midwife to be lulled into a false sense of security when she may have seen relatively large doses given on occasions, regardless of the time of delivery, and which have had no apparent effect on the baby's respiration. The influence is always there even if it is not always obvious. It becomes significant and dangerous when further depression is caused by oxygen lack and general anaesthesia.

Normally the baby has a reserve of oxygen in the placental circulation which protects it from the vicissitudes of labour, but this may be reduced by placental insufficiency due to disease, by compression of the cord or placenta, or by premature separation of the placenta. Oxygen lack often develops insidiously, and we therefore recommend that drugs which are respiratory depressants should be administered in the lowest possible dosage as delivery becomes imminent.

Pethidine is best given by intramuscular injections of 50-100 mg., and the effects of such a dose last up to 4 hours. The maximum effect on the mother occurs $\frac{3}{4}$ -1 hour, and on the baby 1-1 $\frac{1}{2}$ hours, after administration. (A midwife is permitted to administer a total dose of 200 mg. of pethidine to any one patient.)

In labour which is abnormally prolonged, good results are sometimes obtained by giving inhalation analgesia for a few hours, followed by a rest period during which relief is effected by a combination of analgesic and hypnotic drugs. For this purpose, morphine gr. $\frac{1}{4}$ or heroin gr. $\frac{1}{8}$ may be given with a barbiturate such as sodium amytal gr. vi. This combination provides a period of refreshing sleep and freedom from pain, but it also causes marked respiratory depression in a baby delivered before the effect of the drugs has worn off. We believe that this risk is justified provided that the drugs are administered only after a most careful assessment of the progress of labour, but the decision must be made by the medical practitioner in charge of the case.

If, after the mother has received large or recently administered doses of sedative drugs, she is delivered with unexpected rapidity, respiratory depression of the baby may be overcome by nalorphine (Lethidrone), which should be available for such an emergency. Nalorphine is an effective antidote to pethidine and morphine derivatives, but not barbiturates. It is given intravenously in a dose of 10-20 mg. for an adult, or, calculated on a weight basis, 0.5-1 mg. for a new-born baby.

(2) *Intermittent*, where analgesia is obtained by inhalation of a weak anaesthetic mixture during the uterine contractions. In addition to the relief of pain, this has the virtue of being self-administered, and gives the mother something to do when her role in the first stage of labour is essentially passive. Later in labour, inhalation from an apparatus can provide a means of controlling the expulsive efforts of the mother. The bearing-down reflex involves 'pushing' against a closed glottis after deep inspiration, and this is best overcome by forced respiration with an analgesia machine. It may be necessary to control expulsive efforts at the end of the first stage of labour, before the cervix is fully dilated, and again, at the time of delivery, to stop the presenting part passing over the perineum too quickly.

The two drugs for this type of analgesia which are recognized as being suitable for use by midwives are nitrous oxide (permitted mixture 50 : 50 nitrous oxide/air) and Trilene (permitted mixture 0.5% Trilene/air).

Continuously acting drugs and intermittent inhalation may be combined to provide a high degree of pain relief. The midwife is allowed to give drugs such as chloral hydrate and pethi-

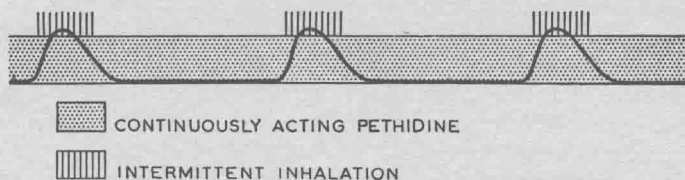


Fig. 2. DIAGRAM TO REPRESENT THE SCHEME OF PAIN RELIEF DURING LABOUR

dine, which have a sedative and analgesic effect. Alone, they are not always sufficient to abolish the pain of uterine contractions. But true analgesia may be obtained by the inhalation of nitrous oxide/air, or Trilene/air during each contraction, the effect of the inhalation being enhanced by the sedative and analgesic drugs already given (Fig. 2).

CHAPTER 3

INTERMITTENT INHALATION ANALGESIA

FOR many years after the introduction of anaesthesia, chloroform was practically the only drug used for analgesia in obstetrics. It was administered intermittently with a mask and drop bottle *à la reine* or from a Junker's inhaler (1867)¹ which the patient could operate herself. The amount of chloroform absorbed in this way can be insidiously high, and all too often these administrations result in anaesthesia rather than analgesia. The acknowledged dangers of chloroform make the drug unsuitable for use in unskilled hands, even though there are some practitioners who still favour it in domiciliary practice, particularly for anaesthesia.

In 1934, Minnitt² introduced an apparatus for the self-administration of nitrous oxide and air. Since then, 'gas/air analgesia' has been widely used and many different machines have been developed. In 1943, the Freedman inhaler³ was introduced for the self-administration of Trilene in air, and has been followed by other apparatus to be used in the same way.

