

# PROCEEDINGS

OF THE

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### ANNUAL REPORT FOR 1934 OF THE SECTION ON ANESTHESIA: INCLUDING DATA ON BLOOD TRANSFUSION\*

J. S. Lundy, M. D., and R. M. Tovell, M. D., Section on Anesthesia: This is the tenth annual statistical report of the Section on Anesthesia, and it includes a report on blood transfusion which is supervised by the members of this section.

In the annual report for 1933, a table was presented (table 1, 1933 report<sup>1</sup>) which gave the relative frequency of the use of special anesthetic agents and methods as compared to the use of the ordinary ones, for a period of ten years. For purposes of clarity this table is again published with the addition of data for 1934, and with a change in the figures for 1932 and 1933 which were misleading because of a misunderstanding about the inclusion of the cases in which local block or infiltration was carried out by the surgeon or his assistants and not by the staff of the Section on Anesthesia. All of the omissions were from the fields of dental, eye, ear, nose and throat work, together with a few miscellaneous cases. We intended that these cases be included and table 1 in this report gives the figures corrected on that basis. The Section on Medical Statistics of the Clinic has largely completed its new set-up and specific detailed studies of the data on anesthesia are in progress.

In line 1 of table 1, special agents and methods indicate not only the selection of a special agent and method but also a special administrator. The percentages for the use of special agents and methods of anesthesia refer to the use of the agents and methods shown in tables 2, 4 and 5. By ordinary methods are meant those, such as infiltration for local anesthesia, performed by the surgeon or his assistants, or the use of ethyl ether, nitrous oxide, or ethylene when given by the ordinary method of inhalation. This

\*Presented at the meeting of the General Staff, April 10, 1935.

1. Lundy, J. S. and Tovell, R. M.: Annual report of the Section on Anesthesia and blood transfusion of The Mayo Clinic; including data on the use of anesthetic agents and methods from 1924 to 1933 inclusive. Proc. Staff Meet. Mayo Clinic, 9:221-240 (Apr. 18) 1934.

group (table 1, line 2) consists of the cases in which special anesthetic agents or methods (table 1, line 1) were not used. It is interesting to note the uniformity of these figures in the last five years. It might be said that about a third of the operations ordinarily done in institutional practice may well require special attention because of the modern anesthetic agents, methods, and aids that are available. Because of the uniformity in the

Table 1  
Comparison of use of special and of ordinary agents, per cent

	1934	1933	1932	1931	1930	1929	1928	1927	1926	1925	1924
1. Special agents and methods	35.2	30.9	30.1	31.6	28.9	19.4	14.6	12.9	16.3	15.9	7.9
2. Ordinary agents and methods	64.8	69.1	69.9	68.4	71.1	80.6	85.4	87.1	83.7	84.1	92.1

last five years in the frequency with which special and ordinary agents and methods have been used, further marked changes in both groups probably will depend on the introduction of new and still more valuable anesthetic agents. The work of the physician anesthetists in the field of special anesthesia only is summarized in table 2, and by the curve in figure 1. As is evident, the peak load occurs in the forenoon and reaches its maximum

Table 2  
Special agents and methods, per cent

	1934	1933	1932	1931	1930	1929
1. Regional block	79.9	81.1	80.8	86.7	88.8	79.1
2. Oil-ether colonic	0.1					0.2
3. Acetylene					0.2	1.0
4. Tribromethyl alcohol and barbiturates					0.03	0.09
5. Barbiturates (by rectum)				0.01	0.4	0.4
6. Barbiturates (intravenously)	2.6	0.3	0.6	1.4	8.9	15.2
7. Tribromethyl alcohol	0.2	1.3	2.2	0.7	0.8	0.3
8. Intratracheal anesthesia	14.8	16.2	15.5	10.4	5.2	2.9
9. Intraparyngeal anesthesia	0.3	0.2	0.6	0.5	0.7	0.3
10. Cyclopropane	1.7	0.3				
11. Divinyl ether		0.1				

about the middle of the morning, at which time anesthetics were administered in about 21 per cent of the cases in which special agents and methods were employed. Time curves for ordinary methods of anesthesia and blood transfusion, and so forth, are not available.

Our most definite impressions in reviewing the data for the year are concerned with: (1) the value of the new barbiturates which produce transient anesthesia for minor surgical procedures of short duration, (2) the usefulness of cyclopropane, (3) the increased usefulness of sacral block anesthesia when the amount of solution injected into the caudal canal is increased, (4) the relative safety of spinal anesthesia when its contrain-

dications are recognized, (5) the increased use of Magill's intratracheal method of anesthesia, and (6) the use of the indirect method of blood transfusion.

