

Middle Articles

CONTEMPORARY THEMES

Use of Entonox in the Ambulance Service

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Summary: An analgesic mixture of nitrous oxide and oxygen (Entonox) has been used in nine ambulances in Gloucestershire for self-administration by patients in severe pain. Over a period of three and a half months 66 patients have been treated. In all cases the pain was wholly or partially relieved, and in no instance was the patient's condition worsened. No undesirable side-effects attributable to Entonox were produced. It is recommended that other ambulance authorities should consider the use of Entonox in this context.

Introduction

Considerable advances have been made in improving the safety of patients in recent decades, but very little has been done to improve their comfort. It is still nearly as unpleasant for a patient to be taken to hospital with a fractured femur or acute urinary retention as it was 30 years ago.

The time-honoured method of relieving severe pain is by the injection of an opiate such as morphine or pethidine. The use of these drugs at the site of an accident, however, has several serious disadvantages. Firstly, narcotic drugs can be given only by or on the specific instructions of a doctor, who will not usually be present. Secondly, the drug may be absorbed from the injection site very slowly unless given intravenously, and it is a common experience for the full pain-relieving effect not to be obtained until the patient has actually arrived at the hospital. This state of affairs is particularly applicable to the shocked patient whose tissue perfusion is greatly reduced. Thirdly, the relatively long action of the drug may hinder accurate diagnosis on arrival at hospital by masking pain and obscuring pupillary signs. Fourthly, these drugs given in adequate analgesic doses are potent cardiovascular and respiratory depressants, particularly to the shocked patient. Because of these disadvantages the relief of pain at the site of an accident and during transport of the patient to hospital has rarely been attempted by members of the ambulance service. The need for adequate analgesia, however, is none the less important, for obvious humane reasons and also to minimize the noxious reflexes which may further reduce the efficiency of a circulation already impaired by blood loss.

The pain caused during extraction from a crashed vehicle and during transport to hospital, sometimes at high speed and in an ambulance whose suspension often leaves a lot to be desired, is often quite intolerable. Furthermore, it may produce a considerable deterioration in the patient's condition, both mentally and physically.

The ideal analgesic for use under accident circumstances must therefore be potent, rapid in action and excretion, completely safe, and free from side-effects, particularly depression of the cardiovascular and respiratory system. Any apparatus

involved must be simple and safe to use. Entonox (B.O.C.), which is a mixture of 50% nitrous oxide and 50% oxygen contained in a single cylinder, has for many years been safely self-administered during childbirth (Gale *et al.*, 1964; MacGregor, 1967) and during painful conditions and procedures in hospitals (Parbrook, 1967a; Lunn and Kennedy, 1968; Baskett *et al.*, 1969). Such experience has shown that Entonox is a suitable analgesic to be used in accidents, and for this reason can be used with advantage in the ambulance service. The County Health Committee of Gloucestershire gave approval for a pilot survey to be carried out, and so far as we are aware this is the first such survey to be conducted in this country.

Apparatus

The mixture of equal parts of nitrous oxide and oxygen is contained in a single cylinder measuring about 15 by 4 in. (38 by 10 cm.) and containing 500 litres of gas. The cylinder is coloured blue, with a characteristic white segment at the neck. It is also fitted with a non-interchangeable pin index valve, which is accommodated in the yoke and is integral with the inhalational unit. The latter consists of a pressure gauge which indicates the amount of gas in the cylinder, a reducing valve, and a "demand" valve which is connected to the expiratory valve and mask by wide-bore flexible tubing 60 in. (150 cm.) in length. The demand valve ensures that gas does not flow until a negative pressure is produced. This is achieved by the patient inhaling after an airtight seal has been formed between the mask and his face. Thus, if consciousness is impaired during self-administration, the mask will fall away from the face and the demand valve will close.

Two types of mask have been used—the common anaesthetic facepiece made of black antistatic rubber, and the clear plastic mask with a soft latex rim. Use of the latter has advantages for the ambulance attendant, who is able to judge the patient's colour and quickly observe any blood or vomitus coming from his mouth. A mouthpiece was also used in place of a mask in some cases, as it was thought that this might be more psychologically acceptable. The entire apparatus weighs 13½ lb. (6.1 kg.).

Organization and Method

This pilot survey which was based on four ambulance stations covering the southern third of Gloucestershire was started in August 1969. All the nine ambulances were equipped with an Entonox apparatus. Before any of the 50 ambulance personnel concerned in the survey used the apparatus they were all given a comprehensive lecture and practical demonstration by one of us (P.J.F.B.). The lecture included details of the therapeutic effects and side-effects of nitrous oxide, together with the technicalities of the Entonox inhalational unit and its attachment to the cylinder. Furthermore, though the gas

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could be of value in almost any painful condition they were instructed not to administer it to any patient whose consciousness was impaired or who was overtly drunk, or had maxillofacial or oral injuries. Particular emphasis was laid on recognizing early the danger of vomiting and the need to protect the airway. The ambulance men were instructed that the gas was to be used only for self-administration by the patient, who would inhale the gas intermittently as required. It was explained that the role of the ambulance officer was purely to offer the gas and to explain to and guide the patients in the technique of self-administration.