There are certain features of intermittent inhalation analgesia which must be understood if the method is to be effective. The patient is conscious of a uterine contraction before she experiences pain (Fig. 3A). At first there is a sensation of tightness in the lower abdomen, and usually some 15 seconds elapse before the pain threshold is reached and the contraction becomes painful. Thus, analgesia by inhalation must develop within 15 seconds, and this allows for at least six deep breaths. Analgesia can be maintained by further inhalation until the contraction weakens, but the inhaled mixture must be sufficiently potent to produce analgesia in about six breaths. On the other hand, it should not abolish consciousness in less than 5 minutes of continuous inhalation. Under these conditions, the patient should never anaesthetize herself.

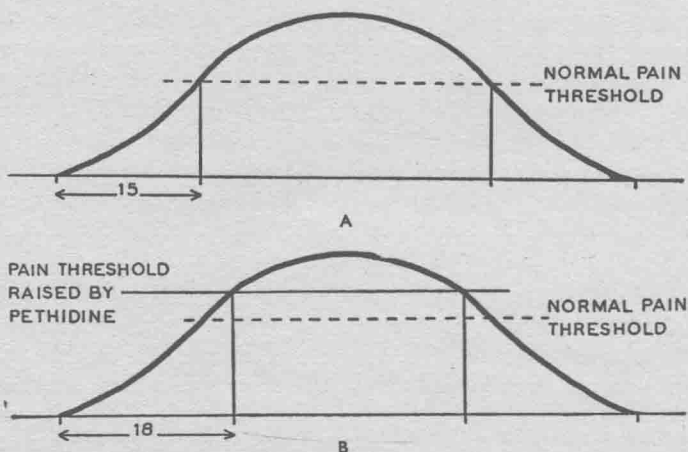


Fig. 3. PAIN RELIEF DURING A UTERINE CONTRACTION

Diagram to illustrate a single uterine contraction during the first stage of a normal labour.

- A. illustrates the normal pattern unaffected by analgesic drugs.
- B. illustrates the effect of pethidine. The uterine contraction remains unaltered, but the pain threshold is raised. Thus, approximately 18 seconds are now available for breathing the analgesic mixture (compare 15 seconds in A) and the contraction is painful for a shorter period.

The permitted 50 : 50 nitrous oxide/air mixture produces analgesia only after 25-30 seconds of vigorous inhalation. Even if inhalation is begun with the onset of a contraction, pain will be experienced. The remedy is to time the uterine contractions and begin inhalations of the mixture before a contraction is due. Alternatively, inhalation may be combined with an analgesic drug such as pethidine which will raise the pain threshold (Fig. 3B). Yet another alternative, though one which is not acceptable to the Central Midwives Board for use by midwives, is the C.M. (Chassar Moir)* attachment. This device, which may be

* The C.M. attachment was developed after Chassar Moir designed an apparatus in 1937.

used with a standard Minnitt machine, allows the inhalation of two to three breaths of pure nitrous oxide before the flow of nitrous oxide/air begins. This provides a rapid onset of analgesia which is then maintained by the usual mixture.

Better results are obtained with a mixture of 75% nitrous oxide and 25% oxygen. This concentration of nitrous oxide must be mixed with oxygen to avoid asphyxia, and therefore the apparatus is cumbersome on account of the extra cylinders. For safety, the apparatus must include a valve which automatically cuts off the flow of nitrous oxide in case the oxygen supply should fail. An efficient valve for this purpose has been designed by Warming,⁵ but neither this mixture nor the apparatus may be used by midwives. Equally good analgesia is obtained with 0.5% Trilene in air without the risk of asphyxia.

A disadvantage of nitrous oxide is that it possesses little specific analgesic power, and only produces analgesia by taking the patient close to the stage of loss of consciousness. This in turn is near to that stage of anaesthesia in which there is 'uninhibited reaction to stimuli' (Fig. 4). Occasionally, a patient inhaling

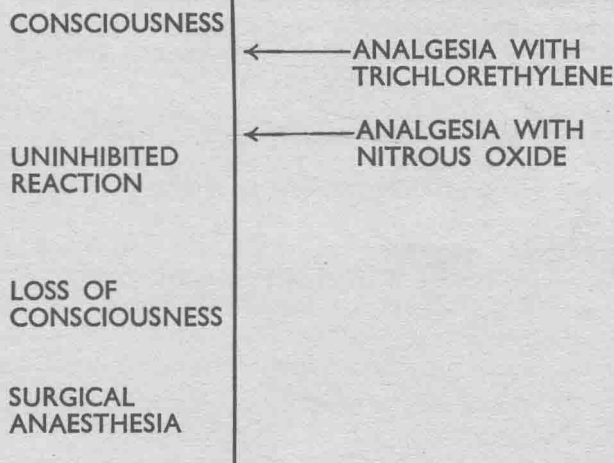


Fig. 4