

ENDOTRACHEAL INTUBATION: EFFECTS ON BLOOD PRESSURE AND PULSE RATE

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KING and associates¹ found a marked, although transient, rise in blood pressure during endotracheal intubation. These authors demonstrated that the elevation in blood pressure occurring during laryngoscopy and tracheal intubation could be minimized by increasing the depth of anesthesia. They did not study the effects of succinylcholine as an aid to intubation. The purpose of this investigation was to observe further the nature of the change in blood pressure during endotracheal intubation, the influence of succinylcholine upon this response and the effect of regional and topical anesthesia on the rise in pressure.

METHODS

Twenty-five patients over 21 years of age were studied during a total of thirty-four tracheal intubations. The tracheas of one group were intubated with surface anesthesia of the pharynx, larynx and trachea. In another group tracheal intubation was with the aid of succinylcholine and in a third group a combination of both techniques was used. All patients were given small amounts of thiopental.

The usual dose of premedicant drugs was 75 mg. of secobarbital, 75 mg. of meperidine and 0.5 mg. of scopolamine intramuscularly approximately 1½ hours before the study. The purpose of premedication was to allay apprehension but maintain cooperation. The last 6 patients studied did not receive belladonna drugs.

A no. 18 Courmand needle was inserted through the skin into the brachial or radial artery with the aid of infiltration anesthesia. Blood pressure changes were recorded with a Sanborn Twin Viso direct writing electrocardiograph with a carrier amplifier and a

variable resistor transducer. Calibration was performed at the beginning and end of each study with the same aneroid sphygmometer used throughout the investigation. The base line was returned to zero frequently during each study. Physiological saline was allowed to drip through the needle when recordings were not being made. The lumen of the needle was cleared with a stylet before every recording or if any indication of damping occurred. The mean blood pressure was computed by adding one-third of the pulse pressure to the diastolic pressure.

All patients were given 100 per cent oxygen by mask throughout the study at a five liter flow with the soda lime absorber in the circuit. The oxygen was administered for 3-5 minutes before any relaxant was given or tracheal intubation attempted to achieve denitrogenation and full oxygen saturation.^{2,3} Respiration was assisted or controlled as needed when there was suggestion of respiratory depression.

All patients received 2.5 per cent thiopental to allay apprehension, produce amnesia, or obtund the eyelash reflex depending on the need of the study. The usual dose was 150-200 mg. of thiopental. When tracheal intubation was accomplished with the aid of succinylcholine, sufficient thiopental was given to obtund the eyelash reflex prior to injection of the relaxant. When tracheal intubation was with surface anesthesia only, usually enough thiopental was given to obtund the eyelash reflex. Occasionally it was necessary to give enough thiopental to keep the patient from moving his head. Anesthesia was thought to be very light in all instances.

Some patients tracheas were intubated two or more times. When succinylcholine was given for relaxation, the respiratory effects were allowed to wear off before another dose was given. Adequate spontaneous respiration as demonstrated by strong upper intercostal action was taken as a sign of loss of relaxant effect.

Regional and topical anesthesia of the upper

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TABLE 1
AVERAGE CHANGE OF MEAN BLOOD PRESSURE AND PULSE RATE IN THE THREE CATEGORIES STUDIED

Aid to Intubation	Succinylcholine Chloride		Laryngoscopy		Intubation	
	Change of Mean B.P.	Pulse Change	Change of Mean B.P.	Pulse Change	Change of Mean B.P.	Pulse Change
Succinylcholine chloride 12 Patients 13 Intubations	+24	+9	+45	+11	+11	+6
	+2 to +50	-8 to +30	+16 to +82	-20 to +16	-1 to +26	-16 to +40
Succinylcholine chloride and surface anesthesia 9 Patients 10 Intubations	+19	+6	+22	+1	+10	+5
	+6 to +44	-6 to +27	+4 to +50	-8 to +16	-4 to +25	-3 to +28
Surface anesthesia 10 Patients 11 Intubations			+16	+6	+13	+6
			+3 to +42	-5 to +20	-1 to +63	-4 to +18

respiratory tract was effected with a combination of transcricoid membrane injection of 3 ml. of 2 per cent lidocaine or 2 ml. of 4 per cent cocaine, bilateral superior laryngeal nerve block with 5 ml. of 2 per cent lidocaine,⁴ and spray of the pharynx, larynx and trachea with 2 per cent lidocaine or 1 per cent tetracaine. Surface anesthesia was considered clinically adequate when laryngoscopy could be accomplished without change in the pattern of respiration.

