THERAPEUTIC INHALATION ANAESTHESIA

BY

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SUMMARY

The limitations of present postoperative analgesic methods are outlined and the rationale of nitrous oxide-oxygen analgesia is developed by contrast. Concentrations of 30–70 per cent nitrous oxide in oxygen were used, being delivered from a standard anaesthetic machine through facepiece or nasal catheter. The application of the technique in 103 postoperative cases, 82 of which had had thoracic surgery, is discussed. Two illustrative cases are described in detail. The analgesia was excellent and a clear improvement in respiratory exchange, acid-base balance and oxygenation was demonstrated. Other uses described are the management of the agonizing pain of acute coronary insufficiency and of acute abdominal pain pending diagnosis. A final suggestion concerns the use of the method in painful terminal states.

The postoperative care of patients is one of medicine’s major problems. This problem has grown particularly acute during the last two decades, since operations on thoracic organs have become practicable for a wide range of surgeons. Modern surgery owes its successes primarily to the outstanding achievements of anaesthesia.

With the discovery of the anaesthetic properties of chloroform, ether and nitrous oxide, as far back as the middle of last century, medicine acquired excellent means of controlling surgical pain. Many operations became possible which could not be performed previously.

The progress manifested by present-day methods of anaesthesia has further extended the scope of surgical intervention. Owing to the joint efforts of clinicians, physiologists, pharmacologists and biochemists, pain and other effects of surgical trauma (provided, of course, the surgeon does not irreversibly impair vitally important functions) have in practice ceased to be problems.

It is somewhat different with analgesia in the postoperative period. The imperfect methods of analgesia after operations employed as far back as the beginning of the century are, with some minor additions, still being used today. Preparations of the morphine group, barbiturates, neuroplegics, field blocks and epidural anaesthesia are still the principal methods available for analgesia during the postoperative period.

It is generally recognized that permissible doses of those morphine preparations which possess the most strongly pronounced analgesic action have little effect on the intense pain which follows major traumatic operations. The brief analgesic effect of morphine and its derivatives demands repeated injections of the preparation. The result is that the patient’s perception of pain is neither continuously nor evenly diminished and periods of analgesia alternate with periods of severe pain. Moreover, preparations of the morphine group, barbiturates and neuroplegics produce a marked central depressant effect on respiration. Large doses or continued administration of usual doses of the aforementioned preparations inevitably lead to respiratory depression. The side effects of these preparations may produce quite severe postoperative complications, especially in persons already suffering from respiratory and circulatory insufficiency (as, for example, in pneumosclerosis, pulmonary emphysema, cardiovascular disease or after operations on the intrathoracic viscera).

While the patient is subjected to the greatest trauma, as during the operation, he is protected by modern methods of anaesthesia, for these ensure
stability of the vital functions; but when the operation ends and anaesthesia is terminated, pain and emotional as well as toxic factors come into play. When they emerge from the anaesthetic state, patients not infrequently lapse into a less satisfactory condition and perhaps even into a state of shock.

There have been reports of patients and experimental animals, who have developed postoperative circulatory collapse immediately after the termination of anaesthesia following an operation being resuscitated by repeated short-term anaesthesia (Narychev, 1953; Shantyr and Dubik, 1958).

These considerations have led the writers to consider the expediency of prolonging the anaesthetic state for long periods of time following major traumatic operations (Petrovsky and Yefuni, 1960, 1962).

There have been attempts to utilize pharmacological sleep lasting many days in psychiatric practice (Sereisky, 1937) and protracted protective reflex inhibition by means of barbiturates during the postoperative period (Busalov, 1951; Yelenetskaya, 1957; Vorobyov, 1958; Romashov, 1958; and others). However, these procedures have been practically abandoned because of the side effects (central depression of respiration, postoperative pneumonia, increased tendency to thrombogenesis, etc.) produced by the preparations used.

POSTOPERATIVE INHALATION ANAESTHESIA

The method of therapeutic inhalation anaesthesia is based on the following principles:
- the ensurance of analgesia;
- the use of anaesthetics which do not depress the patient's vital functions;
- the provision and maintenance of normal respiratory function; and
- the exclusion of the patient's emotional reactions.

