

## SODIUM PENTOTHAL: ACTUAL EXPERIENCE IN THE COMBAT ZONE

FIRST LIEUT. ANTHONY T. ROSE

*Medical Corps, Army of the United States*

MILITARY surgery is confronted with a triad of factors distinguished from civilian surgery. In brief, they are, the necessity for the early recovery of the fighting man, unstable conditions under which work must be performed, and, lastly, the state of the soldier patient who frequently is suffering from exposure, malnutrition, trauma and a great degree of psychic activity. The quest for an ideal anesthetic to meet these needs under such conditions is of vital importance.

The 10th Evacuation Hospital found that intravenous anesthesia has aided materially in the solution of the general problem of anesthesia. This report is an account of our experiences.

The two agents most frequently used in intravenous anesthesia are pentothal sodium and evipal soluble. In recent years, pentothal has almost completely displaced evipal because it is more potent and less frequently attended by undesirable reactions, such as, hiccoughing, sneezing, coughing and tremors.

### PREPARATION OF THE SOLUTION

Previous work (Lundy *et al.*) indicates that the drug can be used in any strength of solution between 2.5 per cent and 5.0 per cent. It has been shown that solutions stronger than 5.0 per cent are likely to cause thrombophlebitis, while solutions weaker than 2.5 per cent seem inadequate for the maintenance of anesthesia.

Our supply provides syringes in 2 cc., 10 cc. and 30 cc. sizes. For practical purposes, the 30 cc. size is most adaptable to use with pentothal. At first, we used a 3½ per cent solution, mixing 1 Gm. of the drug in 33 cc. of solution. However, to conserve the supply of the drug, we resorted to the use of a 2 per cent solution. This was done with some misgivings that it would be difficult to maintain anesthesia with a solution weaker than usual. However, by making certain that each patient received morphine preoperatively, the weaker solution worked very well. In this way, 1 Gm. filled two syringes instead of one, as previously, and in those cases in which 0.5 Gm. or less is required, a saving of 0.5 Gm. is effected. This conservation of agent is important in the combat zone, where transportation is a problem and the waster may soon find himself short of essentials.

## TECHNIC OF ADMINISTRATION

In the average case, venipuncture is quite simple. In the case of small or collapsed veins, these are "brought out" by the application of hot towels (wrung out in boiling water) for five to fifteen minutes. If intravenous administration of fluids is in progress, the pentothal is injected into the infusion tubing at a point as close as possible to the entrance into the vein. In a few cases in which venipuncture is impossible, injection into the sternal marrow has given satisfactory results. (The question of sternal puncture is a separate matter, and a detailed description is to be found in the work of Tocantins, *et al.*)

Our practice has been to secure the arm to an "arm-board" and apply a tourniquet sufficiently tight to produce occlusion and prevent the venous return. A vein in the antecubital fossa is selected and the needle introduced. In order to keep the anesthetist's hands free for the maintenance of airway and such tasks as recording blood pressure, pulse and respiration, we have employed a simple modification of the usual technic. Instead of holding the syringe and needle in place by hand, a 6 inch length rubber tubing is fitted to the syringe and led to the needle via a glass adapter. (These articles are sterilized by autoclaving in the intravenous packet.) In this way, the needle is introduced into the vein and, because of the tubing extension, the syringe is secured to the "arm-board" alongside the arm. Thus, the injection of the solution is performed by advancing the plunger when necessary, allowing the anesthetist to be free for his other duties. This simple procedure has proved of great value when an assistant anesthetist is not available.

## SELECTION OF CASES

In our organization pentothal has been employed for practically every type of case with the exception of those presenting intra-abdominal disease. The generally accepted contraindications to pentothal anesthesia are: (1) long operative procedures; (2) those cases which require an appreciable degree of muscular relaxation; (3) patients presenting actual or potential impairment of the patency of the upper respiratory passages; (4) cases in which venipuncture is difficult or impossible; (5) individuals with coincidental disease of the liver or heart or diabetes; (6) children and the aged, and (7) chemical warfare casualties with pathologic change caused by the lung irritants.

## LENGTH OF OPERATIVE PROCEDURE

Although pentothal anesthesia is ideal for "short" cases, *i.e.*, those with a duration of thirty minutes or less and necessitating the administration of less than 1 Gm. and no more than 2 Gm. of the drug, we have employed it in cases lasting one hour, and in one instance, two hours. The latter was a case in which laminectomy was performed for the removal of a bomb fragment from the extradural space. Pentothal anesthesia was

employed (with an endotracheal tube in place) and a total of 1.5 Gm. was administered. (Morphine, 1/8 grain, was given intravenously after the administration of 1 Gm. of pentothal.)

