The Journal of the American Medical Association

Published under the Auspices of the Board of Trustees

VOL. LVII, No. 23 CHICAGO, ILLINOIS DECEMBER 2, 1911

NEWER METHODS FOR FURTHER INCREASING THE SAFETY OF SURGICAL OPERATIONS *

GEORGE W. CRILE, M.D.
Surgeon to Lakeside Hospital
CLEVELAND, O.

For purposes of this paper, I shall divide surgical operations into two general classes: first, operations performed on patients in fair general health; second, injury or disease. Belonging to the first class are: laparotomies for benign tumors of the uterus and ovaries, simple gastro-enterostomies, appendectomies, uncomplicated operations on the gall-bladder, the kidneys and the urinary bladder, uncomplicated herniotomies, excision of cancer of the breast, excision of benign tumors of the thyroid and simple goiters; in these the operative mortality has all but disappeared. Among 10,723 surgical operations performed by me, 4,127 belonged to this class; among these there was one death in 375 operations. There is but little advantage, therefore, in any discussion of this group of cases so far as the immediate risk is concerned; but while the immediate risk is slight, these operations still bear a certain stigma, viz., a temporary nervous impairment following the operation. Indeed, it is an unpleasant surprise to realize to what extent the public has come to expect that it will require a number of months for complete nervous recovery from the effects of even a simple operation. This, however, does not apply to all types of patients, for there is a vast difference between the woman accustomed to hardships, who, for example, returns to the factory several weeks after delivery, and the woman weakened by protection, whose nervous reactions have been heightened by training and education, and who may require a year or more for her recovery from an operation or a confinement.

Bluntly, and too frequently, has surgery said in effect to these women: "I have successfully performed your operation; if you have allowed yourself to think it an ordeal and your nerves have become shaken, it is because you are a neurasthenic and I leave you to make the best of it."

I shall, I hope, later show that there is a physical basis for such disability, that the surgeon is responsible for it, and that these evil consequences may be almost wholly avoided. While the sturdy patient will get on quite well under present methods, she, too, will appreciate a mitigation of the harshness of surgery.

We turn now to the handicapped patient—the patient whose surgical chances are impaired by acute infections or by hemorrhages, by fractures of the skull and by penetrating gunshot wounds, by acute intestinal obstructions, by stab wounds, by the numerous industrial accidents, by perforative peritonitis—and we turn to the long list of the dangerously ill or dying that are daily brought to the hospital, for it is from these that the lists of mortality in the general hospitals in the city are mainly recruited. These impaired surgical risks resemble each other in one important particular; that is, they all exhibit an impairment of their vitality. Has this impairment a