The anaesthesia is provided by nitrous oxide and oxygen. Nitrous oxide does not unfavourably affect respiration, does not irritate the respiratory mucosa and does not affect cardiac, liver or kidney function. At the same time it ensures analgesia against a background of light and pleasant narcotic sleep.

The extensive bibliography devoted to the effect of nitrous oxide contains no certain indications of any toxic effect of this agent. Of considerable interest in this respect are the studies conducted by Bjorneboe et al. (1953), Lassen et al. (1954, 1956), and Wilson et al. (1956) during the treatment of tetanus by nitrous oxide anaesthesia in combination with large doses of barbiturates and paralysant drugs over a period of many days. Within one or two weeks of this complex treatment the patients showed signs of gradually increasing depression of haematopoiesis. The earliest signs of such disturbances were noted at the end of the first week of treatment, in fact on the fifth day. To avoid these complications during prolonged nitrous oxide anaesthesia in tetanus patients, these authors recommend regular granulocyte and thrombocyte counts.

The foregoing studies make no mention of the effect of the tetanus toxin in the development of this picture; nor do they contain any data excluding the depressing effects of the aggregate of the agents they used (relaxants, barbiturates and nitrous oxide) on haematopoiesis. Nevertheless, when therapeutic anaesthesia exceeding 24 hours with this agent is being used it is expedient to examine the granulocyte and thrombocyte counts.

The authors' attention was directed in the first place to the use of prolonged analgesic anaesthesia during the postoperative period, but encouraging results have also been obtained by the production of prolonged anaesthesia with nitrous oxide and oxygen in acute coronary insufficiency and in certain other disease states associated with pain.

METHOD

Prolonged "analgesic anaesthesia" is produced with a mask by means of the usual type of anaesthetic apparatus using a semi-open system which ensures complete removal of carbon dioxide without an absorber. Anaesthesia is maintained at the stage of analgesia. To produce this, the concentration of nitrous oxide necessary ranges from 30 to 70 per cent with 70–30 per cent oxygen, which in the presence of adequate pulmonary ventilation excludes the possibility of oxygen deficiency.

In some patients this form of anaesthesia has been produced by using nasal catheters instead of a mask. In these cases, the concentration of nitrous

* The term "analgesic anaesthesia" is used by the authors to describe the state of their patients and is deliberately maintained although there may be semantic objections to it.—EDITORS.
Oxide must be increased, since it is diluted considerably by atmospheric air. In the production of prolonged analgesic anaesthesia, the gas mixture must be humidified. This can be achieved by pouring a small amount of water into the reservoir bag.

Therapeutic anaesthesia is usually begun by administering a gas mixture of nitrous oxide and oxygen in a 1:1 ratio. The concentrations of these gases in the mixture are altered, depending on the effect produced in the first minutes.

After operation, on the appearance of the first signs of pain, a mask was applied and the patient given the mixture of nitrous oxide and oxygen, which depressed pain perception.

**RESULTS**

One hundred and three patients were observed, of whom 87 were anaesthetized for a period of 24 hours, 8 for 48 hours, 7 for 72 hours and 1 for 96 hours. Thoracic operations had been performed in 82 cases.

Under these circumstances the patient breathes comfortably, as pain sensations interfering with the depth of the respiratory excursions are not inhibited by pain. There is free expectoration of any accumulated sputum. The haemodynamic indices after the onset of analgesic anaesthesia were usually maintained at a satisfactory level. Examination of the formed elements of the blood showed no abnormal changes. A slight diminution in blood clotting was observed on the second or third day. In some cases marked perspiration was observed on the skin mainly in the upper half of the body, during the stage of analgesia.

**Exemplary cases.**

The following cases are examples of postoperative anaesthesia.

**Patient S.,** 55 years old, was operated on on March 16, 1960, for cancer of the lower third of the oesophagus extending to the cardia. A laparotomy, thoracotomy and resection of the lower third of the oesophagus and cardia were performed, and an oesophago-gastric anastomosis was performed.

