SOME PROBLEMS OF GERIATRIC ANESTHESIA *  

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The United States is a comparatively young country and today one-half of our population is still under 30 years of age (1). In recent years, however, there has been a marked shift in the age distribution and the number of persons over 50 years of age has been on the increase. This shift in age of our population has been brought about by declining birth rate, curtailed immigration and increased life expectancy.

The increased life expectancy (2) is the result of decreased infant mortality, better nutrition and housing, more preventive medicine, better industrial hygiene and improved medical and surgical care.

Because of these factors it is estimated (3) that the future population of the United States will be distributed as presented in table 1.

It has been recognized for many decades that the youngest portion of our population needs special attention for its problems, and as a result the specialty of pediatrics was developed. In contrast to this, attention has been focused only comparatively recently on the aged sick. Not so long ago operations on old patients were considered hazardous and whenever possible were avoided. Because of better understanding of the physiology of the aged, earlier diagnosis of malignant disease and improvements in surgical technic and anesthesia, the number of operations on old patients has been on the increase. In analyzing his own data Dripps (4) has shown that the operative mortality and incidence of complications in old patients is less than generally assumed.

Considering that the number of persons over 60 years of age is steadily increasing (by 1960 it will be greater than the number of children younger than 9 years) and that the relative number of surgical operations on this same age group is also increasing, a study of some of the anesthesia problems of the aged seemed justified. No systematic study of geriatric anesthesia is conceivable without reviewing the anatomical and physiologic changes, and considering the pathologic and pharmacologic aspects of old age. The study of geriatrics and consequently the study of geriatric anesthesia should be based

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on three fundamental principles (3): 1. senescence is a physiologic entity and not a pathologic state; 2. disease in senescence is complicated by degeneration, and 3. in the treatment of the aged the physiologic and not the chronologic age should be considered.

ANATOMICAL CONSIDERATIONS

The essential anatomical changes in old age are dehydration and waste of tissue. The wasted tissue is either not replaced or replaced with less efficient material.

In the circulatory system the important changes are cardiac hypertrophy with or without dilatation, diminished caliber and elasticity of coronary vessels, arteriosclerotic changes in all vessels and myocardial degeneration.

In the respiratory system the changes consist of the stiffening of the thoracic cage, atrophy of the mucous membranes of the upper respiratory tract, calcification of cartilages, dilatation of alveoli and rupture of interalveolar septa, emphysema, narrowing of bronchioles, and drying and thinning of pleura.

The changes in the nervous system are: atrophy and degeneration of cortical elements, dilatation of ventricles, increase in cerebrospinal fluid volume and thickening of meninges.

Bones become more brittle owing to increase of inorganic and decrease of organic components, cartilages calcify, osteoporosis or hyperostosis develops, the mandible atrophies, the teeth fall out, synovial sacs become stiff and calcium is deposited in bursae.

Changes in the parenchymatous organs consist of tissue cell atrophy, proliferation of connective tissue, decrease in size and increase in density of organs and arteriolosclerosis, especially in kidneys.

Blood volume and hemoglobin content decreases and fragility of red cells increases.

PHYSIOLOGIC CONSIDERATIONS

It must be kept in mind that functional disturbances often precede anatomical changes in the aged. Adaptation of the physiologic mechanisms to emergency situations requiring maximum efficiency on short notice is inadequate. In general, the most important physiologic changes in senescence are: diminished functional activity, decreased power and reserve and decreased resistance.
The changes encountered in the circulatory system are: elevated arterial and venous pressure, increased pulse rate, decreased cardiac reserve, sluggish circulation, distant heart sounds and higher incidence of murmurs.

In the respiratory system the changes encountered are: decreased thoracic and increased abdominal respiration, decreased tidal volume and vital capacity, compensatory tachypnea, impaired gas exchange through the alveolar membrane and increased possibility of accumulation of carbon dioxide.

On the part of the nervous system, diminished and sluggish reflexes, early brain fatigue, impairment of sensations and impaired heat regulation are encountered.

The most important changes in the parenchymatous organs are decreased kidney and liver function and hypoactivity of the endocrine glands.

In the hemopoietic system bone marrow becomes less active and the leukocytic response to infections is often missing.

Pathologic Considerations

From the pathologic point of view the aged patient is characterized by an increased sensitivity to oxygen lack, dehydration, hyperhydration, blood loss, trauma, infection and lack of essential metabolites (vitamins, minerals and proteins).

In the circulatory system anemic and arteriosclerotic murmurs, subclinical or clinical decompensation with varying degree of peripheral or pulmonary edema, and liver and kidney congestion are more frequent. The incidence of peripheral circulatory diseases is increased.

On the part of the respiratory system emphysema, acute and chronic infections, pulmonary edema and postoperative atelectasis are often encountered.

In the nervous system the after effects of cerebral hemorrhage thrombosis or embolism are frequently present. Encephalomalacia owing to oxygen lack and pressure paralysis of peripheral nerves are more likely to develop.