#### BARBITURATES

The newest agents in anesthesia from more than one point of view are the new derivatives of barbituric acid which are given intravenously and which produce anesthesia of very short duration for minor operations of short duration. In the past there were two types of barbiturates; one that produced prolonged anesthesia, and the other, sustained anesthesia. The agents which produced a prolonged effect were those reported on before 1932, such as barbital (diethyl barbiturate; veronal), phenobarbital

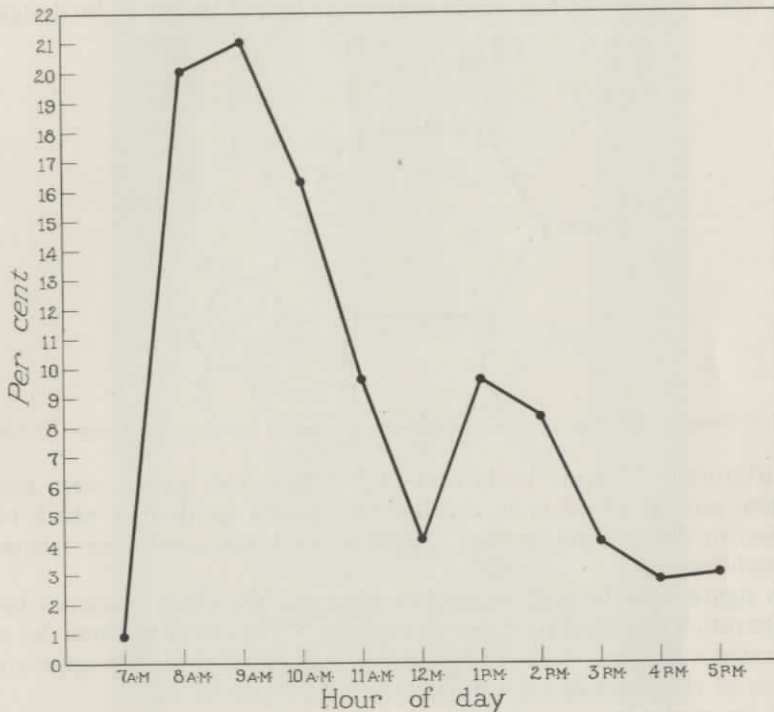


Fig. 1. Percentage of cases in the field of special anesthesia only in which physician anesthetists administered the anesthetic (table 2).

(phenylethyl barbiturate introduced as luminal), and sodium amytal (sodium iso-amylethyl barbiturate). Pentobarbital sodium (sodium ethyl 1-methyl butyl barbiturate, introduced as nembutal), a barbiturate producing an effect of relatively short duration, fell into a different class. For purposes of convenience, we think of three class of barbiturates at this time, (1) those which produce transient effect, (2) those which produce sustained effect, and (3) those which produce a prolonged effect. The duration of anesthesia produced by these agents is a relative matter.

*New derivatives: The sodium salt of n-methyl-cyclohexenyl methylmalonyl-urea (evipal soluble) and others.*—The new barbiturates are different from the old ones in chemical structure; radicals have been substituted

on the urea side of the barbituric acid nucleus as well as on the malonic acid side whereas, in the older agents, the urea side carried no substitute radicals. This more complicated chemical structure makes possible a greatly increased number of barbiturates. Several have been developed and one of them is already available commercially. Following its occasional intravenous use and its use in a considerable number of cases orally as a medicament preliminary to regional anesthesia, in the first six months of 1934, evipal soluble (fig. 2) which was the first of the barbiturates to produce transient anesthesia, was used for certain operations of short duration, principally in the field of ophthalmic surgery. This report is necessarily merely preliminary because it includes only cases of 1934.

Two barbiturates with sulphur radicals which produce transient anesthesia were used in the last six months of 1934 and they will be designated

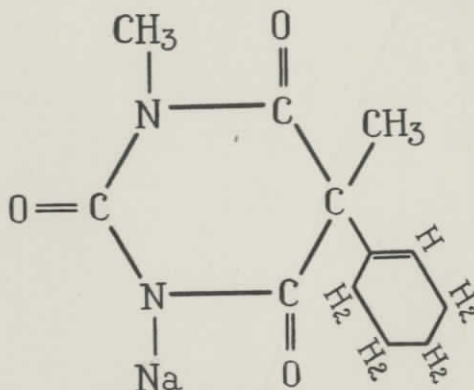


Fig. 2. Chemical structure of n-methyl-cyclohexenyl methyl malonyl-urea (evipal soluble). (Fig. 3 for dose).

as "barbiturate A" and "barbiturate B."<sup>2</sup> These two agents were used in the same number of cases in the last six months as that in which evipal was used in the first six months. Barbiturate A was used more frequently than barbiturate B.

In figure 3 we have attempted to illustrate the effect produced by the administration of evipal by different technics. The curve to show the effect of repeated safe doses needs to be further elaborated to fix the approximate duration of the effect of each dose.

If no preliminary medication has been given, much more evipal is required to produce anesthesia for more than two or three minutes. If anesthesia is needed for a minute or two only, preliminary medication is unnecessary. The patient becomes unconscious quickly on a small dose which is injected rapidly, and a single tooth may be extracted, an abscess may be opened, a painful dressing may be removed, and so forth, but it is a different matter if the patient is to have a spinal puncture, for example, and it may be necessary to administer more than 2 grains (0.12 gm.); that is, from 3 to 6 grains (0.20 to 0.40 gm.) may be needed. For operations

2. Lundy, J. S.: The usefulness of anesthetic agents in clinical practice. (In press); Anesthesia service. *Giornale Ital. di Anes.* (In press); Anesthesia as a career for the young doctor. *Centaur.* 40: 213 (Mar.) 1935.  
Lundy, J. S. and Tovell, R. M.: Some of the newer local and general anesthetic agents and methods of their administration. *Northwest Med.* 33: 308-317 (Sept.) 1934.