In addition to the lecture and practical demonstration the men were given individual practical training by the ambulance instructors. A revision course is planned every six months, and new recruits are individually taught in exactly the same manner before being allowed to use the apparatus. Since this was a pilot survey, a report form giving details of the administration and its effects was completed by the ambulance staff every time Entonox was used. In addition, one of us (P.J.F.B.) followed up 50 patients within two to three days of admission to hospital. We were thus able to obtain an account of the patients' reactions at the time the Entonox was being used and their impressions in retrospect.

Results

In three and a half months, 66 patients (26 females and 40 males) aged 9 to 89 years have been treated. Table I shows the types of case which have been treated and Table II gives the effects of Entonox on the 50 patients who were followed up after admission to hospital. The assessment of pain relief is necessarily subjective.

TABLE I.—*Injury or Illness of the 66 Cases Treated*

Limb injuries	27	Acute urinary retention	2
Burns	3	Myocardial infarction	3
Chest injuries	4	Pneumonia and pleurisy	2
Back injuries	2	Meningitis	1
Cuts and scrapes	2	Terminal N.G. stomach	1
Acute abdomen	13	Obstetric cases	6

TABLE II.—*Results of Follow-up in 50 Patients*

Pain much relieved	50
Anxiety relieved	30 (out of 50)
Felt sick	0
Felt drowsy	23
Fell asleep	0
Would like to have it again	50

Anxiety.—The patients were also questioned about whether they were anxious at the time of administration and whether Entonox had had any effect on this. Only 30 patients frankly admitted to being anxious, and all of these volunteered that they felt much calmer after inhaling the gas. This was particularly so in the case of the three patients with myocardial infarction.

Side-effects.—Specific questions concerning smell, nausea, vomiting, drowsiness, and unconsciousness were asked. None of the patients complained that the gas was unpleasant to inhale or made them feel nauseated; in fact, some volunteered that the nausea associated with their pain was relieved. Twenty-three admitted to feeling a little drowsy, but none actually fell asleep. Three of the patients did not fully remember the ambulance journey. All three had suffered minor head-injuries and had been unconscious for a brief period after their accidents, but they all appeared to be conscious in the ambulance and co-operated well during inhalation of the gas. In no case was there prolonged retrograde amnesia. None of these patients who had Entonox and who did not have a head injury had any amnesia whatsoever. In no case did the admitting physician or surgeon when making his diagnosis, complain that physical signs had been masked. No patient complained of difficulty or fear in using the apparatus and all said that they would like to have the gas available should similar circumstances arise in the future.

Discussion

The introduction of Entonox to the ambulance service was initially designed to bring relief to victims of industrial and road accidents, particularly those trapped by machinery or in cars. The results, however, show that pain associated with a wide variety of illnesses can be reduced. In addition to the subjective pain relief, the reduction of anxiety and reflex responses of the cardiovascular and other systems to pain (Dundee *et al.*, 1969) must be of value.

Owing to the fact that the Entonox apparatus is a demand system a true 50% concentration of oxygen is received by the patients. This enhanced oxygen percentage is of value particularly in myocardial infarction (Petrovsky and Yefuni, 1965) and severe chest injuries. It is interesting to note that inspired concentrations of more than 50% oxygen are rarely achieved by many commonly used continuous-flow devices and masks which are said to be delivering pure oxygen (Bethune and Collis, 1967). The use of an expiratory valve with an airtight seal between mask and face prevents a build up of CO₂ provided that an adequate tidal volume is maintained. This is not always the case with some conventional masks, especially the Polymask, Pneumask, and B.L.B. masks (Bethune and Collis, 1967) which are in use in many ambulances.

The results show that our initial experience with the use of Entonox in the ambulance service has been satisfactory. In the interests of absolute safety, however, certain precautions must be observed. Detailed training of all personnel involved is essential. There is a theoretical danger of inhalation of blood, stomach contents, or a foreign body. This danger, however, is either minimal or non-existent, since at the concentration used nitrous oxide is acting as an analgesic rather than an anaesthetic in most cases (Parbrook 1967b). Because the gas is self-administered the airtight seal between the mask and face—essential for delivery of the gas—is broken should the patient fall asleep; thus a deep level of unconsciousness with severe impairment of the cough reflex due to the effects of nitrous oxide is not likely to occur. Nevertheless, the ambulance personnel were instructed not to offer the gas to patients with oral or maxillofacial injuries or those with depressed levels of consciousness.

For patients suffering from chronic bronchitis there is the theoretical danger that the administration of 50% oxygen would reduce the "hypoxic respiratory drive" and cause a build-up of carbon dioxide. The technique of self-administration should minimize any serious danger. It should be remembered that if the Entonox apparatus were not available these patients would probably be given pure oxygen from the ordinary continuous-flow apparatus, which, of course, is not regulated by the patient.