Four patients were made apneic with succinylcholine, hyperventilated with 100 per cent oxygen for approximately one minute, and then

allowed to remain apneic for 2-2½ minutes during which time no instrumentation was performed. Arterial blood samples were taken from two patients for arterial P_{aO_2} levels before and after the apnea.

Laryngoscopy was performed in all cases with a no. 3 MacIntosh laryngoscope. The laryngoscope was held in place with the larynx exposed for one-half minute to two minutes. Tracheal intubation was accomplished with a cuffed Sanders endotracheal tube with a nylon stylet. The tubes were small enough to require inflation to the cuff to prevent a gas leak. The cuff was not inflated during the

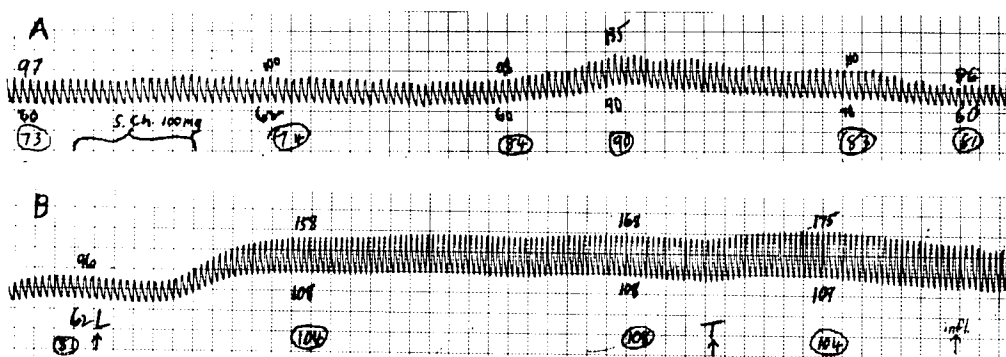


FIG. 1. *Tracheal Intubation with Succinylcholine.* 63 year old normotensive, calm, male. Three minutes of oxygen; 200 mg. of thiopental as a single dose; assisted and controlled respiration. Record A is the intra-arterial pressure tracing during and after 100 mg. of succinylcholine. Circled numbers are pulse rates and uncircled are systolic and diastolic pressures. Heavy vertical lines are two seconds apart. Record B is a continuation of A. L was laryngoscopy and T was intubation.

study. The patient was respired as soon after tracheal intubation as possible.

RESULTS

Tracheal Intubation with Succinylcholine Chloride. The blood pressure rose in all cases after the administration of succinylcholine. The elevation in pressure persisted for no more than 1-2 minutes. The pulse slowed in some instances but there was usually an increase in pulse rate (table 1).

The blood pressure rose in all cases of laryngoscopy after succinylcholine (table 1). Following tracheal intubation with succinylcholine, the blood pressure fell occasionally but usually rose. The pulse change after laryngoscopy and tracheal intubation in patients receiving succinylcholine usually showed an average increase in rate although the rate slowed sometimes.

Figure 1 shows the rise in blood pressure and tachycardia which constantly occurred after the administration of succinylcholine. It also demonstrates a further rise of blood pressure and tachycardia during laryngoscopy and tracheal intubation. The mean blood pressure rise following the injection of succinylcholine was 33 mm. of mercury and the pulse rose 17 beats per minute. During laryngoscopy and tracheal intubation, the highest rise of

mean blood pressure was 58 mm. of mercury and of pulse rate, 23 beats per minute. The blood pressure had returned to the pre-relaxant level when laryngoscopy and intubation were begun.

Intubation with Surface Anesthesia. The blood pressure rose in all cases during laryngoscopy after surface anesthesia (table 1). The rise was significantly lower ($P < 0.01$) in the group receiving surface anesthesia and thiopental as compared to the group receiving succinylcholine and thiopental as aids to laryngoscopy. Occasionally there was a fall in blood pressure during tracheal intubation after surface anesthesia was produced, even though the average change was hypertension. The pulse rate during laryngoscopy and tracheal intubation usually rose.