The operation was carried out under endotracheal anaesthesia with nitrous oxide and oxygen and minimal ether. The respiration was controlled throughout. At the end of the operation, the patient awoke and his respiration appeared normal. In the ward he was given analgesic anaesthesia with nitrous oxide and oxygen. The anaesthesia was produced with a mask by the method described with a 50 per cent mixture of nitrous oxide and oxygen. For short periods of time the concentration of nitrous oxide was increased to 70–80 per cent. At the onset of sleep the nitrous oxide concentration was reduced to 30 per cent.

The administration of 50 per cent nitrous oxide with oxygen induced drowsiness in the patient and then sleep. The pains rapidly disappeared. The patient awoke when called, but was very slow in answering questions.

The mask was removed from the patient 12 hours after the onset of anaesthesia because of the need to change the cylinders. Within 5 minutes wound pain reappeared and rapidly increased. Within 15 minutes...
the patient was moaning and his respiration had become shallow and was rapid. After reapplication of the mask and administration of 50 per cent nitrous oxide with oxygen the pain quickly disappeared and the respiration again became regular and deep. The patient fell quietly asleep. He was again very slow in answering to calls.

Subsequently, during examination of the patient the nitrous oxide was periodically disconnected. It was noted that the pain-free period gradually increased. By the beginning of the second day, the pain-free intervals without nitrous oxide had increased to 30-40 minutes. Within three days of the operation, when postoperative anaesthesia was discontinued, the patient had no pain at all while at rest. The subsequent postoperative period was uneventful.

During analgesic anaesthesia the patient's respirations were deep and even. The respiratory rate ranged from 16 to 22 b.p.m., but on each occasion after cessation of anaesthesia the respiratory rhythm considerably accelerated. On auscultation the patient was noted to have vesicular respiration on both sides in all parts of the lungs; there were no râles. On request the patient expectorated freely and without effort. The haemodynamic indices remained stable and at satisfactory levels. The haematogram showed no signs of disturbance in haemopoiesis (fig. 1).

The electroencephalogram (fig. 2) recorded changes regarded as characteristic of analgesic anaesthesia. After termination of anaesthesia the electroencephalogram returned to its initial state.

Thus the patient spent the most difficult days following a major and traumatic operation in a state of analgesic anaesthesia without requiring any additional analgesics or circulatory supporting drugs. He was only given antibiotic therapy and periodic infusions of physiological saline solution and protein blood substitutes.

PATIENT N., 28 years old, was operated on on December 6, 1962, for mitral valve failure. A mitral commissurotomy was performed under endotracheal ether-oxygen anaesthesia. The respiration was controlled. At the end of the operation the patient awoke and spontaneous respiration was restored. In the recovery room she was given analgesic anaesthesia with a 54 per cent mixture of nitrous oxide and oxygen. Administration of the gas mixture induced sleep. The patient awakened to calls but was slow in answering questions. The intense pain which the patient experienced soon after awakening on the operating table, disappeared during the first minutes of postoperative anaesthesia. The arterial pressure was stabilized at a satisfactory level.

Two hours after induction of analgesic anaesthesia the mask was removed. Within a few minutes rapidly increasing pain appeared in the region of the wound. The patient moaned with pain and tachycardia developed (the pulse rate increased from 98 beats/min to 102 beats/min). The mask was reapplied and after administration of the nitrous oxide and oxygen mixture in a 2:1 ratio the pains rapidly disappeared. The patient quietly fell asleep, her respiration becoming even and deep. Subsequently the administration of nitrous oxide was periodically (every 4-2 hours) suspended and a gradually increasing duration of the painless intervals was observed. Anaesthesia was discontinued within 24 hours. The patient suffered pain only during movement and laboured respiration. This pain was now easily relieved by injection of 20 mg of Promedole (4-phenyl-4-propoxy-1, 2, 5-trimethyl-piperidine hydrochloride) four times a day.

The postoperative period was uneventful, involving no complications. On December 31, 1962, the patient was discharged from the clinic in a satisfactory condition.

