

slightest feeling of fullness in the head or to slightly quicken the pulse; these last are certain indications that other desired physiologic effects occur. Unless unusual susceptibility exists, if enough is always taken to produce a more marked immediate result, such as flushing and slight headache, tolerance is soon acquired, and a quantity may be early reached altogether impracticable of administration. When a rather rapid increase seems necessary in order to maintain a constant effect, an equally important point is temporarily to discontinue the drug for two or more days, at intervals of two or three weeks. On its resumption, a much smaller initial dose will be required to produce physiologic effects than that last taken. So used, inconvenient tolerance will be less likely to occur, and the employment of strong solutions, the handling of which is not altogether free from danger, will be less necessary. It must be remembered that nitroglycerin, so far as we know, has absolutely no action in cases of chronic nephritis apart from its effect on vascular tension. It is only indicated in those cases in which the blood pressure is persistently markedly high, and in which ill consequences, such as cerebral hemorrhage or valvular disease of the heart, or stretching of its cavities, are to be feared. Cerebral hemorrhage is a late complication. It requires for its production not only vigorous heart action, but also weakened (generally aneurismal) cerebral vessels. Valvular disease of the slow sclerotic form, commonly mitral, is not infrequently encountered in cases of granular kidney of long duration in which cardiac hypertrophy has kept pace with prolonged arterio-capillary resistance. As Mahomed long ago showed, the pathologic conditions underlying the cardiac condition in these cases is more often recognized than that in which a leaking mitral has resulted from an over-stretched ventricle. These various more or less remote sequences of persistent, raised arterial tension—save perhaps the last, to prevent which both nitroglycerin and a heart tonic may be required—are late phenomena, and usually less to be dreaded than certain more immediate results from undue lowering of vascular tone.

It must not be forgotten that probably a moderate amount of tension is actually conservative. It seems to be recognized that those cases of chronic Bright's disease in which tension is persistently low from the outset are actually of much more gravity than the commonly observed variety with raised vascular tone, and when arterio-capillary resistance shows a tendency to fail voluntarily, scanty urine, with more marked albuminuria, and dropsy, may be expected.

In the administration of nitroglycerin these points must be borne in mind, and the drug must not be prescribed merely because the case is one of chronic nephritis. Much more was originally expected of nitroglycerin as a remedial agent in conditions of persistent high tension than has been realized. I now employ it less frequently in such cases than formerly, endeavoring, at first at least, to bring about the same effect by limiting the nitrogenous intake and by maintaining a free action of the skin and bowels. The influence of constipation in heightening blood pressure is well known, but this fact is not always applied in therapeutics, and the modifying effects of diet receive even less attention. Nitroglycerin and the nitrites temporarily lower pulse tension without influencing the ever-present cause. The latter, if not arterio-capillary fibrosis—which is little controlled by any measure—is nitrogenous waste in the blood. Free action of the emunctories tends to over-

come this, but the fountain-head must be sought for permanent relief.

I believe I was the first to report the employment of massive doses of nitroglycerin, which, as remarked, although apparently free from danger when reached gradually from initial small amounts, are, however, impracticable and inadvisable. In recent years I have rarely desired to exceed a dose of 10 drops of the 1 per cent. solution, and when from the initial dose of one drop tolerance to the larger dose is apparent, the drug is temporarily discontinued. I regard it as most important that other measures to lower blood pressure be coincidentally employed and be tried alone. Especially is it important to restrict the nitrogenous intake, and occasionally to use a mercurial purge, or, more frequently, salines. Aconite is often substituted for nitroglycerin with advantage in these cases.

PERITONEAL GAUZE DRAINAGE.

AN EASY METHOD FOR ITS USE THROUGH THE VAGINA,
AFTER ABDOMINAL SECTION.

W. D. HAGGARD, M.D.
NASHVILLE, TENN.

The fancied necessity for drainage after abdominal section has been greatly lessened by our knowledge that the peritoneum can easily dispose of considerable amounts of blood and serum and that ancient accumulations of pus are generally sterile. The real necessity for drainage has been greatly minimized by perfected methods of asepticity, by most careful repair of denuded peritoneal surfaces, by efficient hemostasis and control of all oozing, and by avoidance of unnecessary trauma in rude and violent manipulations. Classes of cases that were formerly drained routinely are observed to do quite as well without drainage; yet there is a small minority which requires it.

