THE FUNCTION OF THE ANESTHESIOLOGIST IN THE MANAGEMENT OF THE PATIENT WITH EXTENSIVE BURNS * †

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THE present world situation brings to the foreground many problems. One of these is the serious possibility that within a few minutes any city near any strategic area may become crowded with casualties from a bombed area. Since many of these patients would have extensive burns, it was thought to be appropriate at this time to consider the part that we, as anesthesiologists and as consultants, should have in the medical management of such individuals.

Our discussion is based primarily upon our experience with 240 patients with second and third degree burns who have been hospitalized by our Plastic Surgery Service during the past four and a half years. It includes our impressions derived from 1,400 administrations of anesthetic drugs to members of this group.

Our first consideration is the patient who is extremely restless or in a manic state on arrival at the hospital. The proper therapy for this hyperactivity depends upon differentiating between (1) pain, (2) apprehension, fear and hysteria, and (3) cerebral hypoxia.

In the control of pain, morphine is the drug of choice. The adult dose consists of 8 to 10 mg. dissolved in 5 cc. of physiologic saline solution and injected intravenously over a period of one to three minutes. The intravenous route should be used. A subcutaneous or intramuscular injection of morphine may not be absorbed if the peripheral circulation is slow or inactive, and for this reason pain relief will not be obtained by one or by several such injections. Later, when the peripheral circulation is restored by effective "shock" therapy, if repeated subcutaneous injections of morphine have been made the total injected dose may be absorbed at once with disastrous results (1, 2). The maximum dose is 10 mg. because larger amounts do not increase the analgesia (3) and do add to the respiratory depression. If the first intravenous injection of morphine appears to be inadequate there should be a twenty minute period of rest before an additional injection is made.

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During this period of waiting, it will be realized in many instances that the residual hyperactivity is caused by something other than pain.

Restlessness is often the result of apprehension and fear which are induced by the obvious severity of the injury. Drugs which depress the cerebral cortex should be used to manage this condition. An intravenous injection of 100 to 200 mg. of nembutal usually is sufficient. The injection should be slow and only enough of the drug given to produce psychic sedation. An overdose of barbiturate can change a state of hyperactivity caused by apprehension into a more serious state of hyperactivity owing to cerebral hypoxia. As anuria or oliguria sometimes develops in severely burned individuals, the longer acting barbiturates which are eliminated by the kidney are best omitted.

The treatment of restlessness resulting from hypoxia, although usually considered last, should take precedence over all other forms of therapy. Cerebral hypoxia may be caused by a decreased circulating blood volume or it may be owing to impaired respiratory exchange. Humidified oxygen should be administred by oropharyngeal catheter, by tent or by mask to all extensively burned patients.

The treatment for the circulatory distress includes:

1. Transfusion with whole blood. One or two liters of blood should be given during the first twelve hours. The rate of administration depends upon the degree of shock.

2. Patients should not be permitted to drink ordinary tap water. Moyer (4) has clearly pointed out the fallacy of allowing ordinary drinking water which will produce water-intoxication, with its attendant symptoms of nausea, vomiting, restlessness, delirium, muscular twitchings, convulsions and so forth. In place of this, a modified Haldane's solution should be given orally in as large amounts as tolerated (3 gm. of sodium chloride and 1.5 gm. of sodium bicarbonate per liter of distilled water). (5)

The treatment for respiratory distress is determined by the immediate cause.

1. Obstructed airway: The mouth, nasopharynx, and larynx should be examined and all foreign material removed. If edema of the larynx is present or if the condition of the mouth and nose precludes the maintenance of a free airway, a tracheotomy should be done immediately. Partial obstruction during inspiration will precipitate fulminating pulmonary edema in patients such as these who already have increased capillary permeability.

2. Inadequate respiratory excursion: In the presence of respiratory depression opiates and barbiturates should be reduced or omitted. If the breathing is inadequate because of tight pressure bandages about the chest, the bandages should be loosened.