Under therapeutic anaesthesia the patient showed clear improvement in respiratory exchange as compared with the respiratory function after cessation of therapeutic anaesthesia (fig. 3). Changes were also observed in the gaseous composition of the blood and in the acid-base balance (estimated on the Astrup apparatus; table 1).
TABLE 1

<table>
<thead>
<tr>
<th>Test</th>
<th>pH</th>
<th>Standard bicarbonate (m.equiv/L)</th>
<th>Pco_2 (mm Hg)</th>
<th>Lac acid (m.mole/L)</th>
<th>Pyruvic acid (m.mole/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before operation</td>
<td>7.40</td>
<td>20</td>
<td>34</td>
<td>0.44</td>
<td>0.16</td>
</tr>
<tr>
<td>90 min after operation</td>
<td>7.30</td>
<td>18</td>
<td>38</td>
<td>2.11</td>
<td>0.17</td>
</tr>
<tr>
<td>120 min after onset of anaesthesia</td>
<td>7.45</td>
<td>22</td>
<td>35</td>
<td>0.44</td>
<td>0.11</td>
</tr>
</tbody>
</table>

Results in a series of patients undergoing mitral valvotomy.

To evaluate the improvement in respiratory function, the gaseous content of arterial blood and the acid-base balance were examined in fourteen patients operated on for mitral stenosis. Figure 4 graphically shows the means of the respiratory volume, depth and rate of respiration during the immediate postoperative period (2 hours after the operation) and under postoperative anaesthesia (2 hours after onset of anaesthesia). The acid-base balance was examined in the same group of patients 2 hours after the operation and under postoperative anaesthesia.

**FIG. 4**
Mean respiratory minute volume (l./min), tidal volume (ml) and rate/min, before and during therapeutic anaesthesia (data from 14 patients).

**FIG. 5**
Acid-base balance values before and during therapeutic anaesthesia.
anaesthesia (fig. 5). The results show a tendency for the acid-base balance to return to normal under analgesic postoperative anaesthesia induced with a nitrous oxide and oxygen mixture.

A reduced oxygen saturation was observed in the arterial blood of all the investigated patients during the postoperative period before analgesia. The mean value of arterial blood oxygenation in the fourteen patients of this series 2 hours after the operation was 88 per cent (fig. 6). During analgesic anaesthesia induced with nitrous oxide and oxygen in a 1:1 ratio oxygenation increased on an average to 96 per cent. After discontinuance of postoperative anaesthesia, oxygenation rapidly decreased upon breathing air, to an average of 90 per cent.

![Diagram](https://example.com/diagram.png)

**FIG. 6**

Postoperative oxygen saturation of the arterial blood before, during and after therapeutic anaesthesia.

**THERAPEUTIC ANAESTHESIA IN ACUTE CORONARY INSUFFICIENCY**

Acute coronary insufficiency is still one of the main problems of modern internal medicine. Myocardial infarction, which, as a rule, is due to acute coronary insufficiency, is a frequent cause of death. Pain is the essential factor that often determines the further development of this disease. There have been cases of death during severe attacks of coronary spasm without any serious damage to the myocardium. In such cases the catastrophe develops against the background of shock due to severe pain with which it is very difficult to cope. The use of modern cardiovascular agents has considerably increased the chances of controlling the collapse, but if the pain factor plays an important role in the development of collapse, measures must be directed primarily towards its control. Preparations of the morphine group, widely administered in acute coronary insufficiency, far from always ensure adequate analgesia. Moreover, morphine preparations have a markedly depressant action on the respiratory centre and lead to increased blood clotting. Administration of morphine preparations eliminates neither the patient's emotional stress nor his fear of the impending catastrophe, whereas the production of anaesthesia with nitrous oxide and oxygen within a few minutes completely eliminates pain and distracts the patient from the critical situation.

As far back as 1881, Klikovich effectively administered nitrous oxide to arrest an attack of cardiac asthma. Nitrous oxide is now also used with a good therapeutic effect in the practice of first aid during transportation of patients with acute coronary insufficiency.

