

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 pre-operative, 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 con-

sidered 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

tolerated as well by patients at the extremes of life. The respiratory system of infants and young children is depressed easily by anesthetic agents. Debility and cardiovascular-renal disease may be complicating factors in the cases of aged persons. . . . The mode of life of a patient has a bearing on the risk. Those who use tobacco excessively and have accompanying bronchitis are prone to respiratory complications after anesthesia and operation. Chronic alcoholics usually fare poorly under anesthesia and seem more susceptible to complications during the postoperative period. The same applies to drug addicts, since there are often accompanying nutritional and nervous disturbances. . . . Patients who are 'high strung' usually are more difficult to anesthetize than those of more stolid type. Those who come to the operating room worried, frightened, and with the mental attitude that death is imminent or that they cannot survive the operation do not present a good risk and often have a stormy convalescence. Adequate preliminary medication and assurance are important therapeutic measures in these cases. . . . Toxemia, whether attributable to systemic or malignant disease, infections, or other causes, increases the gravity of the risk in direct proportion to the degree of toxemia present. . . . The risk of operation on markedly debilitated patients is always high. The vital functions of these patients are depressed by even small doses of anesthetic agents and great caution must be observed to prevent overdosage. Prolonged vomiting is serious, since it leads to nutritional disturbances, decrease of glycogen in the liver, and to the more serious conditions of acidosis and ketosis. The other extreme, also serious, is alkalosis, which can be produced, among other conditions, by intestinal obstruction. . . . Obese patients need not neces-

sarily present a poor surgical risk, but by and large a patient who is grossly overweight does not have as good a chance of withstanding anesthesia and operation as one whose weight is nearer a normal figure. . . .

"The liver and the state of its function have an important bearing on the anesthesia and its effect on the patient. . . . The normally functioning liver . . . handles the strain imposed on it by anesthesia and operation well, provided its store of glycogen is adequate and anoxia is prevented. . . . The malfunctioning liver invariably has a low content of glycogen which always increases the risk from the anesthesia and operation. The most toxic anesthetic agent to hepatic tissue is chloroform. . . . Divinyl ether anesthesia also may damage the liver, particularly if the state of anesthesia is prolonged, but not to the extent or with the frequency of that produced by chloroform. Ether anesthesia impairs the function of a normal liver slightly, causing diminution of its content of glycogen, hyperglycemia, and decrease in hepatic secretion, but normal function is soon resumed during the postoperative period. Cyclopropane has little, if any, deleterious effect on hepatic function, and the same is thought to be true in the case of the very short acting barbiturates. The best means of protecting an impaired liver are diet high in carbohydrates in order to increase the content of glycogen of the liver before operation and the maintenance of adequate oxygenation during the anesthesia and after operation. In cases of obstructive jaundice, in which the prothrombin time is increased and postoperative hemorrhage is feared, treatment with vitamin K before operation is indicated. . . .

"Although the kidneys are affected directly by certain anesthetic agents, their function also is impaired indirectly as a result of the effect of the

anesthesia and operation. Chloroform may produce direct damage to the renal epithelium. Ether anesthesia causes a marked decrease in urinary output, ending in almost complete suppression after an hour or more of anesthesia. Normal function is resumed in the first 24 hours after operation. Cyclopropane anesthesia also suppresses urinary output during anesthesia: this is followed by a compensatory increase in excretion after operation. Tribromethanol anesthesia also causes urinary suppression. . . . If, at the time of operation renal damage has occurred, anesthetic agents which are toxic to renal tissue and tend to inhibit renal function will produce more drastic disturbances in these organs than if they were normal. Thus, renal insufficiency markedly increases the gravity of the patient's risk. . . . A marked fall in blood pressure during operation can diminish and arrest urinary secretion. Asphyxia may cause constriction of the renal vessels, leading to diminished blood flow through the kidneys and decreased formation of urine. Owing to the resultant local anoxia, the glomerular epithelium is damaged and permits the passage of albumin, proteins, and blood. Loss of fluids and blood during the course of the operation also contributes to postoperative anuria. In cases of advanced nephritis the risk of operation is not good, and nephritis often is accompanied by arteriosclerosis, hypertension, and cardiac insufficiency which further increase the gravity of the risk. In such cases, careful tests for renal function should be performed and the level of blood urea and nonprotein nitrogen should be evaluated. In the preparation of such patients for operation, the values for blood urea, creatinine, and nonprotein nitrogen should be reduced as far as possible by forcing fluids and intravenous therapy before operation. If these values stabilize readily to

values not grossly abnormal, the patient may stand operation and anesthesia satisfactorily. . . .

"Cardiac insufficiency, if advanced and uncompensated, forms one of the gravest complications the anesthetist has to face. However, it is agreed among cardiologists that patients who have many types of cardiovascular conditions, provided that compensation is adequate and cardiac reserve is satisfactory, stand anesthesia and operation remarkably well. . . . Although a careful cardiovascular examination should be routine before any operation, a fair estimate of the patient's cardiac reserve may be obtained from information the patient can supply. If he does not have dyspnea or precordial pain, either with or without moderate exertion, and if he is able to carry on the usual activities of daily life, it is probable that his heart will stand the strain of anesthesia and operation. The risk increases in proportion to the extent with which his activities are limited by the cardiac condition. Hypertension itself does not increase the risk markedly, provided cardiac reserve is satisfactory. . . .