In the parenchymatous organs the pathologic changes of outstanding importance from the point of view of the anesthesiologist are nephrosclerosis and degenerative liver changes.

Pharmacologic Considerations

Because of the decreased metabolic rate and the less efficient kidney and liver function, drug sensitivity is usually increased in old patients. In addition to these factors, the possible influence of any underlying pathologic process on drug action should also be considered. Since in the aged there is a tendency to depression of functions, these considerations will apply especially to the use of depressants (analgsics, sedatives and anesthetic agents).
Very often the absorption of drugs from the gastrointestinal tract is delayed or incomplete in old individuals and the results of peroral and rectal administration are less reliable than those of intravenous, intramuscular or subcutaneous medication.

Preoperative Preparation

It is even more important than in any other group that the old patient is thoroughly examined and, if possible, any underlying pathologic process corrected preoperatively. In attempting to correct any abnormality, the standard of comparison should be the average of the corresponding age group. An endeavor should be made to remove any unnecessary strain because the operation and anesthesia already place an increased load on the organism of the old patient. Anemia, dehydration and vitamin and mineral deficiencies should be corrected. Fluid in the pleural or peritoneal cavities, as well as peripheral edema, should be removed. When congestive failure is present patients should be given digitalis. In patients with decreased cardiac reserve, when there is danger that congestive failure might develop in the operating room or during the postoperative period, preventive digitalization must be considered. A distended bladder should be catheterized and the bowels should be emptied. Last but not least, assuring the patient that despite his or her advanced age the operation is not unduly hazardous, is also very important.

Premedication

With a few differences, premedication in the aged should be regulated by the same principles as in other age groups. As already pointed out, the doses are smaller, two-thirds to one-half of the adult dose. Because of the slower absorption the onset of action of the preoperative medication may be delayed; therefore, premedication should be given earlier or intravenously in old patients. Owing to slower excretion and detoxification, the effect of premedication is likely to last longer than in younger age groups. In presence of advanced cerebral arteriosclerosis or confusion resulting from other causes, barbiturates and scopolamine are likely to cause excitement and restlessness, and should be avoided. Paraldehyde, chloral hydrate and tincture of opium give satisfactory results in these cases.

Choice of Anesthetic Agent and Method

Whenever circumstances permit local and regional methods are preferred. Regional anesthesia causes the least interference with the functions of the organism as a whole. Because of their decreased reflex irritability and pain sensitivity, old patients tolerate well these forms of anesthesia. For example, in older patients satisfactory re-
laxation for major abdominal procedures may be obtained with bilateral intercostal block.

Spinal anesthesia, if its level is kept below the ninth or tenth thoracic segment may also be safely used in the aged. The general circulatory disturbances produced by low spinal anesthesia are negligible; on the other hand, blocking the sympathetic preganglionic fibers below the eighth thoracic segment has a beneficial effect on diuresis and the circulation of the lower extremities. High spinal anesthesia paralyzes the vasoconstrictors of the splanchnic area and may produce marked fall of blood pressure that may be difficult to correct, especially in the presence of hypertension and advanced arteriosclerosis. High spinal anesthesia should be used only by experienced anesthetists in selected cases. The use of caudal anesthesia in rectal and urogenital surgery and of crymo-anesthesia for amputations of the lower extremity also deserve mentioning.

When general anesthesia is indicated, the agent that will cause the least disturbance of the various organic functions should be selected. In this respect, if given with adequate amounts of oxygen, nitrous oxide is the agent of choice.

Because of its short-lasting effect, cyclopropane at first hand would seem to be a suitable anesthetic agent in the aged. Its use, however, has been limited by two factors: 1. its irritating effect on the myocardium (5) and 2. the elevation of blood pressure because of accumulation of carbon dioxide, often followed by postanesthetic hypotension (6). Both arrhythmias and postoperative hypotension have been encountered more frequently with cyclopropane in old patients. The arrhythmias may be prevented by the prophylactic use of intravenous procaine (7), and procaine also appears to decrease the danger of hypertension during, and hypotension after, anesthesia.

Ether is still the agent of choice when good relaxation is necessary in the presence of the highest possible concentration of oxygen. It should not be used, however, in the presence of marked kidney or liver involvement and great care should be exercised in its use if the myocardium is not intact. If ether must be used in patients with myocardial damage, preoperative digitalization decreases the incidence of circulatory complications.

Contrary to widespread belief, pentothal sodium anesthesia, if properly used, is not contraindicated in the aged. To try to obtain analgesia, and even more so, relaxation, by the use of pentothal alone, however, is inviting disaster. For painful procedures it should be used in combination with nitrous oxide-oxygen, and if relaxation also is required, a suitable muscle relaxant (d-tubocurarine chloride, decamethonium bromide) should be employed.