on the eye, such as enucleation, it may be necessary to give from 4 to 8 grains (0.24 to 0.50 gm.). If an operation is to last from ten to twenty minutes or longer, preliminary medication should be given. An agent producing a short effect, like morphine sulphate, then may be given intravenously. For example, morphine sulphate 1/8 grain (0.008 gm.) given intravenously could be substituted for morphine sulphate 1/6 grain (0.01 gm.) given subcutaneously. The intravenous administration is for the purpose of producing the maximal effect immediately and at the time when this effect is desired. For accuracy and good timing it is best to give the morphine intravenously in emergency treatment. On the other hand, although it may be desirable, it is not essential if there is sufficient time for the effect of the morphine to become apparent before administration of the anesthetic. The difference between barbiturate A and barbiturate B

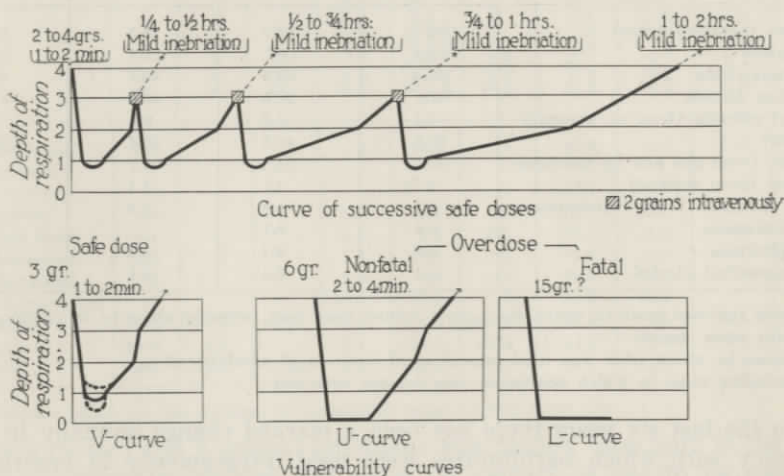


Fig. 3. The dose of evipal soluble intravenously for a man aged forty years, weighing 150 pounds (68 kg.); height 5½ feet; preliminary medication consisted of 1/6 grain (0.01 gm.) morphine by hypodermic injection and 1½ grain (0.087 gm.) pentobarbital sodium orally.

Effect produced by the administration of evipal soluble by different technics. The top curve gives the effect of repeated safe doses and needs to be further elaborated to fix the approximate duration of the effect of each dose. It illustrates the manner in which, when similar successive safe doses are given, the last one given has a longer effect than the previous ones. The curves, marked V, U and L, show the relative effect of the safe dose and of the overdose. The V curve illustrates the safe dose for the short operation, for example, simple extraction of a single tooth. The U curve illustrates the nonfatal result of a moderate overdose; respiration is practically completely depressed for a short time and the recovery is prompt if no more is given. It shows that the period of anesthesia is longer than when a small dose is given and this period of anesthesia is coincidental with respiratory depression. The overdose, that is, one large enough to be fatal, is illustrated in the L curve and needs no further explanation. Certain modifications of this technic might be carried out and the L curve could be broken down into two U curves the second of which might well be fatal, based on the results obtained in the top curve.

is that a smaller dose of barbiturate A is required to produce a certain effect. The difference between barbiturate A and evipal is that barbiturate A seems to produce more relaxation than evipal in the same dose in the absence of preliminary medication and in some cases when preliminary medication has been given.

In the literature the reason for the untoward reactions reported from evipal seems to be the technic of its administration. Fortunately one can tell when the agent is being properly administered. When the patient is unconscious and the natural respiration becomes shallow, anesthesia is usually present. In a short time respirations will again become natural.

It is not by the rate as much as by the depth of respiration that one can judge as to the presence of surgical anesthesia (fig. 3).

The patient does not perspire when these new agents are used and, in some cases, there has been a noticeable absence of postoperative shock. The blood pressure falls when a large dose is administered. The patient usually awakens quietly and there is seldom any nausea or vomiting. As the drug is given intermittently, the effect following administration of each successive dose is increased. Unconsciousness produced by a large dose is of long duration.

Table 3  
Data of interest with respect to both special and ordinary agents, per cent\*

	1934	1933	1932	1931
1. Local, including spinal	56.7	53.6	54.3	58.9
2. Ethylene	15.4	24.7	21.4	26.3
3. Nitrous oxide	42.6	51.9	40.7	42.2
4. Carbon dioxide	41.8	52.5	43.5	45.5
5. Ethyl chloride (local or general)	0.1	0.2	0.1	0.09
6. Ether†	38.2	40.3	40.6	37.1
7. Ether (with gas and by machine)	30.4	31.0	28.7	
8. Ether (drop method)	0.7‡	2.7	4.1	
9. Gas induction ether maintenance	7.1	6.6	7.8	
10. Cyclopropane	0.6	0.1		
11. Barbiturates	0.9	0.1	0.2	0.4
12. Tribromethyl alcohol	0.1	0.4	0.6	0.2

\*This table includes cases in which the agents named were used, whether alone or in combination with other agents.

†Total cases in which ether was used regardless of methods of administration.

‡Not including cases in which anesthesia was induced with gas.

