THE INDUCTION OF ANESTHESIA FOR SUSPENSION LARYNGOSCOPY WITH COCAINE, SODIUM PENTOTHAL AND CURARE *

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PROBLEMS OF ANESTHETIZATION

The suspension laryngoscope, devised by Killian and perfected and popularized by the late Dr. R. C. Lynch (1) of New Orleans, provides a wide unobstructed view of the larynx, maintains this exposure unassisted and, most important, permits the use of both hands in the performance of surgical procedures in the larynx, such as gross examination and biopsy of lesions of the vocal cords, removal or electrocoagulation of tumors of the vocal cords, complete extirpation of early malignant lesions of the vocal cords, removal of certain foreign bodies, and surgical correction of abductor paralysis (1, 2, 3). Anesthetization of patients undergoing suspension laryngoscopy presents certain difficulties. First and foremost, the site of operation, the larynx, is the sensitive "watchdog" of the respiratory tract and its function must be greatly depressed during the procedure. The return of laryngeal and tracheal reflexes should not be delayed, however, since in their absence postoperative bleeding might prove disastrous. Second, profound muscular relaxation is necessary for suspension, particularly in the robust and thick-necked patient. As Dr. Lynch (2) stated in an early paper on suspension laryngoscopy, "Anesthesia must be carried probably deeper into the surgical stage than for any other surgical operation with which I am acquainted." Third, in suspension laryngoscopy the tongue is held in the midline and not pushed aside as with the use of the Jackson laryngoscope. In cases in which electrocoagulation or actual cauterity is to be used, inflammable agents are, of course, contraindicated. Moreover, the advantages of intratracheal intubation are obviously denied. Finally, control of the airway is taken from the anesthetist when the procedure is begun but this should never be disadvantageous, as will be shown later.

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METHODS OF ANESTHETIZATION

Many methods of anesthetization have been used for suspension laryngoscopy, all of which have their disadvantages. Topical anesthetization alone may suffice, but usually it is not as satisfactory for the suspension apparatus as for the Jackson laryngoscope because of the extreme relaxation required for the former. Relaxation may be produced by the use of curare with a topical anesthetic and this combination may or may not prove satisfactory (4, 5). General anesthetization is usually preferred for suspension laryngoscopy, and many agents have been used in an attempt to provide optimum operating conditions. Deep ether was (and still may be) the anesthetic of choice in the early years of suspension laryngoscopy, and chloroform or tribromoethanol (avertin) was used in those cases in which electrocoagulation was performed. The intravenous administration of barbiturates alone proved unsatisfactory, since the large doses required to produce relaxation and obtund the laryngeal reflexes resulted in excessive depression during the recovery period. It was soon realized that much of the burden on agents administered intravenously could be borne by preliminary, efficient, topical anesthetization, and this combination of agents gave much more satisfactory results than were obtained with barbiturates alone (6, 7, 8). The introduction of curare into the field of anesthesia provided yet another means by which more satisfactory conditions for suspension laryngoscopy could be obtained (9, 10).

A small series of 50 consecutive cases of anesthetization for suspension laryngoscopy will be discussed not for comparison of merits of any agents or techniques but in an effort to point out some of the problems encountered in providing adequate operating conditions with minimum physiologic disturbances by the use of a combination of topical anesthetization of the larynx, intravenous administration of sodium ethyl (methyl-butyl) thiobarbiturate (pentothal) and curare. Table 1 contains a summary of the pertinent data in the 50 cases.

| TABLE 1 |
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| **Summary of 50 Cases** | |
| **Average age** | 48.1 years |
| Youngest | 19 |
| Oldest | 74 |
| **Average duration of suspension** | 14.1 minutes |
| Longest | 30 |
| Shortest | 6 |
| **Average amount of pentothal** | 841 mg. |
| Greatest | 2250 |
| Smallest | 375 |
| **Average amount of d-tubocurarine** | 14.1 mg. |
| Greatest | 30 |
| Smallest | 6 |
| **Male patients** | 74 per cent |
Anesthesia for Suspension Laryngoscopy

Prevention of Laryngeal Spasm and Coughing

The prevention of laryngeal spasm is probably the most difficult problem encountered. When a state of unconsciousness is produced and a stimulus of adequate intensity is applied to the region of the throat or larynx, reflex laryngeal spasm may result. If a foreign substance is introduced into the trachea and bronchi, paroxysms of coughing, in addition to laryngeal spasm, may follow unless the plane of anesthetization is extremely deep, and coughing while the suspension apparatus is in place may be injurious to the patient. The reflex arc has both an afferent and efferent limb, and laryngeal spasm and coughing may be attacked from either or both sides. This is effected by withdrawal of the stimulus, by blockage of the sensory nerve endings, by increasing the depth of depression of the central nervous system, or by paralysis of the laryngeal and respiratory muscles. Although it has been stated that pentothal causes or predisposes to laryngeal spasm, a more plausible working hypothesis seems to be that it fails to depress the laryngeal reflexes adequately, since so often removal of a bit of mucus or slight increase in depth of anesthetization results in relief of laryngeal spasm.