3. Pulmonary edema: One should make sure that there is no obstruction to inspiration. Oxygen should be administered under posi-

tive pressure up to 6 cm. of water. The head-up position may be beneficial by reducing thoracic venous pressure. Circulatory distress should be treated if present.

The tendency within recent years has been to simplify the local treatment of extensive burns and place greater emphasis upon measures to combat shock, dehydration, alterations in the circulating blood volume, protein and electrolyte imbalance, anemia and infection (5).

The second consideration is the management of the patient during periods of dressing changes and excision of eschars.

In 1946, the first year of our study of burns, only seven patients with extensive burns were admitted to the service. Five of these patients were children. When dressing changes, debridements or plastic procedures were scheduled, the children were heavily medicated with phenobarbital or sodium amytal at 6 a.m. On several occasions children were brought to the operating room in the late morning or early afternoon still stuporous, with obstructed breathing and in circulatory distress as evidenced by the presence of cyanosis or by a pale, washed-out appearance. In other instances barbiturates had been less intensively used so that only psychic depression was evident. These children responded to most any stimulus, whether painful or not, by outbursts of excitement and thrashing about. We administered ether with oxygen to some of the patients with depressed respiration in an effort to produce surgical anesthesia and a better respiratory exchange. To others we gave cyclopropane and assisted the breathing as indicated.

In December 1946, a death resulted from overdose with a barbiturate. At that time the entire problem of basal narcosis and anesthesia was assigned to the Department of Anesthesiology.

While studying this problem we proceeded to order "nothing by mouth after midnight" and "morphine and scopolamine as premedication one and one-half hours before the scheduled time." Anesthesia was then maintained by any of the following agents: ether, cyclopropane, sodium pentothal or nitrous oxide. It became obvious, however, that although the dressing change and debridement were of much help to the local burned area, the accumulated results of the day's experiences would often set back the general systemic improvement of the patient for several days.

In consideration of this result, the following points became evident:

1. Patients with a strong tendency to develop a state of malnutrition, protein deficiency and "chronic shock" were going without food for twenty-four hours (from 6 p.m. on the preoperative day until the evening meal of the operative day).

2. Patients in toxic conditions with tendencies toward dehydration, oliguria, alterations in circulatory blood volume and infections were going without fluids for sixteen to eighteen hours each time the dressings were changed.

3. The tendency to vomit was being increased by morphine and by some of the anesthetic drugs thus increasing chloride and water loss.

4. The ability of the cardiovascular system of the extensively burned patient to adjust to changes of position from the horizontal to the vertical was so impaired that in many instances the blood pressure became unobtainable immediately after a patient was set upright to apply dressings to the chest.

5. In the superficial blood vessels of an area of thermal injury, blood flow may be sluggish and thrombi may form. In the blood vessels of extremities held always in one position, the sluggish flow of venous blood may easily result in thrombophlebitis. Mallory and Brickley suggested the presence of multiple miliary emboli throughout the pulmonary arterial tree as the precipitating factor in the death of two extensively burned patients (6). When one considers the complications which may follow periods of thrashing about occasioned by attempts to change dressings or debride wounds without pain relieving drugs, the desirability of producing adequate pain relief for these patients is obvious.

6. Other complications have been reported for patients with burns about the head and chest (7, 8). During the first few days following such burns, there was a tendency for edema of the respiratory system to develop. Following this, a diffuse membranous bronchitis was noted which resulted in occlusive bronchial plugs. Added to this was the development of areas of atelectasis and emphysema secondary to bronchial closure (7, 8). The resultant reduction in vital capacity was evident during periods of stress.

Our reactions to these six considerations were as follows:

1. The maintenance of physiologic balance in extensively burned patients is so dependent upon the regular and frequent intake of food, electrolytes and water that there should be no interference with this routine on the days dressings are changed. The use of premedication is discouraged because of the associated period of physiologic depression.