Abdominal drainage has been very generally abandoned for vaginal drainage when possible, except in general peritonitis, where the very large glass tube above the symphysis, combined with the upright sitting (Fowler's) position, leaves little to be desired. Glass is slow to excite lymph adhesions and a large area is drained longer than by any other material. In operations in the pelvis, drainage through the abdominal incision has the disadvantage of being more remote from the area to be actually drained, and therefore unnecessarily involves viscera that are above the infected site. The more or less inherent dangers of all drainage, i. e., adhesions, intestinal obstruction and fecal fistulae, are invited.

The likelihood of wound infection from the drain, resulting in hernia, is perhaps the chief disadvantage. About all infected abdominal incisions have subsequent herniae, which condition is very infrequent in wounds healing aseptically, and without the interposition of a drain. When, therefore, abdominal drainage is used, it is better to bring it out through a separate, small, stab wound, and to close the incision in its entirety. Where the drain must extend for some distance, and adjacent to uninfected viscera, to the point of delivery, gauze should not be unprotected along its whole length. It can be wrapped in gutta-percha tissue, like a cigarette in arrangement, but of any size, or can be encased in a split rubber tube.

In pelvic work drainage through the cul-de-sac into the vagina has the advantage of being very close to the area to be drained, is at the most dependent point, es-

capacities through a natural avenue, is devoid of the danger of hernia, and less likely to occasion fistula, bladder disturbance, and secondary obstruction from adhesive bands. It, however, has the disadvantage that the vagina is difficult to render sterile and that infection of the peritoneum may extend from that source. Occlusive protection to the drain from the outside is also somewhat more difficult. The greatest objection to vaginal drainage is the difficulty of making the puncture through the cul-de-sac and of passing the gauze into the vagina. It is this obstacle that I have in my own work, to say the least, greatly overcome, and which is the purpose of this communication to describe.

The usual method of introducing gauze drainage is to have the patient let down from Trendelenburg's position, or unstrapped, if horizontal, the legs flexed, and the assistant, or sometimes the operator, introduces the fingers into the vagina and makes pressure into the posterior fornix with the fingers or forceps. The operator cuts through at the bottom of Douglas' space and passes the gauze down to fingers or forceps. The assistant has to re-sterilize his hands or, better, has to be eliminated from the subsequent steps of the operation. Aside from the time consumed in this method, which is sometimes considerable, the chief objection is that the vagina is often not prepared, and even if prepared there is likelihood of carrying infection from the outside.

Noble of Atlanta simplified the procedure by designing two instruments which he presented at the meeting of the Southern Surgical and Gynecological Association in 1901. One was a counter-pressure instrument, much like an enlarged Hunter's depressor, which was introduced into the vagina and which by pressure fixed the posterior fornix. It could then be punctured by scissors from above with ease and without danger of injuring any other structure. The scissors have a shoulder on the outside of each blade to prevent the margins of the incision from slipping up on the handles as they are opened to stretch the incision to the desired width. This technic relieves the procedure of some of its drawbacks, but the instruments are not in the armamentarium of every surgeon, and if they are, would not always be at hand. I attempted to simplify that feature still further and used, with considerable satisfaction in a series of cases, an ordinary tablespoon, which was inserted into the vagina and made to put the fornix on a stretch, while the blade of a pair of scissors was thrust through from above into the bowl of the spoon.

Unfortunately, in a bad pus case in an 18-year-old girl requiring drainage, the spoon in its introduction folded over the recto-vaginal septum in front of it and in cutting, as I supposed, into the vagina, the rectum was wounded. The resulting fistula into the vagina readily healed, but caused me to abandon the device. It illustrated, however, the efficacy of pelvic gauze drainage in protecting the peritoneal cavity from contamination in injuries of the bowel low down, if for any reason they are not, or can not be, sutured adequately.

In another series of cases, after preliminary disinfection of the vagina, before operations on the abdomen, where the vagina was packed with sterile gauze, I noticed how easily the mass of gauze could be felt and identified from above. In cases where drainage was necessary, I simply cut down on this gauze through the cul-de-sac and attached the drainage gauze to the vaginal gauze by a safety pin, and after closure of the abdomen the drainage gauze was drawn down by with-

drawing the original vaginal packing. There are, however, many operators who do not pack the vagina as a routine, and this method has considerable limitations. Many sections are undertaken in which the necessity for drainage is not anticipated; indeed, it is not contemplated in the majority of cases. Sterilization of the vagina by ordinary antiseptic douches is notoriously inadequate. Few men have the vagina "scrubbed up" on the table when the operative procedure is limited to the abdomen, and unless the vagina is prepared beforehand through a speculum, it is usually not in an aseptic condition for the institution of drainage when it finally is determined on.