"Disease of the lungs or of the respiratory passages obviously has an intimate bearing on the course of anesthesia, the complications that may arise and the degree of risk for the patient during and after operation. The effect is dependent on the site, nature, and extent of the lesion, to what extent the lesion will interfere with the supply of oxygen and its transportation to the body tissues and the elimination of carbon dioxide. There is also the added risk of the production of other pulmonary complications after operation as a result of the anesthesia and operation or the extension of those which existed before operation. Any pathological condition which lowers vital capacity to a marked degree increases the patient's risk. Moersch stated that

the closer the vital capacity approximated tidal air, the graver was the risk. Examples of lesions which affect vital capacity are emphysema, abscess of the lung, tuberculosis, pneumonia, pleurisy with effusion, asthma, defects of the thorax, and also certain cardiac conditions, particularly mitral stenosis. A reduction in vital capacity always calls for particular care in the maintenance of adequate ventilation during anesthesia. . . . When there is any question of difficulty in maintaining an adequate supply of oxygen, an intratracheal tube should be inserted after induction of anesthesia. . . . One of the greatest hazards of deficiency of oxygen, as demonstrated by Courville, is its damaging effect on the central nervous system, particularly on the cerebral cortex. A few minutes of severe anoxemia may produce permanent damage. . . . Asthma usually does not produce an untoward surgical risk. . . .

"Anemia frequently accompanies pathological lesions of the respiratory system and is present often when the patient is debilitated and when the risk of operation and anesthesia is great. This condition, owing to the lowered oxygen carrying capacity of the blood, interferes with adequate transportation of oxygen to the tissues. When concentration of hemoglobin is less than 8 to 10 grams per 100 cubic centimeters of whole blood, it is wise to give a blood transfusion before operation. When indicated, the value of suction aspiration of the tracheo-bronchial tree during the immediate postoperative period is assuming major importance in relation to the control and prevention of postoperative pulmonary complications, such as atelectasis, massive collapse of the lung and bronchopneumonia. . . . The use of suction bronchoscopy is one of the greatest advances in helping to lower the incidence of postoperative pulmonary complications after anesthesia.

The administration of oxygen . . . has become of routine importance in the postoperative management of surgical patients. . . . Helium with mixtures of oxygen may be respired with less effort than oxygen or oxygen and air. Treatment with oxygen and helium has been beneficial after operation for patients who have asthma and mechanical obstruction to respiration as a result of infections, tumors, foreign bodies, or laryngeal edema. . . .

"Generally speaking, modern methods of diabetic therapy and anesthesia have lifted the diabetic patient out of the group of patients who present a poor risk. . . . With the anesthetic agents available we are of the opinion that we are justified in using those which interfere least with carbohydrate metabolism. Ether not only elevates the level of blood sugar but tends to produce acidosis as a result of postoperative vomiting and restriction of food. Nitrous oxide, ethylene, and cyclopropane are suitable since they only slightly affect carbohydrate metabolism. Anoxemia may result in acidosis and thus, cyclopropane is preferable to nitrous oxide or ethylene, unless these agents will produce adequate anesthesia without deficiency of oxygen. Neff and Stiles found that Bourne's buffer phosphate solution reduces the incidence of postanesthetic nausea and vomiting with cyclopropane anesthesia. Spinal and regional anesthesia also are satisfactory for diabetic patients. Pentothal sodium intravenously administered and used alone or in combination with local or regional anesthesia also is advocated. If it is necessary to operate on a patient who has uncontrolled diabetes, every effort should be made to control the diabetes before the operation is performed unless the operation is urgent. When stabilization has occurred, any of the suggested methods of anesthesia which are adequate for the operation may be

employed and if ether is necessary, it may be used in minimal amounts. . . .

"Divinyl ether and tribromethanol have a place in anesthesia, but the former is somewhat toxic to the liver, particularly for prolonged administration, and the latter produces toxic effect on both the liver and kidneys and is considered safe only when used as a basal anesthetic agent. . . . On the basis of its low toxicity, nitrous oxide and oxygen is safe, but the toxic effect of the anoxemia which may accompany the anesthesia definitely is deleterious. . . . Local or regional anesthesia used with nitrous oxide and oxygen permits larger interventions and is relatively safe for these patients. . . . Like nitrous oxide, the toxicity of ethylene is low and better oxygenation may be obtained than with nitrous oxide. Its uses parallel those of nitrous oxide. . . . Valuable as ether is in anesthetic practice, its use should be avoided as much as possible in cases of poor surgical risk. . . . The value of cyclopropane in many types of cases of poor surgical risk is incontestable on the basis of its low toxic effect on the liver and kidneys, its anesthetic potency with high concentrations of oxygen and absence of irritation to the respiratory system. Its use is particularly indicated in thoracic surgery. . . . Respiratory obstruction and resultant anoxemia should never be allowed to persist when such difficulties may be promptly controlled by passage of an intratracheal tube. In cases of graver risk or in those in which complications are anticipated, its routine use may be advisable. . . . Since procaine is the least toxic of local anesthetic agents, its use is preferred in the cases in which the risk of operation is great. Infiltration and block anesthesia, either alone or supplemented, continues to be one of the safest methods for such patients. In cases in which cardiac disease or hypertension is present, epinephrine is