In suspension laryngoscopy a certain amount of stimulation is inevitable, but the suspension apparatus can be introduced gently, the airway maintained while it is being adjusted, the suction tip used gently and not introduced farther into the trachea than necessary. If stimulation results in laryngeal spasm or coughing, it is important that the stimulus be removed immediately, the normal respiratory rhythm resumed, and adequate anesthetization obtained before further manipulation is carried out. Cooperation of the laryngoscopist and the anesthetist is of utmost importance.

The sensory nerve endings in the larynx may be blocked by infiltration of the superior laryngeal nerves, by spraying thoroughly the pharynx and vocal cords with a topical anesthetic agent, by direct application of anesthetic drugs to the piriform fossae, or by a combination of these methods. Topical anesthetization is usually sufficient. The importance of adequate topical anesthetization cannot be overemphasized and if, after suspension has been accomplished, topical anesthetization is found to be incomplete, it should be supplemented before the procedure is carried any farther. Complete topical anesthetization will result in great economy in the depth of depression of the central nervous system and muscular paralysis required.

Since topical anesthetization cannot abolish all the discomfort of suspension laryngoscopy, further depression is needed. This is accomplished by the administration of pentothal. As stated before, pentothal often fails to depress laryngeal reflexes completely, and one should not attempt to abolish laryngeal activity totally with this drug (9). The stimulation of suspension is great and one finds that larger dosages of pentothal are required for exposure of the larynx with
the suspension laryngoscope than with other instruments. This natu-
urally brings up the question of postoperative depression. As a rule
the operative procedures are short, and once suspension has been ac-
complished, little more pentothal is required. This relatively brief
period during which the drug is injected probably accounts for its
more rapid destruction than would be the case if the duration of in-
jection were longer (11). In our series of cases prolonged depression
due to pentothal has not been a problem.

Laryngeal spasm and coughing may be prevented by carrying the
patient into deep planes of anesthesia or by producing peripheral
paralysis with curare. Although curarization may provide excellent
operative conditions either alone or with a light state of unconscious-
ness, it would seem safer and more physiologic to depend on adequate
blockage of the afferent limb of the reflex arc to obtund laryngeal ac-
tivity and use curare only to provide the additional relaxation of the
muscles of the jaw and neck which is essential to good suspension.

Coughing presents a difficulty which has not been completely solved.
It always indicates that sensory blockage is incomplete, but not neces-
sarily inadequate. Coughing when the larynx is lightly stimulated
indicates the need for additional topical or intravenous anesthetiza-
tion, but the coughing caused by blood running down into the trachea
or by the suction tip introduced to withdraw the blood is another mat-
ter. Although coughing while the suspension apparatus is in place
is undesirable, it would seem wiser to tolerate some coughing or, better
still, prevent blood from entering the trachea than to try to abolish
completely the cough reflex in the trachea and bronchi (9).

Technic of Anesthetization

There is nothing new or particularly complicated about the conduct
of anesthetization for this procedure, but there are several points
which deserve emphasis.

Premedication.—The value and importance of adequate prelimi-
nary medication with a depressant drug and a parasympatholytic
agent (atropine or scopolamine) before pentothal narcosis has been
well established. Any balanced combination of agents may be used
according to established principles of premedication. It is most im-
portant that overdosage of depressant drugs be avoided, but it would
also seem worth while to supplement an obviously inadequate dose
by an additional intravenous injection.

Topical Anesthetization.—As previously mentioned, this may be
accomplished in a number of ways or with any of several agents. More
important than technic or agent is that adequate time be given and
the agent be accurately placed so that the patient notices a definite
change in the throat and experiences difficulty in initiating the act of
swallowing. Haphazard spraying or gargling or inaccurate place-
ment of pledgets accomplishes little. It is our impression that direct application of the anesthetic agent to the piriform fossae and vocal cords has given the best results. A 10 per cent solution of cocaine hydrochloride was used in our cases.