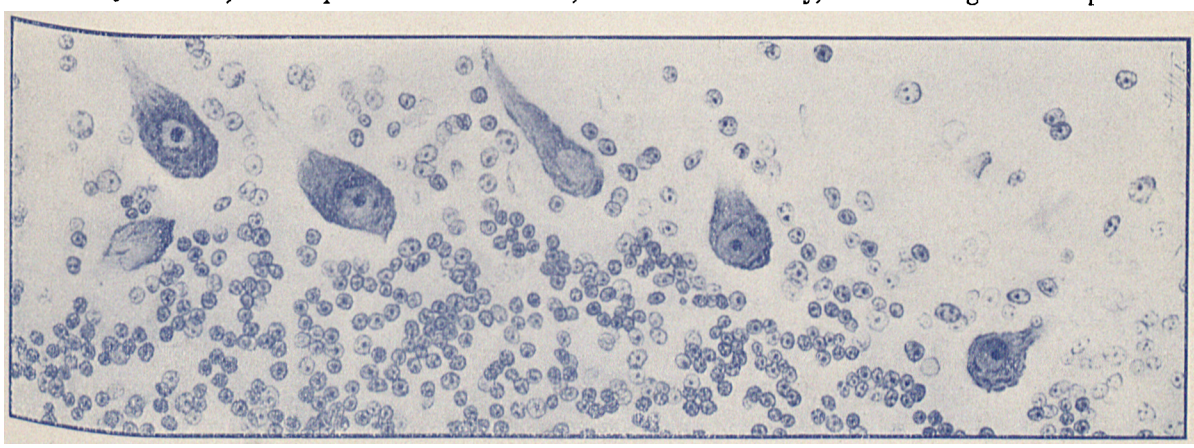

Fig. 1.—Area from cerebellum. Fracture of the skull. The differential Purkinje cell-count showed: active cells, 53 per cent.; fatigued cells, 40 per cent.; exhausted cells, 7 per cent. The patient, a young man, died three hours and twenty-five minutes after receiving his injury. Compare the physical condition of the brain cells in this case of comparatively sudden death in a normal subject with the brain cells of the case of exophthalmic goiter, acute septicemia and that of extensive cancer. From an area like the one portrayed it would be thought the cerebellum was in good condition, but this is disproved by the actual findings in 100 cells.

* Chairman's address before the Section on Surgery of the American Medical Association, at the Sixty-Second Annual Session, held at Los Angeles, June, 1911.

physical basis? We believe that there is as truly a physical basis as there is a physical basis for nephritis or for a fracture. Now the source of the vital force is the cells of the central nervous system, and it is here that we must search for physical changes which are responsible for the decrease in the vital force. Space will permit only of a summary of an extensive research by my former associate, Dr. D. W. Dolly, my present associates, Drs. H. G. Sloan, J. B. Austin, M. L. Menten, and myself, and the clinical researches by my associate, Dr. W. E. Lower. We investigated the alterations in the brain-cells in fatigue, in anemia from hemorrhage, in physical injury, in pyogenic infection, in certain drug poisons, in the primitive emotions and in exophthalmic goiter. As this work has been in part published and an extended publication of the remainder is now under way, I will introduce some typical pictures from a mass of material which will illustrate the changes in the nerve cells in the foregoing types of impairment of the vital force, and hence an impairment of the surgical risk. The alteration in the distribution and the quantity of the Nissl substance, the change in the size relation of the nucleus and the cell body, the rupture of the membrane covering the cell and the nucleus, and the change in the gross size of the cell, all point to physical changes as the cause of the functional impairment. It matters not whether the substance within the cell that produces nervous energy is used up by excessive activity, or whether there is failure to replace the amount used up on account of hemorrhage or starvation, whether the nerve power generating substance is destroyed by a toxin or a poison, the physical changes in the cell are always seen and are apparently proportional to the extent of the loss of vital force. In a painstaking study of the cells of a large number of normal controls, no similar changes were found.