contraindicated in the anesthetic solution. Hypersensitivity to local anesthetic agents in certain cases must be borne in mind, as well as the inadvertent injection of the solution into a blood vessel. . . .

"Spinal anesthesia, although preferred in certain cases of poor operative risk often is contraindicated in others. Here again, procaine is the agent of choice, but if the risk of operation for the patient is fair the use of metycaine may be considered because of the longer duration of effect. . . . The method of continuous spinal anesthesia as advocated by Lemmon has certain advantages for prolonged operations in which spinal anesthesia appears to be the method of choice. . . . By using the continuous method, a minimal dose is administered and if the patient is reacting favorably to the effects of the spinal anesthetic, subsequent doses may be added as required. In this way it may be possible to prevent circulatory and respiratory insufficiency, which often occurs after a single large dose of a spinal anesthetic agent has been given. . . . Pentothal sodium is the anesthetic agent of choice in intravenous anesthesia. . . . The recent trend of opinion is pointing more and more to the increased usefulness and safety of intravenous anesthesia combined with various other methods. . . . If it is possible to generalize concerning anesthesia in cases of grave surgical risk, it may be said that combinations of regional anesthesia and cyclopropane and oxygen anesthesia, or regional anesthesia, intravenous anesthesia and nitrous oxide and oxygen anesthesia possess the widest margin of safety. The latter combination obviates the hazard of explosion or fire. Abdominal wall and intercostal block, when supplemented by intravenous anesthesia and the continuous administration of oxygen or 50 per cent nitrous oxide and 50 per

cent oxygen by inhalation, is one of the safest methods for anesthetizing patients of doubtful risk. Light pentothal sodium anesthesia forms a satisfactory supplement to spinal anesthesia when indicated and aids in the control of nausea and mental trauma. Small doses, slowly administered, are indicated, since the circulatory and respiratory functions already are depressed by the spinal anesthesia. . . . Certain operations carry with them more than the usual degree of risk. . . .

"Modern methods of preoperative and postoperative treatment and advances in the field of surgical shock and supportive therapy have changed the condition of many patients from that which constituted a poor surgical risk to one for which the risk was fair or even good. Modern methods of intravenous therapy, such as administration of sodium chloride, dextrose, and so forth, have been important. . . . The use and value of chemotherapy, particularly with the sulfonamide compounds, for infective conditions, is well known. High in the scale of importance is the treatment of shock during and after surgical operations. . . . Varying degrees of shock occur during any operative procedure, depending on the preoperative condition of the patient, the anesthetic, and the type and duration of the operation. It is obvious that debilitated, anemic, toxemic, and functionally abnormal patients will succumb to shock both more easily and to a more profound degree than will more normal patients. Therefore, the anticipation of the need of treatment for shock is particularly important in a case in which the risk of operation is poor. If shock is to be treated effectively, it must be treated promptly. Better still, if it is known that the patient is in poor condition, the shock should be treated before it actually occurs. This is accomplished by various measures, depending on the

urgency. A fall in blood pressure during the operation need not be serious if it is not persistent and if it is not associated with marked loss of fluid or blood. Vasopressor agents, such as ephedrine or neosynephrin hydrochloride, may be injected intramuscularly or intravenously in order to elevate the blood pressure. If the fall in blood pressure occurs in the presence of marked loss of fluid (profuse sweating) or is obviously attributable to hemorrhage, vasopressor agents give only transient relief and a false sense of security.

"A pale, cold, clammy patient is in a state of shock and needs fluids, blood, or both. In the management of patients for whom the risk of operation is great it is safest to start an infusion of physiological saline solution or a 5 per cent solution of dextrose in physiological saline solution at the beginning of the operation. . . . Transfusion of blood is the best means of combating shock. The amount necessary will depend on preoperative level of hemoglobin, the amount of blood lost during the operation, and the response of the blood pressure, pulse rate, blood volume, color, and skin. . . . The use of plasma, which can be stored in the desiccated state and redissolved before use, provides all the elements of whole blood for treating shock, with the exception of erythrocytes. By its use, shock may be controlled for several hours, even after marked hemorrhage has occurred." 46 references.

J. C. M. C.

MYERS, R. D.: *Injection Anesthesia*. Ohio State M. J. 38: 459-460 (May) 1942.

"The two most efficient and widely used drugs for block and infiltration anesthesia are procaine hydrochloride and Lilly's metycaine. . . . The usual preoperative preparation of an adult consists in the administration of a bar-