Laryngoscopy and tracheal intubation after surface anesthesia produced a lesser change in arterial pressure than a painful somatic stimulus (fig. 2). The average rise in mean blood pressure was 20 mm. of mercury during laryngoscopy and tracheal intubation. Three minutes later pressure behind the ear produced a mean blood pressure rise of 30 mm. of mercury.

Apnea. The blood pressure rose gradually in three of the four patients made apneic with succinylcholine but did not rise in one (figure 3). The arterial P_{CO_2} level in patient 22 was

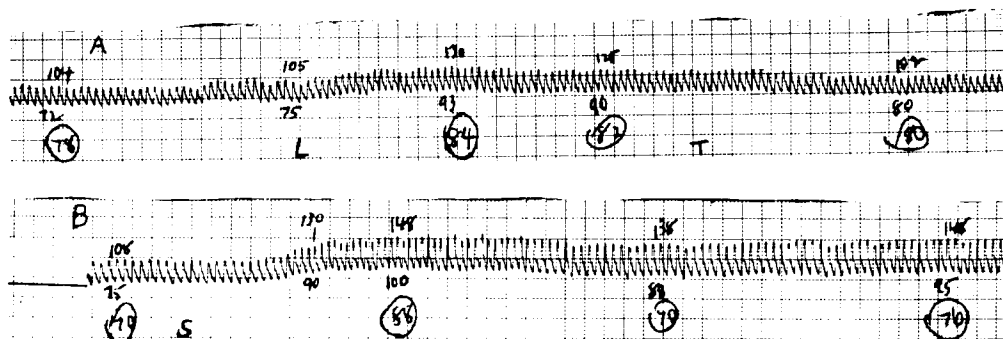


FIG. 2. *Tracheal Intubation with Surface Anesthesia.* 29 year old normotensive, apprehensive, female. During one hour she received 900 mg. of thiopental while surface anesthesia was accomplished. She had a bilateral superior laryngeal block with 5 ml. of 2 per cent lidocaine and a topical spray of 4 ml. of 1 per cent tetracaine. These were not completely satisfactory so 10 ml. of 2 per cent lidocaine were sprayed on the tongue, pharynx, epiglottis, vocal cords and trachea. Oxygen was administered throughout. Spontaneous respiration was present including the period of laryngoscopy and intubation. In record A, L was laryngoscopy and T was intubation. Record B was taken three minutes after A. S indicates strong pressure behind the ear, anterior to the mastoid process.

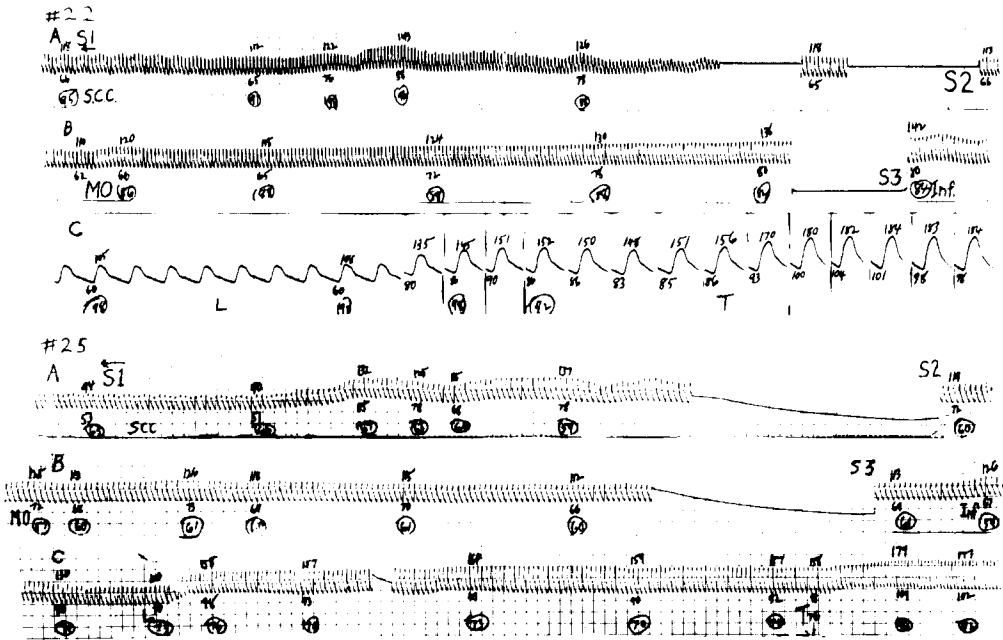


FIG. 3. Apnea: No. 22: Hypertensive 73 year old alert male was given 150 mg. thiopental and 80 mg. succinylcholine. Hyperventilation was performed with oxygen. In record B, apnea started at MO and continued until the mark Inf. Record C was taken during a subsequent injection of succinylcholine with laryngoscopy and intubation. The heavy vertical lines are 0.2 seconds apart. The interrupted segments were taken from the record at 7-second intervals.