Nitrous oxide has on very rare occasions been incriminated as an addictive drug, usually in members of the medical or allied professions. Though there seems to be no danger to patients in this respect, it was considered necessary to warn ambulance personnel of this slight risk. Recently conducted tests have shown that the passage of Entonox through the official breathalyser tubes (Alcotest 80) produced no colour changes (J. A. Fair, personal communication). When alcohol and Entonox were passed through the breathalyser there was no indication that Entonox affected the results in any way (J. A. Fair).

Though Entonox is inflammable, the danger of ignition is also more theoretical than real, since the gas mixture will flow from the cylinder only when a negative pressure is applied. Nevertheless, it would be prudent to exercise caution when there is a possibility of ignition, as when metal-cutting equipment is being used to free a patient.

The relative proportions of the two gases issuing from the cylinder are affected by temperatures below -7° C., when the contents tend to separate in the cylinder. Such low temperatures occasionally occur in this country, but the mixture can

be rapidly restored by rewarming and inversion of the cylinder (Crawford *et al.*, 1967) or, more slowly, by storing the cylinders in a horizontal position at a temperature above 5° C. (Bracken *et al.*, 1968). If these precautions are taken the use of Entonox in the ambulance service is wholly justified as a simple and safe method of pain relief at a time when it is particularly important. The method of self-administration with a demand apparatus allows the patient freedom of choice and regulation of his relief. The use of the gas has raised morale in the ambulance service because, for the first time, ambulance personnel can do something specific to relieve pain. None of the men who have had experience in the use of Entonox would now want to be without it.

As a result of our experience in this survey the Gloucestershire County Health Committee has decided to extend the use of Entonox to the whole of the county ambulance fleet. We should also like to recommend that other ambulance authorities consider the use of Entonox.

We gladly record our thanks to Gloucestershire County Council for approving the survey and for providing the necessary equipment. We also have pleasure in paying tribute to Mr. A. Johnston,

the county ambulance officer, Mr. G. Turnbull, the deputy county ambulance officer, Mr. E. Lovell, the area superintendent, and to all the personnel at the Almondsbury, Wotton under Edge, Yate, and Soundwell Ambulance Stations. Appreciation is due to the casualty surgeons at the hospitals in Bristol and to Miss Gabrielle Routledge, who provided invaluable secretarial help. Without all their enthusiastic support and co-operation the survey would not have been possible.

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Mobile Unit for Screening for Cervical and Breast Cancer

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Summary: In 12 months' use of a mobile unit for cervical and breast cancer screening in Gloucestershire 3,211 women attended at an average of five sessions a week. Clinic sessions were organized and the running costs of the service met by a voluntary organization. The keeping of records, provision of laboratory facilities, and the follow-up of patients were carried out in close co-operation with the county health department.

Introduction

The mobile staywell clinic which took to the roads of Gloucestershire in October 1968 was provided and is maintained by a voluntary organization, the Gloucester City and County Appeal for the Prevention of Cervical Cancer. This article reports our experience in the first year of using the clinic in a programme of screening for cancer of the cervix and breast.

The initial impetus for forming the organization came from small pressure-groups of women who were dissatisfied with the facilities then provided for the detection of cervical and breast cancer. Initially the organization comprised representatives of the various women's organizations operating in this county. The major aspect of the organization's work comprises the general education of the public about cancer, emphasizing in particular the need for taking cervical smears and raising funds to provide this service. The latter aspect was stimulated by the suggestion that a mobile unit could serve the entire area and thus take the service to those who might otherwise find it inaccessible. From the outset the voluntary organization worked in close co-operation with the local authorities, and in particular with doctors from the health departments. Thus it was possible to plan a course of action which was satisfying to the volunteers and acceptable to the medical profession, and which also fulfilled a vital role in the total scheme for providing a cervical cytology service.

Planning of the Service

The general principle of any screening service for cervical cancer is that it must be comprehensive. For this reason, plans for providing facilities for taking smears, examination of slides, general-practitioner follow-up, gynaecological advice and treatment, and an alerting system for repeat investigations were laid well ahead to ensure that this total service should be available. General practitioners were told about the plans through the local medical committee and gynaecologists were consulted about various points. It is evidence of the good will of the pathologists that each of the pathological laboratories serving the area agreed to undertake the extra cytology work when the clinic went on the road. Though co-operation from medical colleagues was readily forthcoming, many were sceptical about whether women would be willing to use such a unit.

During this time public meetings were held over a period of about 12 months. At these a representative of the voluntary organization explained its aims and a medical officer of the local authority spoke about the medical aspects of screening for cervical cancer and about cancer in general. Local groups were also formed for the purpose of raising funds, disseminating information, seeking out volunteers, and helping with the organization of sessions.

Organization of Sessions

The keynote of the organization is to provide an efficient service on a sound economic basis. For this reason the unit visits a location only when there are enough women wishing to attend to make a full session of 20 patients. The local committees make the service known to the residents of their area, compile a list of patients, and inform the central secretary when a visit is needed.

The work of each session is carried out by a volunteer clerk and nurse, and a doctor who is either employed by the voluntary organization or seconded by the county health depart-

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