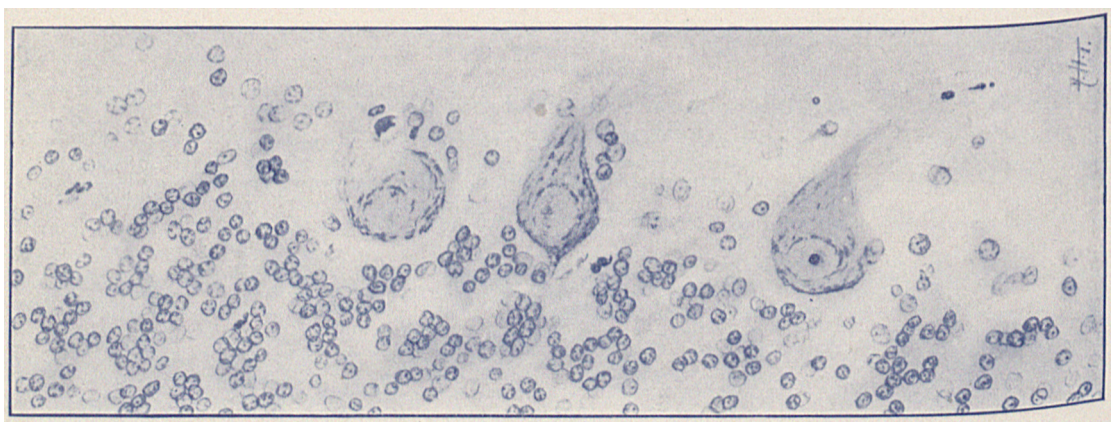

Fig. 2.—Area from cerebellum. Exophthalmic goiter. The average differential Purkinje cell-count from five cases (of which this was one) was: active cells, 34.2 per cent.; fatigued cells, 37.6 per cent.; exhausted cells, 28.2 per cent. The figures represent the typical appearance of the Purkinje cells in all of these cases.

Now, no one more than the operating surgeon is aware of the fact that severe infections, hemorrhages, exhaustion from physical exertion, exophthalmic goiter, surgical shock, and overwhelming emotions, are the common predisposing causes of surgical deaths. In every one of these states there is impairment of the vitality of the patient. An operation that would present virtually no risk in the uncomplicated case may readily prove fatal in any one of these handicapped cases; for example, the amputation of a leg mangled by a crushing accident as compared with the amputation of a leg for tumor; operation in diffuse peritonitis as compared with interval appendix; operation in the presence of overwhelming fear and worry as compared with tranquillity: laparotomy in a patient exsanguinated as compared with a similar operation with normal blood-volume; an explosive half-dying case of exophthalmic goiter as compared with a quiet colloid goiter. What then are the factors in the technic of a surgical operation that may further impair the brain cells and thus be the last straw? The leading factors are fear, traumatic impulses set up in the course of the operation, and the impairment of the immunity of the patient by *ether* anesthesia. In a close risk in cases of acute infection, the impairment in the immunity by *ether* without any operative procedure might easily dispatch the patient. Common experience has taught all of us, and our researches have shown that fear alone may cause grave physical injury, even death. In practical surgery our problem is this: Can we exclude fear? Is there an innocuous substitute for ether anesthesia, and can we prevent the nerve impulses set up by the cutting and handling of tissue from reaching the brain? And finally, when the nerve impulses cannot be blocked, can we prevent the stimulated brain cells from using up their highly dischargeable substance?

First.—The ravages of fear can be avoided by a combination of special consideration on the part of the nursing and the operating staffs, and by the preliminary administration in suitable cases of small doses of morphin and scopolamin. Fear is stronger than the will, hence it must be controlled by the assistance of influences outside of the body. Requiring a patient unprotected to stare death in the face at the time of the operation is like inspecting a photographic film in the sunlight and expecting to find it useful afterward; under morphin and scopolamin one is neither brave nor cowardly, but in a neutral state because these drugs depress the associational power of the brain.

Second.—In external operations, the damaging nerve impulses may be blocked and the brain protected by the local or intraneural infiltration of novocain.

Third.—The damaging reduction of the immunity in the acute infections may be avoided by the substitution of the *innocuous* nitrous oxid for *nocuous* ether.

Fourth.—In the operations, such as abdominal, in which the damaging nerve impulses in the deeper parts cannot be blocked by local anesthesia, nitrous oxid anesthesia, as compared with ether anesthesia, confers a high degree of immunity to shock. Under nitrous oxid a patient will endure approximately four times the amount of operative trauma as under ether, and in addition the patient will go to sleep pleasantly instead of under