In the last six years there has been a marked change annually in the frequency with which barbiturates were used intravenously in anesthetic doses (table 2). In 1934 a significant increase in the use of this method

Table 4  
Regional block done by Section on Anesthesia

	1934	1933	1932	1931	1930
1. Brachial plexus	10	16	15	29	22
2. Cervical	106	86	112	133	150
3. Field*	435	494	686	626	512
4. Infiltration	306	183	143	231	307
5. Sacral†	685	566	591	903	1148
6. Spinal	3078	2192	1865	2873	2601
7. Splanchnic	1			3	
8. Total	4621	3537	3412	4798	4740

\*Includes a mixed group, such as abdominal wall block, block for bunion, paravertebral block, and so forth.

†Abdominal block also in many cases.

occurred because of the introduction of these new barbiturates. In table 3, line 11, and in table 7, line 8, is indicated the relative frequency with which these barbiturates were used in relation to the total number of patients anesthetized for the year. The data for 1935 will indicate whether or not these barbiturates will become as popular in other departments as

they have in special urologic surgery,<sup>3</sup> operations on the eye, dental surgery and neurologic surgery.

## CYCLOPROPANE

The use of cyclopropane and the carbon dioxide absorption technic has increased considerably as compared to 1933 and we are using them in cases in which we think they are particularly indicated rather than in all cases except those in which they are contraindicated (fire hazard, morphine depression and so forth). Cyclopropane has been used when ether was

Table 5  
Regional anesthesia in 1934

	All cases	Untoward reactions, per cent		No operation, per cent	Intentionally combined, per cent	Remaining cases	Results			
		Marked	Slight				Satisfactory, per cent*	Fair, per cent*	Poor, per cent*	Necessarily combined, per cent*
1. Abdominal	191			1.0	59.6	75	38.6	4.0	17.3	40.0
2. Brachial plexus	10					10	100.0			
3. Cervical	106			0.9	9.4	95	80.0	10.5	4.2	5.2
4. Field block	201			3.4	1.9	190	92.1	1.0		6.8
5. Infiltration	306			1.3	26.1	222	90.0	2.7		7.2
6. Intercostal	22			9.0	9.0	18	66.6	22.2		11.1
7. Paravertebral	22			40.9	22.7	8	62.5	12.5		25.0
8. Sacral	685	0.4	0.2	0.8	0.4	676	96.4	1.3	0.5	1.6
9. Spinal	3073	0.1		0.1	17.8	2526	84.2	1.4	0.1	14.0
10. Total	4621	0.1	0.04	0.7	16.5	3820	86.0	1.8	0.6	11.3

\*Percentage based on the number of remaining cases in the same line.

contraindicated and a general anesthetic was needed, especially in the presence of pulmonary disease and when the cautery is not to be used. A striking illustration of this is shown by the following case:

A physician aged fifty-eight years, with bilateral bronchiectasis, had a diaphragmatic hernia repaired through the abdominal approach. He was given morphine sulphate, 1/6 grain (0.01 gm.) and atropine 1/150 grain (0.0004 gm.) by hypodermic injection and pentobarbital sodium 1½ grains (0.087 gm.) orally as preliminary medication. Cyclopropane was administered by the carbon dioxide absorption technic and after the operation the patient was given oxygen as a prophylactic measure. Recovery was uneventful and most gratifying.

In an occasional case, cyclopropane seemed to alter the rate of the heart and to affect its regularity; although these reactions were without apparent untoward result, this phase of the action of cyclopropane needs more study. In some cases we have felt it advisable to give small quantities of ether with the cyclopropane rather than to anesthetize with cyclopropane and oxygen only, which may markedly depress the respiration.

The manufacturers of cyclopropane are working out the best methods

3. Thompson, G. J.: Transurethral surgery for 1934. Proc. Staff Meet. Mayo Clinic, 10:220-223 (Apr. 3) 1935.

for its production as they did for ethylene. When, and if, cyclopropane becomes widely used and takes its place among the valuable anesthetic agents available, it will be because of the wisdom and far-sightedness of Dr. R. M. Waters<sup>4</sup> in introducing it in such a way as to minimize the untoward results that might otherwise have been associated with its early use.

Table 6  
Intratracheal anesthesia

	1934	1933	1932	1931	1930
Surgery on digestive system	18	73	42	140	51
Neurologic surgery	231	161	108	51	39
Gynecologic surgery	2	6	5		2
Surgery on head and neck	560	405	446	358	178
Surgery on breast, thorax, and hernia	12	30	31	28	30
Surgery on the colon	4	2	2	2	
Orthopedic surgery	33	23	13		
Miscellaneous surgery	1	8	5		
No surgery			3		
Total	861	708	655	579	800

ETHYLENE, NITROUS OXIDE AND CARBON DIOXIDE

Ethylene was used less frequently to induce and maintain anesthesia in 1934 than in 1933. This was true also of nitrous oxide and carbon dioxide. The reason for this decrease was not that the gases were in disfavor so much as that the use of local and spinal anesthesia increased, the cases in which anesthesia was induced with gas and maintained with ether increased, and use of cyclopropane and the new very short-acting

Table 7  
Agents, combinations of agents, and methods used in anesthesia, per cent\*

	1934	1933	1932	1931
1. Local (spinal excluded)	33.0	32.4	33.8	30.0
2. Local and ether (spinal included)	0.03	0.17	0.1	0.2
3. Local and gases (with or without ether; spinal included)	10.3	8.7	9.3	11.7
4. Spinal only	13.2	11.8	10.1	16.4
5. Ether (by open drop method)	0.8	2.6	3.7	5.5
6. Gases (with or without ether)	41.4	37.0	34.0	35.1
7. Ethyl chloride (used as general anesthetic)	0.01		0.01	0.02
8. Barbiturates, intravenously and rectally	0.8	0.07	0.1	0.1
9. Tribromethyl alcohol	0.03	0.07	0.05	0.01