In employing pentothal for long operations, we have taken advantage of the synergism that exists between the action of pentothal and of morphine. Morphine is given in the preanesthetic medications and also during anesthesia. If the patient has a high pentothal tolerance, a small amount of morphine, given intravenously, will prolong appreciably the duration of anesthesia.

### MUSCULAR RELAXATION

In cases in which an appreciable degree of muscular relaxation is required, pentothal alone may be found inadequate. This is true in abdominal operations, particularly in the muscular abdomen of the young male. In the cases of fracture of long bones, such as the femur, it would be expected that the large muscle groups would be troublesome because of inadequate relaxation. This has not been our finding. Fractures of the femur and humerus have been reduced under pentothal anesthesia in a very satisfactory manner. It is admitted that abdominal operations could be done with pentothal anesthesia, supplemented by regional block, spinal or inhalation methods, but this method has not been found feasible under the existing conditions.

### THE PROBLEM OF AIRWAY

Cases in which the problem of an airway may arise may be divided into three groups: (1) those in which actual or potential impairment of the airway results from operation or the surgical position; (2) cases of laryngospasm and (3) cases of emesis.

(1) Impairment of an airway caused by operation or surgical position: Impairment of an airway has long been felt to contraindicate intravenous anesthesia. Operations in and about the mouth, face and neck and in which the prone position is required are the main instances. In our work, however, this consideration has not occasioned any insurmountable difficulty. In the type of case in which any difficulty with maintenance of an airway was anticipated, the patient was anesthetized with pentothal, intubation performed with an endotracheal tube of proper caliber and the surgeon given the "go" signal. This technic has been used in operations on the chest and about the face, reduction of jaw fractures, the treatment of neck wounds and in other instances in which the surgeon required that the patient be placed in the prone position.

(2) Laryngospasm: Laryngospasm can be a serious problem and its prophylaxis and treatment must be efficient and rapid. Laryngospasm is likely to occur in intravenous anesthesia because the pharyngeal reflexes remain active. In the prevention of laryngospasm, three factors are important: *a*, restricted use of the oropharyngeal airway; *b*, the administra-

tion of atropine or scopolamine in preanesthetic medication and *c*, the maintenance of a sufficiently deep degree of anesthesia.

*a*. Use of the oropharyngeal airway: Because of the activity of the pharyngeal reflexes under intravenous anesthesia, the use of the oropharyngeal airway should be restricted as much as possible. Its indiscriminate use will result in a high percentage of cases complicated by laryngospasm. In the majority of cases, an airway can be readily maintained by simple, nonstimulating procedures such as raising the chin and anterior elevation of the mandible. When these measures fail to alleviate impairment of the airway ("snoring" caused by dropping back of the tongue), the oropharyngeal airway is employed. In using this appliance, care must be exercised in its introduction. It should be lubricated with vaseline, mineral oil or jelly and inserted slowly and gently, in a curved plane that follows the shape of the dorsum of the tongue. This procedure, when resorted to, will relieve the difficulty and still not provoke laryngospasm.

*b*. The administration of atropine or scopolamine: Laryngospasm occurring under pentothal anesthesia is believed to be based at least partially upon the parasympathomimetic action of the drug. As in other instances in which such side-actions are combated, the sympathomimetic drugs have been of great value because of their paralyzant effect upon the parasympathetic portion of the autonomic system. Either of these drugs is given in the preanesthetic medication. The usual ratio between the dosage of atropine (or scopolamine) and morphine is maintained, that is, 1 to 25 (morphine, 1/6 grain, with atropine, 1/150 grain; morphine, 1/4 grain, with atropine 1/100 grain, and so forth).

*c*. The maintenance of a sufficiently deep degree of anesthesia: It is commonly known that stimulation of various peripheral nerves may set up reflexes during operation that eventuate in laryngospasm. The afferents stimulated may be in the skin, periosteum, mesentery, eye and other widely dispersed sites. Laryngospasm occurring during the course of surgical manipulation is frequently the result of these reflexes "breaking through" because of insufficient depth of anesthesia. When this occurs, we have found that the best way to handle the problem is to cease the stimulation, *i.e.*, ask the surgeon to stop for a moment, during which time additional agent is administered to increase the depth of anesthesia to such a point that the manifestation of the reflex will be prevented. It is far better to stop the operation for a moment than to try to increase the anesthetic depth in the presence of continued stimulation. Ideally, of course, the proper depth should be reached before operation begins, by anticipating the stimulating manipulation and giving the pentothal sufficiently in advance, but this is not always possible.