To obviate all these difficulties in the way of establishing drainage in the usual manner, and as an evolution of the methods heretofore mentioned, I have, for the last year or more, in a considerable number of cases, employed with entire satisfaction the following easy method, which I commend to you.

After the intrapelvic work is completed and drainage is deemed necessary, the gauze is introduced into the cul-de-sac and arranged as desired in plaits, the omentum is drawn down on the right side over the operated area and the sigmoid on the left, and the abdomen closed with the gauze left in. After the abdominal dressings are applied, the patient is drawn with hips to the edge of the table and the vagina cleansed thoroughly, as for any operative procedure. The bunch of gauze can be easily felt as a mass behind the cervix, which is steadied and drawn down with a volsella, and the fornix is opened with one snip of the scissors, cutting directly against the gauze, which is seized with forceps and drawn down. It can be done as quickly as it has been described. It has the advantage of being done under absolute aseptic control from the vaginal side and after the abdomen has been closed from above so that no danger of contamination is incurred. The drainage strip should be tied to the packing in the vagina so that there will be no possibility of ever leaving any gauze behind.

Iodoform gauze should always be used in the vagina, as an effective occlusive dressing is desired. It stays sweet longer than plain gauze. The 1-inch strips of 5 per cent. iodoform gauze with selvedged edge, which come in glass container, have been found most convenient.

The life-history of gauze as a drainage material is very short. The meshes soon become blocked with exudate, and its capillarity ceases. The gauze should not plug the aperture too tightly. The chief function of gauze drainage in a severely infected region of the peritoneum is not so much for its capillarity as for the quarantining of that area from the general cavity by the exudate which is so promptly and effectively thrown out around the area, with the gauze as the excitant. That is nature's plan for segregating all infections. The gauze invites and initiates this very plan.

Occasionally an abrupt rise of temperature occurs when gauze drainage is employed in conditions where free exudation occurs over a long time, and if it is withdrawn, a little quantity of serum will sometimes be found pent up. In cases of that sort, the gauze should be withdrawn a little each day. Generally, however, if gauze drainage is needed at all in the peritoneum, it should be left six days. It can then be easily withdrawn. The walls of exudate around it will be well formed and they are stiff enough to afford a pipelike drain from any septic point for some days without ir-

rigation. If gauze is withdrawn too soon, the fresh granulations will be disturbed and bleeding occurs and atria for fresh infection are opened by the trauma. The external part of the tract may close if not kept open by frequent dressings.

I have not attempted to define the cases which require it, but merely to describe this simpler way of establishing gauze drainage through the vagina.

Special Article

IMMUNITY.

CHAPTER XVI.

PHAGOCYTOSIS.

As one may learn from the writings of Metchnikoff, phagocytosis in its broad sense has three distinct channels of activity: nutritional, resorptive and protective.

Phagocytosis for purposes of nutrition is most highly developed in unicellular ameboid organisms, but is found also in animals of considerable organic differentiation. It is perhaps nowhere more striking than among certain myxomycetes, which are large, naked, multinucleated, protoplasmic masses belonging to the plant kingdom, and which possess that peculiar, slow, undulating motility which characterizes the ameboid cells. Ingestion is accomplished through protoplasmic arms (pseudopodia) which are thrown out to envelop the object. Minute plant and animal cells, living or dead, are ingested in this manner by the myxomycetes, amebæ and other unicellular organisms and are subsequently digested by means of intracellular ferments. The ferments which have been extracted are proteolytic, digesting gelatin or fibrin, usually in an acid but sometimes in an alkaline medium; that from amebæ has been called amibodiastase. In the process of digestion a "vacuole," acid in reaction and containing the ferment, forms around the ingested particle. In certain unicellular organisms which are phagocytic the protoplasm shows a degree of differentiation, a mouth and an anus being simulated at points where the food is most readily taken in and discharged. Instances are cited in which ameboid organisms protect themselves against inimical cells by ingesting, killing, and finally discharging or digesting the latter.

Pfeffer first described the phenomena of negative and positive chemotaxis in relation to the myxomycetes. Under certain conditions they either are attracted toward or move from moist places. That a negative chemotaxis may be changed into a positive was shown in relation to salt solutions. When placed in the vicinity of or in contact with strong solutions the cell recedes, whereas if one passes gradually from weaker to stronger solutions the latter eventually attract rather than repel the cell.