\*This table includes only those cases in which the agent, combination or method named was the only one used; that is, unless otherwise indicated.

barbiturates also increased. There seems to be a natural annual variation in the use of various agents and, as new agents are introduced, older ones will be less frequently used. The fact that cyclopropane is economically usable only when special equipment is available and strict vigilance against waste is maintained, has delayed the immediate widespread use of this

4. Waters, R. M. and Schmidt, E. R.: Cyclopropane anesthesia. *Jour. Am. Med. Assn.* 103: 975-983 (Sept. 29) 1934.



agent as compared with the rapid introduction of ethylene. An early complaint against ethylene was that occasionally bleeding increased with it; the same criticism has been raised in connection with the use of cyclopropane. A further consideration is the significance of the effect of cyclopropane on the heart. With ethylene the cardiac question did not arise.

The decrease in the frequency with which carbon dioxide was used is due to the decrease in gas anesthesia and to the use of the carbon dioxide absorption technic in a certain number of cases.

Carbon dioxide 10 per cent and oxygen 90 per cent was used in an attempt to relieve patients with persistent hiccough in a series of cases in 1934, and is sufficiently successful so that it is worth a trial in each case of persistent hiccough.

#### ETHER, TRIBROM METHYL ALCOHOL AND ETHYL CHLORIDE

The frequency with which ether was used remained much the same in the last four years (table 3, line 6). There was a slight decrease in its use in 1934 that may be accounted for by the same reasons that caused the decrease in the use of ethylene, nitrous oxide and carbon dioxide. On the other hand, there was a noticeable change in the method of administration of ether in the last year, that is, the open drop method was seldom used (table 7, line 5). Tribromethyl alcohol (table 3, line 12; table 7, line 9) was not used as often as previously because, although we find it to be valuable in particular cases, only rarely does it have outstanding advantages over the other agents and methods available here, especially the intratracheal method of Magill.

Ethyl chloride (table 3, line 5; table 7, line 7) is rarely used as a general anesthetic agent but occasionally its use seems to be indicated. The agent would be more frequently used as a general anesthetic if the tubes were equipped with a single tip that could be used either for spraying the agent as a local anesthetic or for using it by the drop method as a general anesthetic.

#### OXYGEN

The administration of oxygen or oxygen and carbon dioxide in the operating room is carried out frequently in connection with spinal anesthesia, and in many cases relieves the patient of nausea and seems to have a beneficial effect on vasodepression, especially if there is a slight positive pressure in the breathing bag for the patient to exhale against. At the termination of operation when the patient's condition does not seem to be as satisfactory as it might be, the administration of oxygen and carbon dioxide seems to have a beneficial effect and after the patient returns to his room, especially after certain operations in the upper part of the abdomen, such as those on the stomach, in a series of cases we have administered moistened oxygen by a nasal catheter as a prophylactic measure to prevent or minimize postoperative pulmonary complications and it has seemed to benefit many of the patients. This method of administering oxygen has been used in certain nonsurgical cases and in certain instances has appeared to be a most practical method. This is especially well illustrated by a case of tetanus previously reported<sup>2</sup> and by that of a child, aged thirteen years, with cardiac disease who was able to obtain rest when oxygen was administered through the nasal catheter and who became suf-

ficiently familiar with this procedure so that he was able to insert the tube himself and use the oxygen when he needed it.

#### REGIONAL ANESTHESIA

Regional anesthesia as carried out by the physician anesthetist changes but little from year to year (tables 4 and 5). The same may be said for the local methods of anesthesia and regional anesthesia that are carried out by the surgeon and his assistants. Fluctuations in the use of new agents is confined largely to their use in about a fifth of those cases in which special agents and methods are used. Procaine was used almost exclusively in the production of anesthesia by infiltration. Surface anesthesia was produced by a number of agents in continuing our work with the incorporation of a mild antiseptic with a local anesthetic in either ointment or jelly. We have been pleased with the effect obtained by merthiolate and metycaine borate in jelly. At least, the patients expressed more satisfaction when this combination was used than when the others were tried. In some patients in which the urethra was to be anesthetized, diothane was used and seemed to be satisfactory. The clinical work with 1, 2-dihydroxyphenyl-4-propanolamine (corbasil, cobefrin) is in progress and will be reported on by Dr. Touhy at a later date.

*Brachial plexus block.*—Brachial plexus block, although used in 1934 in fewer cases than in any year for the last five, was for the first time here successful in 100 per cent of the cases.

*Cervical block.*—Cervical block has varied considerably in the last five years in the frequency with which it has been used. Its decrease in 1933 was largely due to the marked increase in the use of Magill's intratracheal method of anesthesia for operations on the neck. The increase in the use of cervical block in 1934 was due largely to the return of the custom of having the physician anesthetist anesthetize some of the patients for operations on the thyroid gland. This change brought into use superficial cervical block<sup>5</sup> plus infiltration and allowed the deep part of the cervical block to be omitted from the injection.

*Field block.*—Field block varies somewhat from year to year in proportion as certain types of operations vary from time to time.

*Infiltration.*—The infiltration method of local anesthesia continues to be usable and indicates somewhat the widespread favor of our custom of using balanced anesthesia.