It was decided to use nitrous oxide and oxygen anaesthesia for long periods of time under hospital conditions (Yefuni, Krivonosova and Shatorina, 1962). In addition to the usual therapy the patient is given therapeutic anaesthesia immediately upon admission to the department. The duration of anaesthesia may vary between several hours and 1–2 days, depending on the extent of the affection and the character of the pain.

Brief anaesthesia during the transportation of patients in an ambulance (Belkin, 1961) usually produces an unstable analgesic effect and only occasionally produces a constant therapeutic effect. There appears to be great sense in prolonged therapeutic anaesthesia during acute coronary insufficiency with a marked pain syndrome. Apart from the prolonged depression of the patient's emotional reaction which eliminates the psychic stress, owing to the high concentration of oxygen in the gas mixture administered to the patient (usually containing about 50 per cent oxygen),
the tissue oxygenation is improved, which is obviously especially important in myocardial ischaemia.
In connection with prolonged therapeutic anaesthesia there is an anticoagulant effect as a result of a slight decrease in the number of thrombocytes.
Lastly, the relief of pain eliminates unfavourable neurohumoral reactions. In cases of substernal pain or sensations akin to pain (sense of constriction, numbness, etc.) the volume of pulmonary ventilation not infrequently decreases owing to shallow respiration, since deeper respiration intensifies the discomfort. Under therapeutic anaesthesia all these sensations disappear and pulmonary ventilation is improved.

Specimen case reports.
The following cases may serve as examples.

PATIENT S., 62 years old, was admitted to the clinic on February 2, 1961, with complaints of severe substernal pain, dyspnoea and general weakness. The patient had become ill on the previous day, when, suddenly and for the first time in his life, he felt sharp and gradually increasing pains in the precordial region.
The pain was of an intensely compressing character and could be Mitigated, only for a short time, with an injection of a narcotic. According to his son, the patient was extremely restless. The systolic pressure had dropped from 130 to 90 mm Hg. An electrocardiogram revealed a vast transmural myocardial infarction involving the septum, anterior wall, lateral wall and apex of the left ventricle.

Owing to the inadequate response to narcotics the patient was anaesthetized with nitrous oxide and oxygen in a 2:1 ratio. Within a few minutes, the pains considerably diminished, then completely disappeared and the patient fell asleep. Signs of euphoria (motor reactions, talkativeness and incommensurate gaiety) gradually appeared. The nitrous oxide concentration was reduced to 30 per cent. The phenomena of euphoria disappeared and the patient again fell quietly asleep. The haemodynamic indices were stabilized at satisfactory figures (arterial pressure 130/75 mm Hg, pulse rate 84 beats/min with normal rhythm).
The patient would awake to calls and answer questions correctly. The mask was removed within 3 hours. The patient had no pain and observed that he had had the first real rest since the onset of the illness. Soon the patient lapsed into natural sleep. Half an hour later he awoke with a sense of constriction and slight pain in the region of the heart. The mask was re-applied and anaesthesia readministered with nitrous oxide and oxygen in a 1:2 ratio. Within a few minutes the patient fell asleep and was difficult to arouse and slow in answering questions; all pain in the cardiac region disappeared.

Subsequently painless intervals alternated with slight sensations of compression about the heart, the patient immediately reporting these sensations to the anaesthetist, who induced analgesic anaesthesia anew.

Within 36 hours therapeutic anaesthesia was discontinued in view of the continued absence of pain. On the 13th day the patient was transferred to a therapeutic clinic with satisfactory indices of vital functions.