Induction and Suspension.—The patient is placed on the operating table and prepared as for any general anesthetization. A gas machine for artificial respiration is at hand and ready to use, as is a supply of oxygen for oral or nasal insufflation. An intravenous infusion is started, with a three-way stopcock interposed for the administration of pentothal. Curare is injected into the tubing. Any apparatus which permits intravenous administration of these two drugs without mixing is satisfactory. Adequate supplies of these agents are on hand and ready for injection. Pillows are removed from the patient's head, and in heavy, short-necked individuals it has been found advantageous to place a sandbag under the mattress beneath the patient's shoulders. The suspension apparatus is checked before anesthesia is induced, or one may find a deeply anesthetized patient on his hands while a nurse goes to the supply cabinet. Anesthesia is then induced to the point of unconsciousness with a solution of pentothal of convenient strength. As soon as consciousness is lost, a dose of curare is injected which, it is estimated, will produce relaxation of the muscles of the jaw. Usually from 6 to 12 mg. of d-tubocurarine is given, depending on the size of the patient. It is obviously better to add to a dose which is too small than to combat the effects of overdosage. The teeth are protected with a lead plate, and the introduction of the laryngoscope is begun, gently and slowly. This usually results in some sign of lightening of the anesthetic effect of the pentothal and additional quantities of this agent are injected as the suspension apparatus is gently put into place. Respiration during this phase should be smooth and uninterrupted, and if laryngeal spasm or coughing occurs, the procedure should be halted until a deeper plane of anesthetization is reached. If muscular relaxation is inadequate, additional curare is added. Since the laryngoscopist is at the head of the table, the anesthetist may use the tone of the abdominal muscles as an index of the effect of the curare. The closest cooperation of the anesthetist and the laryngoscopist is necessary for the smooth conduct of the suspension. A few moments are then allowed for the patient to become adjusted. At this time additional amounts of a topical anesthetic agent may be applied directly to the vocal cords, and insufflation of oxygen is started. In many cases insufflation of oxygen may not be necessary for adequate oxygenation, but there can certainly be no objection to its use. Nitrous oxide-oxygen insufflation may be used, as recommended by Adams (9, 10), but this has not been done in our series of cases. Nitrous oxide-oxygen by semiclosed technic has been used with pentothal and curare in patients who have a tracheotomy, and seems to be worth while in re-
ducing pentothal consumption. These cases are not included in the present series.

Maintenance.—Once the suspension laryngoscope is in proper position, only small additional doses of pentothal or curare are usually necessary to maintain good operating conditions. It should be remembered that one of the shortcomings of the Lynch suspension laryngoscope is that occasionally it does not provide good exposure of the anterior commissure of the larynx in spite of adequate relaxation, and overdosages of curare have been given in a futile attempt to provide this exposure. This is obviously more likely to occur in the short, thick-necked individual and in these cases a sandbag is placed under the shoulders and a Jackson laryngoscope is kept available for use if exposure under suspension is inadequate.

As previously stated, laryngeal spasm and coughing may be encountered during this period, particularly when the sensitive trachea is stimulated by the suction tip. Usually the patient immediately readjusts himself following withdrawal of the stimulus, the larynx opens again, and smooth respiration is resumed. It is still believed that it is better to tolerate this minor inconvenience than to risk further anesthetization of the trachea, either topically or by further central depression (9).

After the procedure has been completed, which usually requires about fourteen minutes, hemostasis is secured by electrocoagulation or direct application of epinephrine or tincture of benzoin. The patient is usually beginning to respond to stimuli at this time, and rarely is further anesthetization necessary to secure hemostasis.

Recovery.—The suspension apparatus is removed or, if the patient is too depressed, it may be relaxed and left in place until further functions return. Pharyngeal or nasal airways are left in place if needed. Many of these patients have been able to talk within a few minutes, and some have voluntarily moved themselves into bed in the recovery room. None has been permitted to leave the operating room until he has shown some response to stimulation and is obviously well oxygenated on room air. All these patients are returned to the postoperative recovery room, where they are under constant nursing care, with suction and oxygen supply immediately at hand. Although no comparative statistics are available, it is the impression of the nurses and anesthetists that these patients have recovered more rapidly and with less discomfort than those in whom ether was used. Suspension has been accomplished by both methods in several patients, all of whom have expressed preference of this method to etherization.

Complications

In the present series, there have been several complications, most of which have arisen from the fact that several different agents of different pharmacologic properties were used in an attempt to pro-
vide a certain operating condition. Either one or more of the drugs has been inadequate or has been given in overdosage because of failure to evaluate properly the effects which the different drugs had already produced. As is often the case when a drug fails to produce a desired effect or produces some undesirable result, these complications may have been the result not of the use of a particular agent, but of its misuse. Obviously, use of this combination of drugs should not be attempted by anyone unfamiliar with their actions and side effects (9), and it is, of course, absolutely necessary to have at hand adequate resuscitative measures.

