propane. Spinal analgesia and chloroform have been found of value only in exceptional cases. The importance of being able to intubate the trachea skilfully is emphasized, and the author believes in intubation as prophylaxis rather than as treatment.

Where a patient has been buried under wreckage for some time he may be suffering from starvation as well as from his injuries. If a limb must be amputated to extricate him from the debris, the choice usually lies between open ether, intravenous morphine, and an intravenous barbiturate. The difficulties of induction of anesthesia in patients suffering from wounds of the face are discussed. Carbon dioxide should be used sparingly if at all in severely injured patients, but oxygen should be given after operation. Oxygen is of great value in the resuscitation of persons severely shocked.

N. A. G.

LEMMON, W. T., AND PASCHAL, G. W., JR.: *Continuous—Serial, Fractional, Controllable, Intermittent—Spinal Anesthesia: with Observations on 1000 Cases.* Surg., Gynec. & Obst. **74**: 948–956 (May) 1942.

"Since April 10, 1939, when we gave the first continuous spinal anesthetic, we have administered more than 1,250 entirely satisfactory anesthesias by this method. In this paper we are giving some of our observations and a statistical report on 1,000 cases. In this series of cases we have used novocaine (procaine hydrochloride) as the anesthetic agent. Our choice of this drug has been deliberate since it is the least toxic of all drugs used in producing anesthesia by injection into the subarachnoid space. . . . Safety and controllability are the two things we desire most in spinal anesthesia. . . . We believe, that by giving much smaller initial doses of the drug, it should increase the safety. . . . The toxic symptoms seen following injection of a drug into the subarachnoid space are not due to the drug that is fixed in the lipoid elements of the sensory and motor synapses producing anesthesia but are due to the absorption of the drug from the cerebrospinal fluid into the systemic (venous) circulation. . . . The respiratory center is the most vulnerable to attack. When and if toxic symptoms of an alarming character develop, the first thing to do is to withdraw rapidly the cerebrospinal fluid containing the toxic agent. The greatest concentration of the drug is in the vicinity of the point of the needle. The nerves promptly recover from the anesthesia. This observation was first made accidentally when a turned stopcock on the syringe permitted an unintentional escape of cerebrospinal fluid into the syringe with a subsequent loss of anesthesia. This phenomenon has since been confirmed on numerous occasions. Spinal anesthesia is maintained by the drug that is present in the cerebrospinal fluid and when the concentration of this drug falls below a definite level the anesthesia promptly wears off. After anesthesia is established it takes relatively small doses to maintain the anesthesia for any desired length of time. If we are doing serious technical operative procedures and it is important to maintain complete relaxation at all times, we give an additional dose of 50 milligrams of novocain (3 per cent) solution at the expiration of every 30 minutes. Otherwise, we wait for the initial or previous dose to show signs of wearing off before we give an additional injection. . . .

"With a single exception anesthesia was produced to the desired level and degree and the operation was completed under spinal anesthesia. The exception here referred to was a case in which the right middle and lower lobes were being removed for bronchogenic

carcinoma and while sensory anesthesia was present up to the level of the hyoid bone, a persistent cough, induced by the incidental tugging on the bronchus, could not be controlled. In this instance, cyclopropane was used for this part of the operation. In no other case was a supplementary anesthetic necessary. There were no anesthetic fatalities and no neurological complications. Toxic symptoms were promptly controlled by withdrawal of the drug by rapid aspiration of spinal fluid (3 to 10 cubic centimeters) and by giving inhalations of oxygen. . . . Novocain produces anesthesia promptly when introduced, in sufficient quantity, into the subarachnoid space. We have observed that it takes approximately 90 seconds to relieve pain completely and produce muscular relaxation when it is given in subsequent injections. We feel that each patient is a case unto himself and that each has an individual response to novocain. We have observed a case in which the anesthetic action of novocain disappeared every 15 minutes while doses of 100 milligrams each were being used. We have had anesthesia with 50 milligrams of novocain last for an operation that required 1 hour and 45 minutes. Subsequent injections of 50 milligrams each last approximately 30 minutes, producing both motor relaxation and sensory block. By injecting small doses of novocain (15 to 20 mg.) into the subarachnoid space we have been able to produce sensory block (anesthesia) without causing motor paralysis. In the case of an elderly woman with a strangulated hernia we produced satisfactory anesthesia with 30 milligrams. . . .