As one goes higher in the animal scale intracellular digestion for purposes of nutrition is confined to rather definite groups of cells. The intestinal epithelium of certain multicellular invertebrates consists of "sessile phagocytes," cells which, individually or after fusion into plasmodial masses, surround and digest solid particles of food. It is said that in sponges the digestive tract is not sharply separated from the mesodermal tissue, and the cells of the latter share with the former the function of intracellular digestion.

In higher invertebrates and in all vertebrates the intestinal epithelium ceases to be essentially phagocytic, digestion being accomplished rather by the ferments which have been secreted by the intestinal and related glandular epithelium. Such animals, nevertheless, possess an abundance of phagocytic cells, but they are in the main mesoblastic in nature, and may have nothing more than a remote relationship to the nutrition of the organism.

Metchnikoff classifies the phagocytic cells of vertebrates into the macrophages and the microphages. The macrophages

or large phagocytes include the large lymphocytes, endothelial cells, ameboid connective tissue cells and others which may occasionally take up foreign particles. Our polymorphonuclear leucocytes are the microphages. In relation to immunity we are concerned chiefly with the large lymphocytes (macrophages), and the polymorphonuclear leucocytes (microphages). Although such cells may contain many ferments Metchnikoff recognizes but one type in relation to their resorptive and digestive functions. This he calls cytase and distinguishes that of the macrophage as macrocytase and that of the microphage as microcytase. The two cells do not have identical activities, the macrophage being concerned especially in the resorption of tissue cells and in immunity to certain chronic diseases as tuberculosis and leprosy, whereas the microphage is the cell which is conspicuously antimicrobial in relation to acute infections.

Metchnikoff has studied the resorption of cells over a wide range of animals. He speaks of the process as the resorption of corpuscular elements. During the metamorphosis of certain invertebrates it is said that the larval tissues are disposed of by the action of wandering phagocytic cells. In involution of the uterus the muscular tissue is invaded by leucocytes which take up and digest or carry away the "retrogressive elements." Perhaps of more interest is Metchnikoff's conception of certain atrophic processes, particularly those which are grouped among the senile atrophies. In sclerotic atrophy of the ovaries the large lymphocytes invade the tissue, surround and destroy the ova and follicular epithelium and eventually, as fibroblasts, participate in the formation of fibrous tissue which to a degree is substituted for the original structure. In old individuals or in those of failing mentality it is said that ganglionic cells are found in a greater or less degree of atrophy because of the action of certain mononuclear phagocytes (neuronophages) which are contiguous to or form a zone around the cell. The neuronophages may represent mononuclear cells from the blood or those of proliferated neuroglial tissue. The best examples of this condition were found in very old dogs.

The chromophores of the skin, according to Metchnikoff, may be considered as chromophages. Whether or not they are of epithelial origin, as he claims, they are said to exist normally in the hairs in a latent or inactive condition. As old age comes on, or as a result of other obscure causes, their attitude becomes an active one, and they proceed to take up and digest the normal pigment of the hairs. Hence white hairs are the result of an autoparasitism by certain mononuclear phagocytes—an atrophic process.

In muscular atrophy it is held that the sarcoplasm takes up the striated tissue after the manner of phagocytes. We come into closer touch with our general subject of immunity when we consider the attitude of the phagocytes toward cells which are foreign to the host, for example, toward erythrocytes which are injected for the production of a hemolytic serum. Following such an injection into the peritoneal cavity there occurs a great accession of macrophages which ingest the erythrocytes, dissolve the hemoglobin and eventually digest the stroma. The same phagocytes are involved in the resorption of any other foreign cells of animal origin which may be injected. In view of the intracellular hemolysis by the leucocytes one may well suspect that the latter contain a hemolytic ferment; one which perhaps is analogous to the hemolysin (hemolytic amboceptors and complement) of a serum. On this point there has been a sharp discussion. Metchnikoff cites observations to show that a ferment of this nature may be extracted from lymphoid organs, that it contains a heat-susceptible constituent, and that when fresh it may be used to reactivate a heated hemolytic serum. This would indicate that the leucocytes contain cytase (complement), but it is not clear that they would also contain the fixators (amboceptors). Nevertheless the demonstration of an intraleucocytic hemolysin, coupled with the phagocytic power of the leucocytes for erythrocytes, forms the basis for the belief that serum-hemolysin is nothing more than intraleucocytic hemo-

The whitening of Hairs.

Cytotoxins.