*Sacral block.*—Sacral block was in more favor in 1934 than at any time in the last three years and an interesting change in the technic was instituted in some cases. If an operation would involve more than the perineum, as for example, vaginal hysterectomy, and sacral block was to be used, more than the usual 30 c.c. of 1 per cent solution of procaine was injected into the caudal canal. In some cases, as much as 75 c. c. was injected and the injection was so timed that the solution might have at least a half hour to saturate the nerve trunks before operation. In most of these cases the anesthesia was practically as satisfactory as when low spinal anesthesia was

5. Lundy, J. S.: Local anesthesia for operations on the neck. *Current Res. Anes. and Anal.* 8: 152-160 (May-June) 1929; Anesthesia in surgical procedures on the thyroid gland. *Bull. Pan-Pacific Conference*, 1929.

used, with the added advantage that there was no lumbar puncture headache subsequently and that anesthesia would last much longer than with a small dose of anesthetic administered intraspinally. This revival of a modification of Braun's original technic<sup>6</sup> of blocking the sacral nerves increases the usefulness of sacral block sufficiently to provide the missing link between sacral block and low spinal anesthesia in certain cases in which the question of using spinal anesthesia is raised.

*Spinal anesthesia.*—Spinal anesthesia was used frequently in the last five years but more frequently in 1934. In 17.8 per cent of the cases of spinal anesthesia (table 5, line 9) it was used as a part of balanced anesthesia; this percentage is the reason for feeling that spinal anesthesia has become safe. The real reason is, of course, that only a safe dose of an anesthetic is ever given regardless of whether it alone will produce anesthesia of sufficient duration for the operation. In previous years the percentage of cases in which spinal anesthesia was used was based on the total number of anesthetizations, regardless of the type of operation done (table 7, lines 2, 3 and 4). We now feel that the information would be more specific if the frequency is considered with which spinal anesthesia was used out of the total number of cases in which it might possibly have been used. Of the total number of operations below the diaphragm, spinal anesthesia was used in about 56 per cent of the cases. A further investigation of these statistics showed that there was a considerable difference in the personal preference of surgeons for spinal anesthesia. For example, on one surgical service spinal anesthesia was used in about 81 per cent of cases in which a certain intra-abdominal operation was performed whereas on another surgical service it was used in only about 33 per cent of the cases in which a similar type of operation was done.

Procaine was the agent most often used in the production of anesthesia by the intraspinal technic, although butyl-aminobenzoic acid- $\beta$ -dimethyl-amino-ethylestromonohydrochloride (pantocain) was used also in a limited number of cases.  $\alpha$ -butyloxy-cinchoninic acid diethyl ethylenediamide-hydrochloride (nupercaine) was not used.

Ultimate satisfaction from the use of spinal anesthesia depends on the safety of its use and this, in turn, depends on avoiding its use if the patient is markedly debilitated, or, if it is used, the dose must be small enough to be relatively harmless.

#### INTRATRACHEAL ANESTHESIA

Magill's method<sup>7</sup> of intratracheal anesthesia has occupied the physician anesthetist in about 15 per cent of the cases to which he has been paying special attention in the last three years (table 2, line 8). It is a splendid method and merits our confidence and admiration<sup>8</sup>. Table 6 indicates the general use of this method in the last five years and indicates its increase in favor. The most marked increase in any one field has been its use in neurologic surgery. The practice there has been to insert a tube and use

6. Braun, Heinrich: Local anesthesia; its scientific basis and practical use. Philadelphia, Lea and Febiger, 1924, 411 pp.
7. Magill, I. W.: Endotracheal anaesthesia. Proc. Roy Soc. Med. (Sect. Anes.) 22:1-6 (Dec.) 1928.
8. Tovell, R. M.: Intratracheal anesthesia. Current Res. Anes. and Anal. 10: 97-103 (May-June) 1931.

it as an airway at the beginning of operation. Because of the resulting effortless breathing, operative conditions have been improved as will be pointed out by Dr. Love. The advantages of this method which have been referred to in previous reports still obtain. The only modification of the technic has been to lubricate the inside as well as the outside of the intratracheal tube and whenever aspiration of mucus is necessary during the time the tube is in place, the procedure is facilitated. Furthermore, it is more difficult for mucus to obstruct the tube if the inside of the tube is lubricated. This is particularly advantageous in those cases in which the patient's head is elevated for the operation.

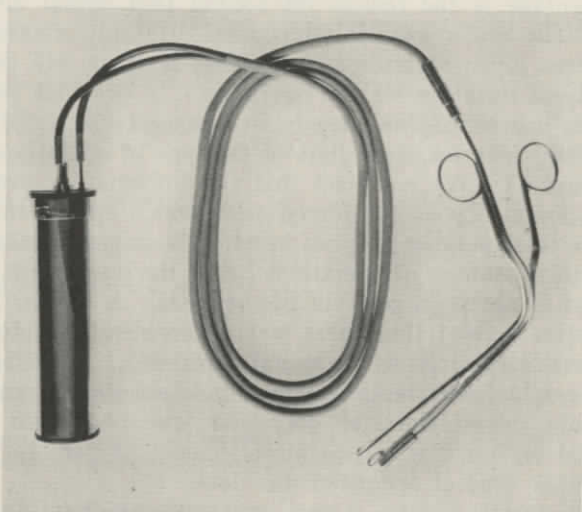


Fig. 4. Lighted forceps. Magill's intratracheal forceps has been modified by adding a light to the instrument.

