applied over the wound line. Over this a strip of gauze is placed, and its edges glued to the skin with adhesive plaster straps. This gauze and adhesive plaster are then painted with the collodion solution, after which the rubber dam protective is drawn up and laid flat on the back, and its three remaining margins are glued to the skin, as was the underlying gauze, by adhesive plaster straps. Next a small triangular piece of adhesive plaster is so applied that a sharp point passes downward between the buttocks, with the base of its triangle overlying the straps of adhesive plaster securing the lower border of the rubber dam. The adhesive plaster is then covered with collodion so that the zone of operation is sealed against infection by excreta.

In certain rare forms of spina bifida, as in spina bifida occulta, the suggestions offered in this paper are, of course, without value. However, in one rare form, the anterior meningocele, a successful operation for which is reported by S. Roux,⁸ the use of the clamp might remove many inconveniences. In the several forms of meningomyelocele, it is submitted that the application of the light clamp will facilitate and render more safe the additional steps required in the attempt to deal in a radical way with this condition. With the simple meningoceles it is believed that the careful application of the technic herein embodied will make the operative mortality of this form quite as low as that in the analogous condition of inguinal hernia.

CONCLUSIONS

1. Spina bifida associated with increasing hydrocephalus is inoperable.
2. Operation should be performed in cases of spina bifida associated with paralysis only for the purpose of preventing subsequent ulceration and rupture.
3. A rubber dam sutured at one margin to the skin below the tumor, adhesive plaster, and plentiful collodion should be used to prevent fecal and urinary contamination.
4. A light, rubber-covered clamp applied to the neck of the tumor is the safest method of preventing the loss of cerebrospinal fluid and also of excluding infection from the cord.
5. The sac can usually be tied off as in inguinal hernia.

8. Roux, S.: *Rev. méd. de la Suisse Rom.* 38: 47 (Jan.) 1918.

Civil Versus Military Syphilis.—All returning Canadian soldiers whose military history sheets bear the record of venereal disease are given the Wassermann test before being discharged. In August, 1918, 2 per cent. of those returning reacted, all tertiary, noninfectious cases, for no primary or secondary cases are permitted to return. The average number of reactions in the civil population is estimated at from 8 to 12 per cent., showing four to six times as much syphilis in the civil population as in the army. It is not the civil population that has to fear the soldier, but the soldier the civil population.—Adami, *Canad. Med. Assn. Jour.*

SURGICAL DRAINAGE FROM A BIOLOGIC POINT OF VIEW*

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The biologic defenses of the body against disease, trauma and the wear of age are wonderful, but they are not perfect. If they were perfect, man would live forever. Particularly interesting is the manner in which the body protects itself against injurious foreign substances. The epithelial lined body cavities have more or less specialized methods of protection. The stomach, for instance, by vomiting emits food that is spoiled, and many drugs that are irritating or disagreeable to the taste, and sometimes even rejects substances that are thought to be nauseating or noxious even though they are not. The excessive salivation when nausea occurs probably tends to dilute the offensive material, or to protect the walls of the mucous membrane. Vomiting undoubtedly is a habit that was acquired in the early days of evolution. The more refined drugs or poisons that are a result of chemical manufacture have not created a similar defense by the stomach, and are often retained.

Foreign irritating substances in the rectum, the bladder or the larynx are also expelled by muscular action. Irritating matter in the nose causes a profuse secretion, which tends to wash away the offending substance. An irritating foreign body in the eye causes at once a flow of tears in an effort

Fig. 11.—Inverted position used by Babcock to prevent sudden escape of cerebrospinal fluid.

to wash it away, and at the same time the spasm of the muscles of the eyelids is probably due partly to an effort to expel the foreign body, as well as to protect against further injury.

In endothelial lined cavities or in solid tissue there is an attempt to wash away foreign irritating matter. This is done by the pouring out of serum from the lymph circulation in the neighborhood of the foreign substance, which is accomplished by the reversal of the circulation in the local lymphatics, so as to empty their contents around the irritating material. This is really the chief basis of surgical drainage.

In surgical drainage, mechanical measures that are followed by fortunate results would appear ridiculous if no biologic conditions existed. In preventing infection of a fresh raw surface, or in the so-called walling off of healthy tissue from the products of infection, gauze is often placed over the raw surface or as a coffer-dam in the abdominal cavity, and an abscess is drained through the center of this gauze packing. If we could convert this into a mechanical proposition and imagine that the pus was a solution of methylene blue and that it was flowing over this raw surface which had been covered with absorbent gauze to pre-

* Read before the Southern Surgical Association, New Orleans, Dec. 18, 1919.

vent contamination, we know that both the gauze and the wound would be deeply stained. However, this method of protection does act in a beneficial manner, and a clean wound is often by this means kept from septic infection. The drainage of a peritoneal abscess is practically always up-hill and is usually successful. If mechanics were the only principle, how could an appendical abscess ever be drained by putting a tube down to it through the abdominal incision? The whole method of drainage really depends on the reversal of the circulation in the local lymphatics and is chiefly a biologic process. It is nature's effort to extrude a foreign substance.¹

A splinter in the finger which becomes mildly infected will discharge a thin seropus for days. This is nature's effort to expel the splinter. After it has been removed, the wound rapidly closes; and the lymph circulation, which was in part at least reversed in an effort to extrude the splinter, assumes its normal course, and probably in twenty-four hours after the splinter has been removed there is no further discharge.