stress; there will be little or no postoperative nausea such as follows the use of ether; there will be an immediate complete awakening from anesthesia instead of ether intoxication. In what manner does nitrous oxid protect the brain cells more than ether? It must be remembered that nitrous oxid produces anesthesia by the prevention of the use of oxygen by the brain cells—an anoxemia of the brain cells. Now, the chemical response of the brain cells is, of course, only possible in the presence of oxygen; therefore, in nitrous oxid anesthesia there being a large reduction in the amount of oxygen available the highly dischargeable substance of the brain cells is prevented from being so rapidly used up for want of oxygen. It is like turning on the fire extinguisher before the torch is applied. Nitrous oxid has several limitations: it is difficult to administer well; it requires a specially trained anesthetist; it is more expensive than ether; it does not give so complete a relaxation in abdominal operations as ether; there is more venous congestion in the operative field. All these shortcomings may be either overcome or circumvented. The surgeon can readily adapt himself to its use in operating, as I have found by using it in over 2,400 operations; it compels gentleness and precision, surely not surgical faults. In over 2,400 administrations in general surgery in my own experience, and in 17,762 in the experience of Dr. Teter for dental and surgical work, making over 20,000 in all, there was no anesthetic fatality. All these were administered by the Teter apparatus. We have thus far considered the conservation of energy in the course of operation; is there any means of restoring, in part, lost vitality sufficiently to reclaim certain otherwise hopeless risks?

Turning now to the patients handicapped by starvation or by hemorrhage—such, for example, as neglected pyloric obstructions, whether malignant or benign, hemorrhages from gastric ulcers, extra-uterine hemorrhages, various types of pathologic hemorrhages; these conditions handicap the patient by reducing the nourishment of the brain cells, hence diminishing their functional power. Further experience has amply confirmed observations heretofore reported, viz., that by either a preliminary or a simultaneous transfusion of human blood, these desperate risks may at will be converted into safe ones. Even in cases of patients with chronic starvation from cancer brought to the hospital in the ambulance, I have succeeded by a two-stage operation; first, by a gastro-enterostomy with the assistance of transfusion; then, when the patient recovered a sufficient vitality from the combined effect of the transfusion and subsequent taking of food, by a resection of the stomach. In certain forms of pathologic hemorrhage, the transfusion of normal blood may at once control the bleeding, and also replace the blood that has been lost.

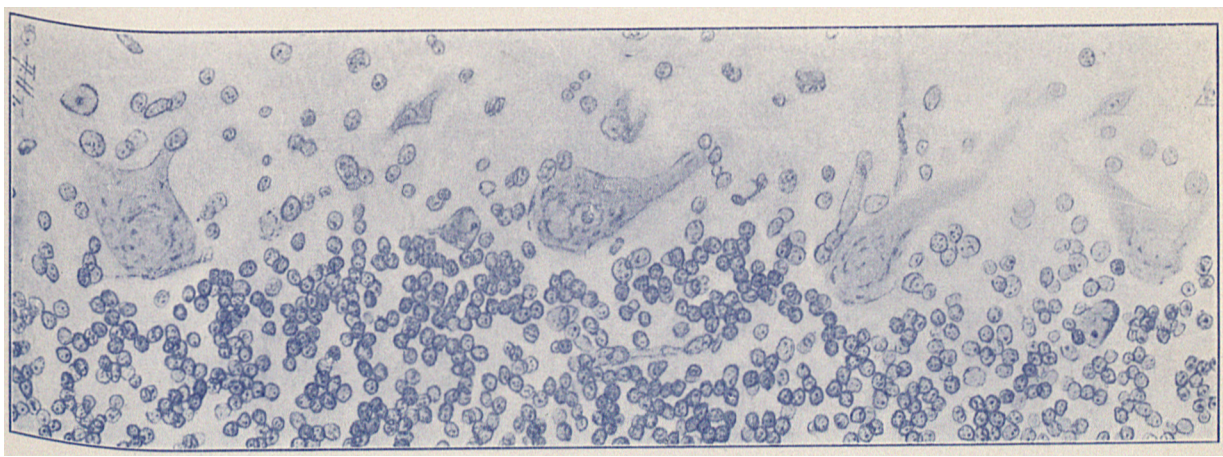

Fig. 3.—Area from cerebellum. Septicemia from streptococcus. The differential Purkinje cell-count showed: active cells, 11 per cent.; fatigued cells, 59 per cent.; exhausted cells, 30 per cent. The patient, a man 48 years of age, died forty-eight hours after receiving a scratch on his hand. The percentage of exhausted cells is very high. Compare this case with that of Fig. 1, a comparatively normal case. Similar changes were seen throughout the cortex as well.