No. 25: Normotensive 44 year old alert female was given 225 mg. thiopental and 100 mg. succinylcholine. She was hyperventilated with oxygen. In record B, apnea began at MO and lasted until the mark Inf. Record C was taken at a subsequent injection of succinylcholine with laryngoscopy and intubation.

35 mm. of mercury before succinylcholine, 28 mm. of mercury after relaxation and hyperventilation and 50 mm. of mercury after 2½ minutes of apnea. The mean blood pressure rise during apnea was 23 mm. of mercury. Fifteen

minutes later the patient was given 250 mg. of thiopental, 80 mg. of succinylcholine, laryngoscoped and his trachea intubated. The maximum rise of mean blood pressure during all these maneuvers was 58 mm. of mercury.

TABLE 2
AVERAGE CHANGE OF MEAN BLOOD PRESSURE AND PULSE RATE
SHOWING NO EFFECT OF BELLADONNA DRUGS

Premedication	Succinylcholine Chloride		Intubation		Laryngoscopy	
	Change of Mean B.P.	Pulse Change	Change of Mean B.P.	Pulse Change	Change of Mean B.P.	Pulse Change
With belladonna drug 18 Patients	+22	+5	+27	+8	+11	+5
22 Intubations	+2 to +43	-8 to +30	+3 to +82	-10 to +46	-1 to +63	-16 to +28
Without belladonna drug 6 Patients	+21	+10	+32	+5	+10	+6
12 Intubations	+5 to +50	-1 to +27	+6 to +67	-20 to +20	-1 to +26	-1 to +10

The patient was apneic a shorter period of time during tracheal intubation than during the apnea when no manipulation occurred.

The arterial P_{CO_2} in patient 25 was 34 mm. of mercury before succinylcholine, 22 mm. of mercury after the relaxant and hyperventilation, and 42 mm. of mercury after 2½ minutes of apnea. The mean blood pressure fell 6 mm. of mercury during apnea. Eleven minutes later she was given 225 mg. of thiopental, 100 mg. of succinylcholine and her trachea intubated. The time span of relaxant and apnea were the same as relaxant and tracheal intubation. The maximum rise of mean blood pressure including tracheal intubation was 55 mm. of mercury.

Belladonna Drug. There was no significant change in blood pressure or pulse rate during the administration of succinylcholine, laryngoscopy or tracheal intubation when the group receiving either atropine or scopolamine in doses of 0.4 to 0.6 mg. was compared to the group that did not receive either drug (table 2).

DISCUSSION

The blood pressure rise which occurred following succinylcholine was a transient one. Usually, within one minute, the pressure was back to normal. The rise of pressure and the tachycardia which resulted from laryngoscopy and tracheal intubation also was transient. The hypertension and tachycardia returned to near control levels within four minutes after tracheal intubation in all patients studied.

King *et al.*¹ did not find an elevation in blood pressure during apnea. Their patients were more deeply anesthetized than those reported here. It is possible that an increase of carbon dioxide tension during apnea contributed to the rise in blood pressure found in this study. The sudden change occurring at the moment of instrumentation suggests, however, that mechanical stimulation was probably the major factor.

Little reaction was noticed when the laryngoscope was introduced into the mouths of the patients who had been prepared with surface anesthesia. Touching the mucosa did not appear to cause discomfort. However, patients frequently moved heads, hands or

feet when pressure was put on the epiglottis and base of the tongue. The patients differed in the amount of response to this soft tissue stimulus. Those who were better sedated from their premedication drugs moved least and also exhibited less variation in their blood pressure and pulse. The patient whose record is presented in figure 2 had a rise of blood pressure when the laryngoscope pressed into the soft tissues but no response when the endotracheal tube was inserted.