The following cases illustrate some of the complications encountered in our series.

Case 1. A man, aged 74 years, was given 10 mg. (1/6 grain) of morphine as premedication and received 750 mg. of pentothal and 9 mg. of d-tubocurarine for suspension lasting twelve minutes. Postoperatively there was prompt return of reflexes, and he soon responded to spoken commands, but slept an unusually long time.

Comment.—This patient showed the slowing of respiration and pinpoint pupils characteristic of overdosage of morphine.

Case 2. A man, aged 58 years, received 800 mg. of pentothal and 12 mg. of d-tubocurarine. He encountered considerable difficulty with laryngeal spasm. A small bronchoscope was introduced which served as an airway during the suspension.

Case 3. A well-developed and obese man, was given 1250 mg. of pentothal and 24 mg. of d-tubocurarine. Laryngeal spasm added to the difficulty of the procedure. In addition, visualization of the anterior commissure was inadequate, and a Jackson laryngoscope had to be employed.

Comment.—In Cases 2 and 3 there was little change in laryngeal sensation following cocaineization, and it is believed that the difficulties encountered were the result in part of inadequate topical anesthetization.

Case 4. A man, aged 56 years, 5 feet 6 inches tall, and weighing 223 pounds, was given 21 mg. of d-tubocurarine in an attempt to provide relaxation for suspension. This was not obtained in spite of almost complete muscular paralysis and laryngoscopy was performed with a Jackson laryngoscope. Postoperatively, he was slightly cyanotic on room air because of inadequacy of muscular effort, and was given oxygen for fifteen minutes. Recovery was not otherwise unduly delayed.

Comment.—Cases 3 and 4 illustrate not only the inadequacy of the suspension instrument for visualization of the larynx in certain individuals but also the danger of providing more than adequate relaxation with curare.

Case 5. A small edentulous man had intubation postoperatively because his tongue persistently obstructed respiration. About twenty minutes after completion of the procedure he withdrew the endotracheal tube himself and experienced no further difficulty.

There have been no complications of significance other than those just cited. At no time has the use of any analeptic drug to overcome the effect either of pentothal or curare been deemed advisable. No signs of reaction to cocaine have been noticed.
Most of the patients in this series exhibited a rise in systolic and diastolic blood pressures and in pulse rate almost immediately after the procedure was begun. These values tend to return to normal promptly, however, unless difficulty is encountered with coughing or laryngeal spasm, when they may remain elevated until completion of the procedure. It is thought that this initial elevation of blood pressure and pulse rate is due to stimulation under light anesthesia, since it takes place almost immediately and in the absence of other signs of hypoxia or carbon dioxide excess. Bradycardia has occasionally been noted accompanying coughing. No other arrhythmias have been observed by palpation of the pulse, although we have looked for them.

Postoperative difficulty owing to laryngeal spasm or bleeding has not occurred in our series. There have been no deaths during the hospital stay of these patients.

Summary

The provision of good general anesthetization for suspension laryngoscopy requires almost complete depression of laryngeal activity and profound muscular relaxation usually over a short period of time. In certain cases employment of the electrosurgical unit prohibits the use of inflammable anesthetic agents. The occurrence of laryngeal spasm and coughing adds greatly to the difficulty and danger of suspension laryngoscopy.

A method of anesthetization employing a combination of cocaine, pentothal and curare is described. Adequate preliminary topical cocaineization is important to reduce sensory stimulation. The intravenous administration of pentothal provides additional sensory depression and the addition of curare intravenously insures muscular relaxation. Reflex laryngeal spasm and coughing arising from tracheal stimulation are not prevented by this method but may be minimized by careful aspiration and prevention of the entrance of blood into the trachea. Results of anesthetization by this method in a series of 50 consecutive patients have usually been satisfactory.

Since the method, however, possesses the potential dangers of persistent laryngeal spasm and overdosage of pentothal or curare, given in a vain attempt to provide adequate exposure, it should be employed only by those who are familiar with the drugs used and have available adequate resuscitative measures.

References

NEW ENGLAND SOCIETY OF ANESTHESIOLOGISTS

The next regular meeting of the New England Society of Anesthesiology will be held on Tuesday, March 14, 1950, at 7:30 P.M. in the Amphitheatre, Building A, Boston University Medical School, 80 East Concord Street, Boston, Massachusetts.

SCIENTIFIC SESSION

The speaker and subject of the Scientific Session will be: "Fluid Therapy in Surgical Patients," by Doctor Donald E. Brown, Beverly Hospital, Beverly, Massachusetts.

Francis J. Audin, M.D.,
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