PATIENT Z., 43 years old, was admitted to the clinic on May 31, 1961, with complaints of sharp substernal pains, a feeling of suffocation and general weakness. The patient had had angina since 1955 and had had a myocardial infarction in 1957. On May 31, 1961, several hours before admission to hospital, the patient developed severe substernal pain which rapidly became increasingly intense. An ambulance delivered the patient to the department of reanimation of the hospital surgical clinic. On admission, the patient had an arterial pressure of 75/60 mm Hg, a pulse with a rate of 120 beats/min and cyanosis. The condition was diagnosed as anteroseptal myocardial infarction and acute cardiovascular insufficiency. After administration of strophanthid and adrenaline the patient's arterial pressure rose to 90/65 mm Hg but his condition remained extremely grave. The patient was given an intravenous noradrenaline infusion (1 ml of noradrenaline in 200 ml of 5 per cent glucose) and an intravenous injection of heparin (20,000 units). The mask was applied and the patient was given a mixture of nitrous oxide and oxygen in a 1:1 ratio. Within a few minutes the pains diminished and then completely disappeared. The patient fell asleep and was slow in answering to calls. Respiration was even and deep. The mask was removed within 2 hours. The patient dozed for a period of 8-10 minutes and then began to complain of a sense of substernal constriction, developed dyspnoea and grew restless; cyanosis increased. Signs of cardiac asthma with premonitory signs of pulmonary oedema appeared. All this took place in the course of 3-4 minutes. The patient was immediately given therapeutic anaesthesia. With a few minutes the pains disappeared and premonitory signs of cardiac asthma disappeared. One and a half hours later the mask was removed and the signs of cardiac asthma reappeared; they soon disappeared again after administration of nitrous oxide and oxygen. Anaesthesia was continued with brief interruptions for 48 hours in order to render a few days of euphoria.

On the third and seventh days the patient developed mild substernal pain which was easily eliminated by brief administration of a mixture of nitrous oxide and oxygen. On the ninth day the patient was transferred in a stable condition to a therapeutic clinic.

Analgesic anaesthesia proves particularly effective in attacks of angina. In these cases the authors employed the so-called "auto-anaesthesia" method in which the patient himself puts on the mask of an intermittent flow anaesthetic apparatus (Soviet apparatus, NAPP-60) designed for obstetrical analgesia and anaesthesia and inhales the mixture of nitrous oxide and oxygen in pre-fixed proportions.

Experience with employing analgesic anaesthesia in cases of acute coronary insufficiency associated with intense pain and other distressing sensations in the cardiac region warrants the hope that therapeutic anaesthesia offers a real prospect of alleviating this disease.
ANAESTHESIA USED FOR THERAPEUTIC PURPOSES
IN PAIN SYNDROMES OF VARIOUS AETIOLOGY

The rapid onset of the anaesthetic effect and the rapid elimination of the nitrous oxide constitute the great merit of anaesthesia produced with nitrous oxide and oxygen. To produce the necessary analgesic effect requires but 3–5 minutes. It takes the same period of time for the analgesia to wear off. It was decided to make use of this property of nitrous oxide anaesthesia in emergency surgery.

As a rule, the surgeon who examines a patient with an acute pain syndrome does not give the patient any analgesic before he has arrived at a precise diagnosis which will determine whether the therapy should be conservative or involve surgery. This expectancy is usually distressing and not infrequently is the cause of a deterioration in the patient's general condition. On the other hand, administration of one of the preparations of the morphine group will alter the patient's reactions for a long time and will thereby render the diagnosis difficult.

Anaesthesia with a mixture of nitrous oxide and oxygen quickly relieves the pain, yet its effect ceases as rapidly a few minutes after removal of the mask. This makes it possible to administer first aid to patients having intense pain without adding to the difficulties of diagnosis.

**Specimen case report.**

The following case may serve as an example.

**PATIENT N.,** 43 years old, was admitted to the clinic of hospital surgery of the First Moscow Medical Institute on February 14, 1961, with complaints of intense, gnawing pains in the left half of the chest and the epigastric region.

Examination of the patient in the reception ward revealed acute pancreatitis. Diastase in the urine, 4,096 units; leucocyte count 36,500/c.mm; granulocytes with a shift to the left.