No greater incidence of bradycardia was found in those patients who failed to receive a belladonna drug. One such patient had a fall of pulse rate of 10 beats per minute on laryngoscopy but an immediate rise of 16 beats per minute on tracheal intubation (fig. 3, no. 22, record C). However, patients who did not receive belladonna drugs had copious secretions. They had to have tracheal aspiration frequently.

SUMMARY

The blood pressure and pulse response of 25 adult patients to laryngoscopy and tracheal intubation were studied during light thiopental anesthesia. The following phenomena were observed.

Succinylcholine produced a transient rise in the blood pressure. The pulse rate sometimes slowed but usually became more rapid.

Laryngoscopy and tracheal intubation during relaxation produced by succinylcholine caused an elevation in blood pressure; frequently a marked rise. Occasionally, the pulse rate slowed but usually there was an increase in rate.

Laryngoscopy and tracheal intubation with surface anesthesia only, produced a definite rise in blood pressure but it was significantly smaller than with tracheal intubation aided by succinylcholine alone. Pressure of the laryngoscope on the deep soft tissues of the throat probably contributed to the elevation in blood pressure when surface anesthesia was used alone for tracheal intubation.

A belladonna drug did not decrease the incidence or degree of bradycardia during laryngoscopy and tracheal intubation.

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PROCHLORPERAZINE REACTIONS

Eight patients, while receiving small daily doses of prochlorperazine, developed extrapyramidal-type motility disturbances. These reactions consisted of spasms of the masseter muscles; protrusion, loss of control, numbness, and athetoid movements of the tongue; tonic contractions of the sternocleidomastoid and trapezius muscles; gross tremors; oculogyric crises; tonic spasms of the back muscles with opisthotonos; and a mask-like facies. These disturbances were not the result of overdosage but were the regular effect of such compounds on the subcortical motor system in certain susceptible individuals. Appropriate therapy for patients exhibiting such reactions includes: (1) discontinuance of the use of prochlorperazine and all phenothiazine derivatives; (2) patient reassurance; (3) for mild reactions, small doses of phenobarbital; for severe reactions, 0.25 Gm. amobarbital sodium (Amytal) given slowly intravenously. The duration of these reactions varied from 30 minutes to 48 hours. No permanent after-effects developed. (*Scime, I. A., and Tallant, E. J.: Tetanus-Like Reactions to Prochlorperazine (Compazine), J. A. M. A. 171: 1813 (Nov. 28) 1959.*)

SUCCINYLCHOLINE ALLERGY In a patient who received several drugs during the course of induction of anesthesia, an unusually severe allergic reaction occurred, with skin manifestations and circulatory collapse due to histamine release. This patient was later proved to be specifically allergic to succinylcholine (Anectine) chloride. Although intracutaneous tests to the drug were negative, intravenous administration successfully identi-

fied the offending agent. (*Kepes, E. R., and Haimovici, H.: Allergic Reaction to Succinylcholine, J. A. M. A. 171: 548 (Oct. 3) 1959.*)

VASCULIT Vasculit is the butyl derivative of the para-oxy-homologue of phenylephrine. When given intra-arterially it produces vasodilatation for the duration of the infusion. The effect is not abolished by epinephrine or norepinephrine. (*Duff, R. J.: Peripheral Effects of Vasculit, Brit. M. J. 1: 1007 (April 18) 1959.*)

DRUG REACTIONS The value of skin testing for drugs is doubtful. For prevention of allergic reactions from local anesthetics, a preliminary small amount should be administered before giving the total dose; 0.05 cc. of a local anesthetic may be injected intradermally into the oral mucosa as a test. If such a small dose elicits a constitutional reaction, it will be less severe than one from a full dose. (*Waldbott, G. L.: "Constitutional" Allergic Reactions and Their Prevention, J. A. M. A. 171: 1172 (Oct. 31) 1959.*)

ATROPINE The statement that children with mongolism are hypersensitive to atropine has been investigated. A drop of 1 per cent atropine was instilled in the right eye of 19 mongols and 20 similarly retarded children without mongolism. The mongols tended to react more quickly and the reaction was sustained longer. The difference was statistically significant. (*Berg, J. M., Brandon, M. W. G., and Kirman, B. II.: Atropine in Mongolism, Lancet 2: 441 (Sept. 26) 1959.*)