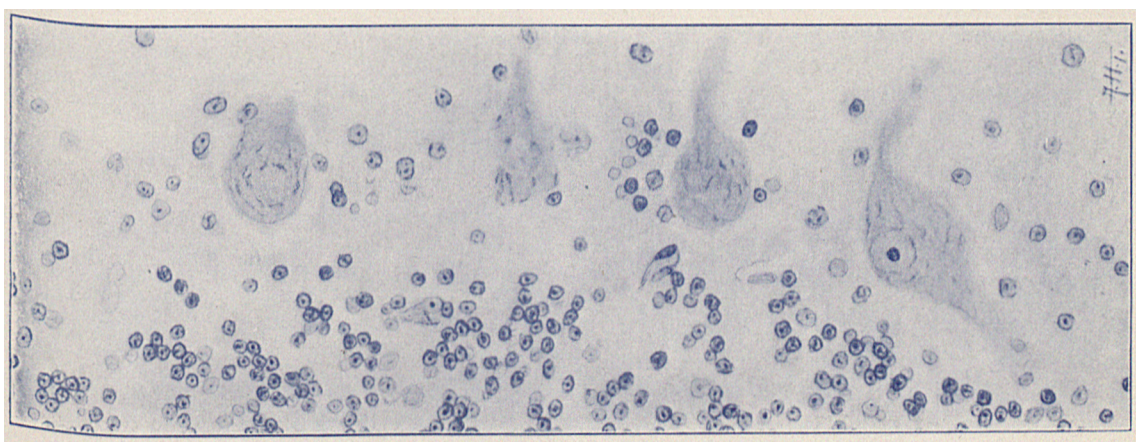

Fig. 4.—Epithelioma of tongue and lymphatic glands. The differential Purkinje cell-count showed: active cells, 4 per cent.; fatigued cells, 39 per cent.; exhausted cells, 57 per cent. Of the 57 per cent. of exhausted cells one-half were almost completely disintegrated. Note the general loss of chromatin in the Purkinje cells, the total loss of nucleolus in three cells and the indefinite cell outline. Compare the brain cells of this exhausted, cachectic patient with Fig. 1, a comparatively normal brain picture.

In that great horde of industrial accidents—especially in crushings of limbs, when the patient is admitted in the condition of grave shock—a transfusion usually rescues the patient. Transfusion should be done either just preceding or during the operation. Should there be a postoperative hemorrhage in any case, transfusion renews the surgical opportunity and may convert defeat into victory.

There has now been a number of strikingly successful cases, any one of which, in my opinion, compensates a thousand fold for the experimental labors and the use of animals in the development of the principles and the technic of transfusion. Applying the two great principles, that of the conservation of the energy by special technic during operations, and that of transferring energizing blood from the normal to the patient, we have in our hands new powers in both attack and defense. It enables one to operate in an explosive case of exophthalmic goiter in such a manner that the patient at the end of the operation is approximately the same as when in bed the day before, and every case may by this method have at least the minimum operation performed. We may reclaim the starved and bleeding abdominal cases; we may amputate the diabetic leg with confidence; besides great control of the vital processes allows the needed time, even in the handicapped case, for a more precise and complete technic. In more than 90 per cent. of my patients, in the routine operations, there are no unpleasant memories of the operating room, the postoperative discomforts are greatly minimized, and the mortality rate, in my own experience, is certainly reduced, as indicated by a rate of 1.9 per cent. in the 2,410 operations performed under the foregoing principle in a general surgical service. In a number of these, the operation was done with a complete exclusion of fear, under nitrous oxid anesthesia, and local anesthesia as well, thus completely protecting the brain from all harmful associations—a state best designated by a new word, viz., *anoci-association*. In this state the brain is completely isolated from operative influences and is not more affected than if the operation were performed on the clothing. This is the ideal surgical state.