In connection with intratracheal anesthesia an instrument has been developed by installing a light on Magill's intratracheal forceps (fig. 4). This is useful in the operating room if by any chance the light in the laryngoscope fails and it is particularly valuable for the occasional patient who, during the postoperative period, raises strings of mucus and material from the lungs to the throat, and who is unable to clear the throat of this material. In several instances we have modified a threatening complication and have made it possible for the patient to relax, to rest and to breathe freely and quietly. This was well illustrated by a case in 1934. A patient in the postoperative period was unable to raise a fibropurulent, tenacious exudate in the throat and the material could not be aspirated because of its consistence. With the lighted forceps it was wiped away with gauze.

#### ARTIFICIAL RESPIRATION

Artificial respiration by means of the pulmonary ventilator which has been described previously<sup>9</sup> was employed occasionally. Obviously, there are cases in which it would be advantageous if the intratracheal tube could

9. Lundy, J. S.: Adequate and properly controlled artificial respiration for surgical patients by means of a new pulmonary ventilator. Proc. Staff Meet. Mayo Clinic, 7:225-228 (Apr. 13) 1932.

be avoided and so we have continued to modify the vest previously described and have added to it a belt containing an inflatable bag (fig. 5). This arrangement has its drawbacks but we feel that it is a start at least in the development of some device which will permit the posture of the patient to be changed and, at the same time, will allow the artificial respiration to be carried on without prolonged use of the intratracheal tube. It might be a matter of vital importance when artificial respiration is necessary for a period of more than fifteen or twenty hours.

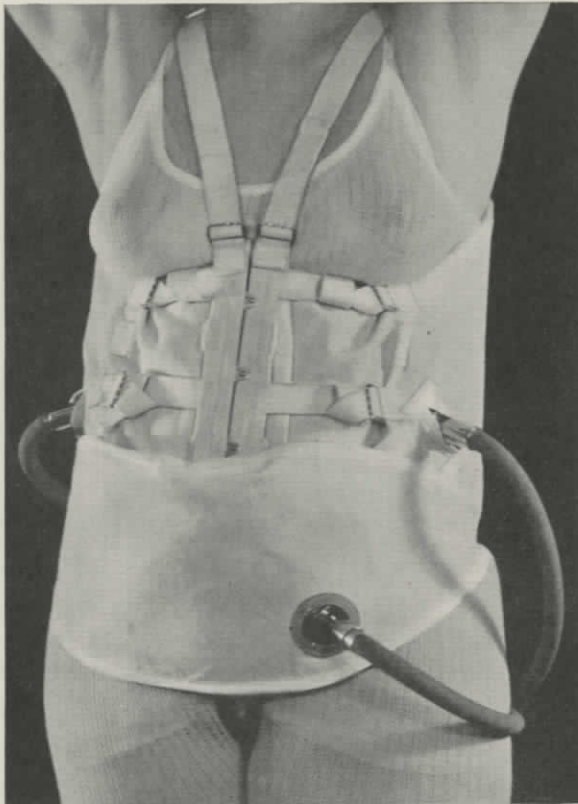


Fig. 5. The belt which is composed of a section of inner tubing held in place by a belt of canvas is shown. It is now used in addition to the vest previously described. The purpose is to prevent descent of the diaphragm which occurred when the vest only was used. This device permits any posture in which it might be desired to place the patient and is shown as a suggestion for an attack on the problem of artificial respiration rather than as a solution of it.

#### FELLOWSHIP IN ANESTHESIA

There is an increased demand for training in anesthesia by recent graduates in medicine, and applications for the fellowship in anesthesia offered by The Mayo Foundation are more frequent. The training in this field is broadening because of the various subjects that are related to anesthesia in which the individual may receive training as part of the fellowship course in anesthesia. It is probable that when a fellowship man selects physiology as his minor subject, he will be able to establish or substantiate some fundamental facts. There are enough opportunities even today in this

field to accommodate a fair number of men who have completed this type of training, and the probabilities are that in the future there will be more such opportunities.

#### BLOOD TRANSFUSION

Data concerning the transfusion of blood in 1934 are given in tables 8 and 9. It is of more than passing interest that transfusion of blood can be so conveniently handled by the anesthetist. From our experience here it would appear that a similar arrangement would work well in other instances and transfusion offers an additional field of interesting work for the anesthetist. Figure 2 shows that there are hours of the day that are not crowded with the administration of special anesthetics and that the majority of the blood transfusions can be performed conveniently at such times by the staff of the Section on Anesthesia. We feel that transfusion of blood may develop into a much bigger field than it is at present. Some theoretic possibilities aside from the technical steps in the drawing and administration of the blood need the attention of investigators and even in this phase there is opportunity for improvement. We are well pleased with the indirect method of using citrated blood, and seldom use the direct method.

Table 8  
Grade of untoward reactions after blood transfusion

Grade	Definition	Per cent
1	Doubtful minor reactions and those of doubtful cause	39.2
2	Rise in temperature over 101° F.	7.2
3	Chill and rise in temperature	38.4
4	Bizarre reactions	15.2

During 1934, 1,021 blood transfusions were given. This represents a considerable increase over the 841 transfusions given in 1933. No change in the method of administration was made. Practically all transfusions were given by the indirect citrate method. Blood was supplied by 520 professional donors and 501 nonprofessional donors. The policy of the previous year was continued, in that reports on flocculation tests for syphilis of all relatives to be used as donors were obtained. In one instance in which both the mother and the father were in the proper blood group to donate blood to their son, transfusion was delayed until the results of flocculation tests were reported. On the father this test gave a 4 plus reaction while the mother was negative to the test. Ninety-nine of the recipients were under the age of twelve years.