Despite injections of Promedole and morphine and production of procaine block, the pain sensations did not diminish. In view of this, analgesic anaesthesia with a mixture of nitrous oxide and oxygen was prescribed. Nitrous oxide and oxygen were administered to the patient in a 2:1 ratio by the semi-open method. Within a few minutes the pain completely disappeared and the patient fell asleep. He responded to calls by opening his eyes and adequately reacted to his surroundings. When questioned about pain, he answered in the negative. Two hours after the beginning of analgesic anaesthesia the mask was removed. Within 5–6 minutes the pain increased rapidly and within 10 minutes the patient was moaning. The mask was reapplied and analgesic anaesthesia was started anew with the gases in the same proportions. Within a few minutes the pain disappeared and the patient fell asleep again. One and a half hours later the mask was removed. The painless interval lasted 25 minutes, then the pains recurred and anaesthesia was produced again.

Subsequently anaesthesia was maintained in the analgesic stage and the patient slept, awakening only in response to calls.

Twelve hours after the beginning of anaesthesia the mask was removed. There was no pain and the patient lapsed into natural sleep. Pain did not recur. Subsequently no analgesics had to be administered.

Whether anaesthesia with the aid of a mask applied on the patient's face by the anaesthetist is recommended, or "auto-anaesthesia", when the patient himself puts on the mask, depends on the physical condition of the patient.

The production of analgesic anaesthesia with nitrous oxide and oxygen is humane in cases of patients dying with intense pain. The administration of nitrous oxide through a nasal catheter for several (3–5) days may considerably alleviate the suffering of a doomed patient and create against the background of analgesia and mild euphoria an illusion of well-being.

**CONCLUSION**

In summarizing the writers' experience of the use of anaesthesia for therapeutic purposes there is, in their opinion, no doubt of the therapeutic effect of the mixture of nitrous oxide and oxygen in the postoperative period and in a number of cases of other disease states associated with intense pain. Thus, during the postoperative period no patient (even among those who had undergone thoracic operations) had a radiographically demonstrable pulmonary complication, such as atelectasis or pneumonia. Moreover the fact that postoperative anaesthesia was produced mainly in the most seriously ill patients must be taken into account. Any case of disturbed pulmonary ventilation associated with pain during the postoperative period may serve as an indication for such anaesthesia.

The contraindications to employing prolonged anaesthesia with nitrous oxide include cases with unarrested haemorrhage. This form of anaesthesia is also undesirable in cases of addiction to narcotic drugs. Even low concentrations of nitrous oxide may evoke intense psychomotor reactions in these patients.

The mixture of nitrous oxide and oxygen makes it possible quickly and effectively to eliminate pain.
in the most diverse diseases. At the same time none of the vital functions are affected. By changing the proportions of the gases administered, the anaesthetist finds within a few minutes the dose of anaesthetic necessary for a given patient; as the pain alters, he readjusts the concentration of the gases, thus maintaining the necessary level of anaesthesia for a long period of time. This enables the anaesthetist to give each patient a dose of anaesthesia according to each individual's true requirements, without resorting to the usual standard doses of analgesics as calculated by weight, age and other insufficiently precise indices.

The new application of general anaesthesia has been given by the writers the designation of "therapeutic anaesthesia".

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ANESTHESIE THERAPEUTIQUE PAR INHALATION

SOMMAIRE
Les auteurs signalent le caractère limité des méthodes post-opératoires rationnelles d'analgésie par protoxyde d'azote plus oxygène. Ils utilisèrent des concentrations de 30 à 70% de protoxyde d'azote administrées à l'aide d'un appareillage d'anesthésie, soit par masque soit par sonde nasale. Ils discutent leur expérience acquise dans l'application de cette technique dans 103 cas post-opératoires, dont 82 avaient fait l'objet d'interventions thoraciques, et en fournissant le détail de deux cas particulièrement instructifs. L'analgésie fut excellente y compris l'amélioration nette des échanges respiratoires, du rapport acide/base et de l'oxygénation. D'autres utilisations décrites ici sont la réduction de la douleur abominable de l'insuffisance coronaire sique et de celle, non moins insupportable des accidents abdominaux en attendant l'établissement du diagnostic. Enfin, les auteurs suggèrent — et avec combien de raison — l'emploi de cette méthode dans les moments pénibles précédant la mort.

THERAPEUTISCHE INHALATIONSANÄSTHESIE

ZUSAMMENFASSUNG