"The height of the anesthesia can be extended and controlled by the following means: position of patient, volumetric dilution of anesthetic agent (barbotage), rate of injection, and total dosage of drug. . . . As the anesthesia begins to wear off it is so indicated by the fact that the intestines become less contracted, the abdominal muscles grow more tense, and the patient complains of abdominal discomfort or pain. . . . We consider the preoperative medication to be of great importance. On the evening before operation the patient receives 3 grains of nembutal. Three hours before operation the patient is given a second dose of 3 grains of nembutal by mouth. One hour before operation a hypodermic of ¼ grain morphine and $\frac{1}{100}$ grain of scopolamine is given. If the sedation is not sufficient, ⅛ grain of morphine is given intravenously or hypodermically as often as is necessary during the operation. By using proper sedation the patients are spared the unpleasant memories sometimes accompanying such an experience. Most of them sleep throughout the operative period and afterward for many hours. During long and difficult procedures an intravenous injection of 10 per cent glucose solution is given via a vein in the leg. These patients also receive a blood transfusion at the end of operation if it is indicated. We make an effort to prevent and combat shock rather than wait until its onset before treatment is begun. . . .

"We are presenting a report on the first 1,000 cases in which this method has been used. The operations in this series include 970 below the abdominal diaphragm and 30 above it. . . . The average age for this group was 37.2 years. The oldest patient was 83 years old and the youngest was 7 years of age. . . . The average length of the operations in this series was 50.4 minutes. A total gastrectomy required 215 minutes (3 hours and 35 minutes). The shortest procedure took only about 2 minutes for the incision and drainage of an abscess. One of our colleagues reported using this method to produce satisfactory anesthesia during the en-

tire course of a gastrectomy requiring 6 hours. . . . For these 1,000 cases the average total dose of novocain was 219.9 milligrams. In the operations done above the diaphragm the dosage was much larger than the general average, being 445 milligrams. This high figure influences the total percentage considerably for it is seen that in the remaining 970 cases the average total dosage was only 181 milligrams of novocain. The average number of injections was 2.4. It is interesting to compare the average total dose of the first 500 cases which was 242 milligrams with that of the second 500 cases which was 198 milligrams. We feel that this reduction in amount of total dose is due to our increased experience. The largest dose given to any one patient was 2,200 milligrams. This patient had had an earlier operation in which she required 1,800 milligrams of novocain to produce anesthesia. This would indicate an individual tolerance and points out, too, that the dose in any given case is *enough*. The smallest dose was 20 milligrams of novocain for amputation of a toe. We have used various dilutions from 1 per cent to 10 per cent solutions of novocain. We have obtained best results from using a 5 per cent solution of novocain. At times we have used previously prepared solutions of novocain in distilled water and while anesthesia was obtained the results were not always as satisfactory as when the solutions of novocain crystals in spinal fluid were used. In thoracic surgical procedures we generally employ a dilution of 1 to 3 per cent. . . .