Throughout the year, information regarding untoward reactions following transfusions was collected. Untoward reactions were graded on the basis of 1 to 4. Untoward reactions, irrespective of grade, occurred in 12.2 per cent of the cases. Definitions of the several grades and the percentage of untoward reactions occurring in these grades may be seen in table 8. If we eliminate the reactions of grade 1 from consideration, and this might fairly be done, the incidence of untoward reactions was 7.4 per cent. One hundred and seventy-five transfusions were preoperative, sixty-

nine were carried on in the course of operation, 436 were postoperative, and 341 were given to nonsurgical patients. In the nonsurgical cases many of the patients had extremely severe blood dyscrasia. These individuals are known to be extremely susceptible to untoward reaction following the introduction of normal blood containing normal cells.

An attempt was made to obtain information regarding the incidence of untoward reactions of patients who were given blood from donors who were not in the same blood group. The information obtained is represented in table 9. As yet, the series is too small to allow definite conclusions to be drawn, but it seems significant that the greatest incidence of reaction occurred when group 2 donors gave blood to group 1 recipients. It has been recognized that donors in group 2 might be divided into sub-groups; possibly the data we have obtained further confirm that assumption.

Table 9  
Percentage of untoward reactions after blood transfusion\*

Donors, blood group	Recipients, blood group				
	1	2	3	4	Unknown
1	11.1				
2	33.3	13.1			
3	16.6		16.4		
4	11.1	12.5	13.0	10.1	12.3

\*Based on total number of transfusions in each division.

#### INTRAVENOUS THERAPY

Dr. Osterberg<sup>10</sup> has presented his new device which has greatly facilitated the preparation and handling of certain intravenous solutions in his laboratory and their delivery and use in the hospital. Our part in the administration of these solutions has been largely limited to those cases in which venipuncture has become difficult, usually as a result of repeated intravenous administration of solutions with sacrifice of many of the veins. The importance of conserving the remaining veins is obvious in the presence of serious illness, and seldom is there a service rendered to a patient that is as greatly appreciated as is the careful and painless intravenous administration of solutions under any circumstances, but especially after difficulties have previously been encountered.

#### DISCUSSION

J. G. Love, M. D., Section on Neurologic Surgery: Operations on the brain and spinal cord are usually serious undertakings, and the reasons for this are obvious. These tissues do not regenerate, and once a portion of the central nervous system is removed or destroyed it is never replaced. Although physiologic adaptation may occur, in that one portion of the brain may take over the functions previously carried on by another, there is no anatomic restitution of the central nervous system. Operations on the

10. Osterberg, A. E. and Little, G. G.: An apparatus for the preparation and intravenous administration of various fluids in large quantities. Proc. Staff Meet. Mayo Clinic, 10: 241-246 (April 17) 1935.

brain and spinal cord are time-consuming because of the bony protection that nature has placed about these structures and because of the meticulous care that is necessary to control hemorrhage. If hemostasis is not perfect, the most complete operation otherwise may result in failure.

Only fifty years ago last November Rickman Godlee, of London, first successfully removed a tumor of the brain which had been localized by newer neurologic methods. He employed Lister's antiseptic technic. Since that memorable date neurosurgery has come into its own, and today it is recognized as one of the surgical specialties. The mortality and the post-operative results compare favorably with those obtaining in any division of major surgery, and the splendid development of this branch of surgery has not been the result of the efforts of any one man or group of men but is to be credited to the coöperation of groups of individuals each of whom is a specialist in his own field.

Tonight you have heard the report from Drs. Lundy and Tovell, and I wish to emphasize the essential part that the Section on Anesthesia plays in the successful handling of our grave risks. I would like to call attention to two things in particular, and the first is the use of intratracheal anesthesia. Since Dr. Lundy introduced the Magill intratracheal tube in this procedure, we have been using ether by the open drop method through the tube routinely for operations on the brain and for many other types of operations, and we have found that our patients breathe more quietly, the brain is not nearly so tense, and bleeding is reduced to a minimum. These factors, of course, contribute to a more satisfactory operative procedure, obviate the necessity for the intravenous administration of hypertonic solutions during operation, and lessen the frequency of postoperative complications.

The second subject I wish to mention is blood transfusion. At the Clinic blood is grouped prior to operations on the brain in all cases, and if relatives wish, their blood is typed also. If there are no suitable donors among the relatives, professional donors are always at hand. In this way the surgeon is forearmed and no time is lost in the transfusion of blood if indications arise.

Since the Section on Anesthesia has taken over the work of blood transfusion there is always someone present who can begin transfusion within a few minutes. The centralization of this duty has been a great step forward, and it is a source of great satisfaction and comfort to the surgeon to know that this necessary adjunct to neurosurgery is well cared for and that the service can be obtained on a moment's notice.

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*ANNUAL MEETING, MINNESOTA STATE MEDICAL  
ASSOCIATION — MINNEAPOLIS,  
JUNE 24, 25 and 26, 1935*