Muscle relaxants may also be used to advantage with cyclopropane and ether to obtain relaxation in higher planes of anesthesia. Until recently the muscle relaxant used most frequently was d-tubocurarine
chloride. In the last year a new synthetic muscle relaxant, decamethonium-iodide or-bromide, has been introduced in England and has also been used in this country.

**Conduct of Anesthesia**

When regional anesthesia is employed, the total volume and the concentration of the agent used should be decreased. Because of slower absorption a somewhat longer time is necessary to obtain anesthesia by this method. This must be taken into consideration when spinal anesthesia is administered to old patients. The upward spread of the agent should be terminated when the analgesia reaches a level two or three segments below the desired height of anesthesia.

When a general anesthetic is administered induction should be smooth, and the depth and duration of anesthesia should be kept at a minimum. Hypoxia and accumulation of carbon dioxide cannot be tolerated. The maintenance of an absolutely free airway and minimal resistance to breathing are very important. Endotracheal tubes may frequently be used. Open and semi-open systems (endotracheal insufflation with Richardson bottle, Flagg can) are better tolerated by the aged than closed systems. If a closed system must be used, to-and-fro absorption is preferred to circle filters. Positive pressure anesthesia is an extra load on the circulation of old patients and should be kept to a minimum. Assisting the patient’s respiration will also ease the circulatory load.

The maintenance of a closed system without an endotracheal tube is often difficult in edentulous old patients because it requires a well-fitting mask. The new Bennett mask is often helpful. Recently a prosthesis has been recommended (8) which, when placed between the inner surface of the lips and cheek and the outer surface of the gums, will make good closure possible with almost any kind of mask.

Because of the decreased cough reflex and frequently depressed respiration during the postanesthetic period in the aged, careful tracheobronchial toilet is of great importance. The incidence of postoperative atelectasis will also be decreased if the lungs are filled with air at the end of anesthesia.

**Postoperative Care**

Aged patients need careful medical supervision in the postoperative period. Atelectasis and other pulmonary complications must be prevented and if they develop should be recognized early. Patients should be turned from side to side frequently, deep respirations encouraged and blow bottles used to facilitate the expansion of the peripheral alveoli. Patients should be stimulated to remove bronchial secretions by coughing and, if unable to do so, secretions may be removed, after anesthetization of the pharynx and larynx, by trachea-
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bronchial aspiration. This can frequently be done without the bronchoscope, using a woven silk catheter. Prophylactic administration of penicillin will also decrease pulmonary complications.

Patients should be encouraged to move their lower extremities freely to prevent phlebothrombosis. In many clinics preoperative ligation of the femoral vein or postoperative heparinization of the old patients has been employed routinely, with marked decrease in the incidence of phlebothrombosis and pulmonary embolism. Early mobilization of old patients will also tend to decrease the incidence of pulmonary and vascular complications.

Analgesics and sedatives must be used sparingly. The use of postoperative intercostal block with a long-acting agent (intracaine or nupercaine in oil) ensures the patient’s comfort without depressing respiration. The intravenous use of 0.1 per cent procaine in 5 per cent dextrose, or 5 per cent alcohol in 5 per cent dextrose also produces sedation and analgesia without respiratory depression. Procaine, given intravenously, tends to decrease the edema present in the tissues traumatized in the course of operation, and thereby promotes wound healing.

The fluid, mineral, protein and vitamin requirements of the old operative patients also must be watched with great care. Dehydration and too much fluid are equally harmful. The total daily fluid intake should be equal to the amount of the measurable loss (urine, feces, vomitus, drainage), plus 1200 to 1500 cc. for the insensible loss. The fluid intake must be distributed as evenly as possible without interfering with the patient’s sleep. In cases of prolonged intravenous feedings the essential quantities of sodium, potassium and other minerals must be furnished. In cases of acidosis lactate may be administered. If the liver function is good the protein requirements can be met by the intravenous administration of protein hydrolysates; when liver function is poor, however, plasma or serum albumin solutions must be used. Generous quantities of the water soluble vitamins should also be added to the intravenous fluids.

In summary: The anatomical and physiologic differences of the aged organism, and the resulting changes in reactivity to pathologic processes and drugs administered must be kept in mind in the anesthetic management of the older patient. Preoperative preparation, premedication, choice and conduct of anesthesia and postoperative care should be handled with extra care to the minutest detail. If these conditions are fulfilled the incidence of operative mortality and morbidity of aged patients will not be materially greater than that of other age groups.

REFERENCES

SECOND BIANNUAL WESTERN REGIONAL CONFERENCE ON ANESTHESIA

The California Society of Anesthesiologists is sponsoring the Second Biannual Western Regional Conference on Anesthesia, to be held April 2, 3 and 4, 1951, at the Hotel Del Coronado, Coronado (San Diego), California. Outstanding international and national men will participate in this Second Conference.

The Oral Examinations of the American Board of Anesthesiology are to be held immediately following the Conference on April 5, 6 and 7, 1951, at the Hotel Del Coronado.

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