3. Emesis: Emesis is an anesthetic "accident" which may be quite serious—which may, in a twinkling, convert an "easy," routine case into a fatality. Again, because of the persistence of the pharyngeal and laryngeal reflexes under pentothal anesthesia, it deserves special mention.

Emesis is best prevented by making certain that no patient comes to the operating room with food in his stomach, *i.e.*, who hasn't had anything by mouth within three hours before the scheduled time of anesthesia and operation. Obviously, while operating in the field, under wartime conditions, it isn't always possible to insist upon this rule. It has been suggested that, in such cases, the stomach be emptied by either gastric lavage or induced vomiting. These methods, in our hands, haven't been found feasible or efficacious. When a patient who may be assumed to have material in his stomach is brought in for necessary immediate operation, provisions are made for the contingency by having the head lower than the body and making certain that efficient suction is available for instantaneous use.

We have had three notable experiences with intravenous anesthesia complicated by emesis. In two elective cases, emesis occurred during the induction stage (it was later learned that the patients had been fed surreptitiously by sympathetic fellow-patients). Respiratory obstruction developed and cyanosis ensued. The vomitus was aspirated and endotracheal intubation performed, followed by the administration of oxygen. Both patients made uneventful recoveries. In the third instance, we were not so fortunate. An officer sustained lacerations of the face and scalp. Inasmuch as he was brought in at midnight, it was assumed that his stomach was empty. However, he vomited copious quantities of what smelled like beer, "hamburger" and chocolate, and, despite vigorous efforts to prevent it, he aspirated some of this material and died within thirty-six hours. Autopsy showed diffuse and extensive pneumonitis.

4. Cases in which venipuncture is difficult or impossible: Very few of our cases presented any appreciable difficulty in respect to venipuncture. In those cases in which the problem arose, we have resorted to venesection or the sternal marrow route of administration, and have obtained uniformly satisfactory results. These methods are mentioned in "Technic of Administration."

Contraindications 5, 6 and 7 are mentioned for the sake of completeness. None of these indicated conditions had been encountered, so we cannot discuss their bearing upon the problem of intravenous anesthesia in the combat zone.

Cognizance should be taken of the question of the toxic synergism that some workers believe to exist when pentothal is given to patients under sulfonamide therapy. Our cases were carefully observed for this phenomenon, but no manifestation was apparent.

#### SUMMARY

The ideal anesthetic agent has certain indubitable characteristics which are continually sought for as various drugs are introduced. The exigencies of military surgery give the quest a vital significance.

Although intravenous anesthesia is seventy years old, the recent introduction of the thiobarbiturates has placed the method on a sound basis.

Pentothal sodium is a thiobarbiturate that seems preferable to evipal soluble. Its physical and chemical characteristics are described. The preparation of the drug and its administration are relatively simple. It is readily portable, noninflammable and nonexplosive.

In the selection of cases the commonly accepted contraindications are enumerated, and in the subsequent discussion, our experiences are related. The synergism existing between the actions of morphine and pentothal is pointed out, and the value of its employment is indicated.

The factor of muscular relaxation is mentioned. It has been found that in many cases it does not loom as the contraindication it had been thought to be.

The problem of maintenance of an airway is discussed under three sub-divisions that seem logical on the basis of our experience. Methods of management are presented and the importance of endotracheal intubation and the administration of oxygen is pointed out.

Other contraindications, since they are of but theoretical importance in this study, are merely mentioned.

The question of toxic synergism between pentothal and sulfonamides is mentioned; we have not observed it in our cases.

Although the actual number of cases cannot be mentioned, it may be said that pentothal was administered in 78 per cent of cases requiring anesthesia. While these cases were predominantly wounds of the extremities, a goodly number of other types—*i.e.*, wounds about the face and neck and the extra-abdominal trunk—is included. Our results have been good in these cases, and certainly comparable to those obtained with agents which have been used longer. The method has been found to satisfy all but one of the six prime characteristics of the ideal anesthetic agent, namely universality of application.

#### CONCLUSIONS

1. An evaluation of pentothal anesthesia in war surgery is attempted. Observations are based upon actual experience in a combat zone.
2. Pentothal anesthesia was found to be satisfactory, within certain limits, for practically any type of case. Methods are presented whereby the usual contraindications have been minimized.
3. The value of certain adjuvants is assessed. The importance of the availability of oxygen and endotracheal intubation is stressed.
4. The value of morphine is indicated.
5. On the basis of our experience, pentothal anesthesia affords certain indubitable advantages and is considered a "must" in the armamentarium of the Medical Department.

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