"The average systolic blood pressure at the beginning of operation for this series was 125.9 millimeters of mercury. The average systolic pressure at the end of operation was 113.9 millimeters of mercury. This indicates that there was an average fall in systolic blood pressure of only 12 points. The blood pressure was recorded every 5 minutes of the operation. It was noted that soon after the patient received the preliminary injection of ephedrine sulfate and novocain used to anesthetize the skin and support the blood pressure, there was a general elevation of the blood pressure, but after the operation was in progress, the pressure had a tendency to become constant or to fall below that at the onset. . . . In several instances the blood pressure fell to a systolic of 40 millimeters of mercury. We rarely use vasoconstrictors in these conditions but have found that venoclysis or blood transfusion affords the best relief. Most of these patients leave the operating room in good condition. They have a dry skin and a full pulse of good quality. . . . Our incidence of headache after spinal anesthesia is 2.8 per cent, which approximately corresponds to the incidence seen by the former single injection method. We call attention to the fact that we had 150 consecutive cases in which there were no postoperative headaches. In most instances this complaint is relieved by the use of aspirin or by lowering the head of the patient. . . . Our incidence of urinary retention was 3.4 per cent. In some of our plastic or pelvic operations we inserted an indwelling catheter for the first few postoperative days so that these patients do not enter into our statistics. . . . There were 34 cases of pulmonary complications, 19 of these were bronchopneumonia, 9 were lobar pneumonia, 4 were atelectasis, and 2 were pulmonary embolism. . . . There were no motor or sensory disturbances, no cranial nerve palsies or other neurological phenomena. A number of these patients have been observed for more than 2 years. . . . There were 47 deaths among this series of 1,000 cases, making the gross mortality of 4.7 per cent. The average time that elapsed between operation and death was 6.9 days. In

none of these deaths do we believe that the anesthesia was a contributing factor. Of the 47 who died 24 were suffering with malignant growths. There were 9 deaths from diffuse peritonitis. Among the remaining factors causing death were pulmonary, cardiac, and renal conditions. From several others using this method we are informed of something more than 1,000 additional cases in which continuous spinal anesthesia was used. These added to our series make a known total of more than 2,000 cases. There has not been a death reported from the use of continuous spinal anesthesia."

J. C. M. C.

ADAMS, R. C., AND LUNDY, J. S.: *Anesthesia in Cases of Poor Surgical Risk: Some Suggestions for Decreasing the Risk.* Surg., Gynec. & Obst. 74: 1011–1019 (May) 1942.

"When a patient who is classified as presenting a poor surgical risk comes to operation today, he stands a better chance of withstanding the effects of both the anesthesia and the operation than he did a few decades ago. . . . Advances in the field of anesthesia and its related specialties have been of prime importance in the successful preoperative, operative, and postoperative management in cases of poor surgical risk. These advances are classified broadly as follows: (1) the evolution of less toxic anesthetic agents; (2) improved methods of administration of anesthetic agents; (3) the use of a combination of agents and methods, thereby decreasing the toxicity resulting from the use of a single agent. . . . (4) improved methods of administration of oxygen and other inhalants; (5) supportive measures during the operative and postoperative period and (6) special measures, such as the use of tracheobronchial aspiration after operation. Finally, the skill and versatility of the anesthetist must be considered as important contributing factors to the welfare of the patient for whom the risk of operation is great. The patient's life often depends more on the way a certain anesthetic agent is administered than on the effects of the anesthetic agent itself. . . .

"One of us (Lundy) suggested a brief classification of operative risk as follows: grade 1, patients in such good physical condition that they will probably tolerate any anesthetic agent well; grade 2, cases of so-called average risk, in which the risk of the operation is greater than the risk of the anesthesia; grade 3, patients for whom the anesthetic agent must be selected with care, since, owing to pathological conditions, the risk of the anesthesia is as great or greater than the risk of the operation; and grade 4, patients who are in such serious physical condition that the use of any anesthetic agent is dangerous. For such patients, local infiltration may be used to control the pain but only half the concentration and half the usual amount of solution should be employed. . . .

"All anesthetic agents may be toxic to human tissue, but certain organs and tissues may suffer more acutely than others. . . . In choosing the anesthetic agent for a patient who presents a poor surgical risk, the main factor to consider is to what extent the agent or agents will affect physiological processes already impaired. . . . A few facts which can be ascertained from the physical and laboratory examinations usually will be all that are required in order to form a fair approximation of the risk of anesthesia and operation in a particular case. Important among these are the estimation of hemoglobin, the level of blood pressure, findings on urinalysis, degree of cardiac and renal sufficiency, and the general appearance of the patient in regard to nutrition, debility, and loss of weight. . . . Anesthesia and operation are not