2. The tendency to upset the electrolyte balance and the fluid volume by vomiting in response to the administration of opiates or general anesthesia discourages their use.

3. The persistence of marked vasomotor instability discourages the use of spinal anesthesia, sodium pentothal anesthesia or profound anesthesia with any of our drugs.

4. Possible pulmonary complications lead one to omit any agent that depresses respiration, irritates the respiratory tree or encroaches upon an adequate oxygen intake in the presence of a decreased vital capacity.

It was decided that in the management of all second and third degree burns, nitrous oxide analgesia should be employed for dressing changes

and debridements whenever possible and that only light premedication with very light cyclopropane or nitrous oxide-ether anesthesia be used for the early skin grafts and plastic repairs.

To produce pain relief without loss of consciousness with nitrous oxide is easy; to maintain the condition satisfactorily requires work. Fear and apprehension are probably the greatest obstacles to the successful administration of analgesia.

Usually, premedication should be omitted because it may interfere with the constant mental contact which must be maintained between the patient and the anesthetist. The patient should be mentally prepared for the procedure by understanding that he will not go to sleep; he will feel pressure and be aware of movement but will not feel pain. This assurance is not always readily accepted by some children, but they usually relax in the euphoria of the laughing gas and are much less reluctant to accept it on subsequent visits.

It is extremely important that analgesia be established before procedures which might cause pain are begun. For this reason, the patient is allowed to breathe a 4 to 6 liter per minute flow of a 75 to 25 mixture of nitrous oxide-oxygen for three minutes. A to-and-fro set-up with the tail of the bag partly open is preferred. The circle filter set-up has been abandoned because the patients complain of resistance to breathing. As soon as analgesia is well established, the patient is gently lifted from the carriage to the table. There should be no further delay of the surgical team. The dressings are removed, burned areas are scrubbed with soap and water, excision of eschars completed and the dressings reapplied within ten to ninety minutes. The patient should then be carefully lifted back onto the stretcher and the analgesia discontinued.

Throughout the period of analgesia, the anesthetist should continually talk to the patient and vary the concentration of the nitrous oxide according to the response of the patient. If the patient complains of pain, the flow of nitrous oxide should be increased at once. If the patient fails to respond to questions or if he becomes uncooperative, the oxygen content should be increased. As the period of analgesia progresses, it is usually possible to decrease the content of nitrous oxide so that frequently a 50 to 50 mixture suffices for extensive procedures.

The anesthesia records of pressure, pulse rate and respiration show surprisingly little variation during satisfactory analgesia. Instances of nausea or vomiting are seldom observed.

During the past four years, nitrous oxide analgesia has been used for dressing changes and debridements for 780 administrations. Only 10 of these were considered to be unsatisfactory.

At the present time, our patients, on return to their beds, often take liquids immediately and there is little or no interference with their regular food intake. Daily blood studies show that the fluid and

electrolyte balance is as satisfactory on the days when dressings are changed as on the other days.

When areas of the extensively burned patients are ready for grafting, analgesia is maintained until the dressings have been removed and the donor and recipient areas prepared. A three minute period of surgical rest is then maintained while the patient passes into light surgical anesthesia by the addition of a small flow of cyclopropane to the 4 liter per minute flow of the nitrous oxide-oxygen mixture. As soon as the grafts are cut, the cyclopropane is discontinued and the patient gradually returns to the state of analgesia. The grafts are laid on and dressings applied. Thus by the utilization of the technic of analgesia, the surgical procedure may have consumed from one to three hours but the period of anesthesia has been limited to ten to thirty minutes. As a rule, these patients are ready for oral fluids on return to bed. Very little physiologic depression is evident.

CONCLUSION

We have concluded that nitrous oxide analgesia should be substituted whenever possible for basal narcosis and anesthesia in the successful management of patients with extensive burns.

By the use of nitrous oxide analgesia, adequate pain relief for the changing of dressings of burns, debridement and preliminary skin grafting has been accomplished with a minimal disturbance of physiologic function.

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