Against the development and the use of these methods of greater safety and efficiency in operative surgery, there may be urged the objections that these methods involve a higher training and increased labor on the part of the nursing and the operating staff, that certain new apparatus is required, and that the hospital must meet an increased cost. These easily surmountable objections must be balanced against the disappearance for good of the ether drunken patient, the freedom from postoperative nervous impairment, and the preservation of life itself.

6203 Euclid Avenue.

Clinical and Laboratory Diagnosis.—Under present conditions of private practice crude, rough-and-ready methods of diagnosis are in many cases the best that can be utilized. A refined method poorly executed is worth far less than a rough method carefully and intelligently used by an experienced, keen-sighted, thoughtful man. But the public has a right to demand the more refined methods. Within a generation we have seen most of major surgery transferred from the home to the hospital. There the surgeons can depend not only on the nursing staff to provide better hygienic treatment than is possible in the home but he can also in a well-manned hospital depend on the interns to utilize many of the more refined and time-consuming methods of diagnosis. To these factors surgery owes no small part of its success.—C. R. Bardeen in *Science*.

THE PATHOGENESIS OF THE BALANTIDIUM COLI *

FRED B. BOWMAN, M.B. (Tor.)
BALTIMORE

During the past decade the *Balantidium coli* has been attracting much attention in respect both to its pathogenicity and to its life history.

In Manila the material for study, both clinical and pathologic, has been comparatively abundant. The literature on the subject has been thoroughly reviewed by previous writers and will not be discussed here. Only those points bearing directly on the pathogenicity of the organism will be considered. During the past three years I have examined many specimens containing the organism, but have been unable to follow many of the cases because the patients complained of no symptoms and could not be detained in the hospital; in all I have been able to study clinically ten cases, three of which came to autopsy and have been reported elsewhere.[1]

At present, four cases are under observation, three of which have balantidia in the feces intermittently, the other one, although complaining of little diarrhea, has them constantly present.

ZOOLOGY

Balantidium coli belongs to the *infusoria* class; subclass, *Ciliata;* order, *Heterotrichida;* family, *Bursaridæ.*

It has an oval body from 0.07 to 0.1 mm. in length by 0.05 to 0.07 in width, is pointed anteriorly when the periostome is extended and covered with parallel rows of cilia giving it a striated appearance. It has a bean-shaped macronucleus and a globular micronucleus. It apparently has three methods of reproduction: budding, conjugation and division, though in my studies I have only been able to see definitely the latter, and this is probably the most common. The organism may change its shape in passing through some obstruction, narrowing until the projected portion appears almost like a pseudopod. Sections cut through tissue very often show these processes and they might be mistaken for budding forms.

In the fresh feces, organisms are found in pairs and even larger groups and this has probably often been construed as conjugation, but this grouping seems to be a characteristic of all ciliata and flagellata and is probably in most instances purely physical in character. Both in stained feces and in stained sections of intestinal ulcers these groups were seen, but no cytoplastic changes were found in the nuclei.

The rapid circular motion of the periostome cilia seems to exert an attraction which brings the organisms in contact. I have observed many times in fresh feces two of them moving along rapidly in the fecal material, suddenly, on approaching each other, dart together and remain in this position for a considerable period of time, though no interchange of material could be seen taking place between them and no evidence of reproduction changes.

The hog has been thought to be the most common host of the organism, but the method of transmission to the human host is indefinite. In studying the organism in the human, I have never seen any evidences of encyst-

* Read in the Section on Pathology and Physiology of the American Medical Association, at the Sixty-Second Annual Session, held at Los Angeles, June, 1911.

* From the Biological Laboratory of the Bureau of Science, Manila, P. I.

1. Philippine Jour. Sc., December, 1909, iv, No. 6; April, 1911, vi, No. 2.