The peritoneum and its underlying structures in the abdominal cavity constitute an enormous lymph space, and the lymph is here abundantly poured out in response to an irritation. The insertion of a drainage tube causes a reaction in which there is a flow of lymph in an effort to expel the drainage tube. Drainage of the abdominal cavity prevents positive pressure in the septic region, and also the drainage tube is a stimulus for a reversal of the lymphatic circulation. The packing of a fresh wound with gauze causes a similar reversal of the lymphatic circulation; and though pus may flow over this gauze from a deeper focus, the lymphatics, instead of absorbing the pus, pour out lymph into and around the gauze to extrude it. The beneficial action of the cigaret drain, which is soon clogged with coagulated lymph, is comprehensible when we look on it as a stimulus for reversal of the local lymphatic circulation.

In regions of the body in which the lymph supply is less abundant than it is in the abdomen, unless the infected focus is very small it will be necessary to utilize gravity when instituting drainage, because there is not a sufficient flow of lymph to flush the septic cavity thoroughly and constantly, as is the case with abdominal drainage.

Drainage in surgical operations may be classified under three heads:

CLASSIFICATION OF SURGICAL DRAINAGE

1. Drainage of solid tissue or endothelial lined cavities:
  - (a) Drainage of endothelial covered tissues of the abdominal cavity.
  - (b) Drainage of other endothelial lined cavities, as pleura, joints.
  - (c) Drainage of solid soft tissue, as muscle, fascia, fat.
  - (d) Drainage of bone.
2. Drainage of inflammatory products from infected epithelial lined hollow viscera, as the gallbladder and the urinary bladder.
3. Drainage of hollow viscera in order to restore function or to secure physiologic rest.

1. DRAINAGE OF SOLID TISSUE OR ENDOTHELIAL LINED CAVITIES

Considering first 1a, drainage of abdominal abscesses, we find, as has already been stated, that the abdomen has an enormous supply of lymph and that the successful drainage of an abscess in this region

consists, first, of relieving the pressure in the abscess cavity by opening it and inserting a drain; and, second, of inducing a sufficient reversal of the lymph circulation by the presence of the drainage material to cause much of the septic products to be washed away along the drainage track. If the drainage material reaches the abscess cavity so that the pus is not under positive pressure, and if the drainage is sufficient in amount and of the proper kind to act as a stimulus for reversal of the lymphatic circulation, so much lymph is poured out that practically a continuous irrigation is going on from the local lymphatics along the tube or track of the drainage material, and it is a matter of but little importance whether the drainage material is pointed up or down. But in other endothelial cavities (1b), such as the pleura or the joints, where the lymphatic supply is much smaller than in the abdomen or where the configuration is such as to make the drainage difficult, gravity must aid and the problem becomes more mechanical than biologic. Drainage here should be at the lowest point possible.

Drainage carried down to the sutured bowel frequently results in a fistula, particularly if gauze in the form of a cigaret drain is employed. The reversal of the lymphatic circulation in the neighborhood of a recently sutured intestinal wound, which will direct the current of lymph to the drainage, interferes with the normal process of repair in the intestinal wound, causes a weak fibrinous deposit, and diminishes the nutrition of the repairing bowel; consequently, the sutures readily break down and a fistula results.

In drainage of muscle, fascia and fat (1c), gravity drainage must be considered, but the biologic problem is also prominent. An abscess in the thigh heals better if gravity drainage is instituted. The drainage material should be sufficient not only to carry off the secretion but also to excite the local lymphatics to reverse their circulation. The local lymphatics, being much less abundant than in the abdomen, cannot usually furnish enough lymph to cause the flushing out of the septic products, as occurs in the abdomen. In rapidly spreading inflammation, wide incisions and drainage are useful in relieving the pressure that is made by the binding fascia or skin, and in reversing the circulation of the lymphatics and so preventing absorption of much of the septic products into the main lymphatic trunks.

The old operation of "fence rail" incisions along the margin of an advancing erysipelas causes the pouring out of lymph from these cuts and the diversion of the lymph current, which would otherwise carry the septic products to further uninfected regions. The undermining of the skin and insertion of tubes or gauze drainage from point to point make the pouring out of lymph along the drainage material even greater than after a simple incision.

That the reversal of the circulation is the chief biologic process by which surgical drainage acts beneficially in solid soft tissue can also be recognized when there is a small abscess in a large amount of inflammatory exudate and it is impossible to locate the small abscess cavity. If a drain is placed in the immediate neighborhood of the abscess, it frequently opens into the drain. It seems probable that this occurs because the lymphatic current attempts to extrude the drain and so the products of the abscess are carried in this direction, and the abscess burrows to the tube.

The drainage of tissues whose lymphatic trunks have been clogged and where, consequently, edema is present depends on an effort to increase the lymphatic circula-

1. Horsley, J. S.: The Value of Biologic Principles in Surgical Practice, J. A. M. A. 72: 1263-1266 (May 3) 1919.

tion or to create new lymphatic connections. In the operation of Handley in which long threads of silk are placed under the skin in edema of the arm, lymphatic channels form along the threads. In the operation of Kondoleon, the deep fascia of the arm or leg is split in order to promote an anastomosis between the deep and the superficial sets of lymphatics and so to divert the lymph current from the superficial to the deep lymphatic trunks.

Local edemas that are persistent are usually caused by blockage of the lymphatic channels and not by interference with the blood circulation. The edema that sometimes appears in the arm after a radical operation for cancer of the breast in which the axilla is thoroughly dissected is due to the removal of the lymphatics. If this immediately follows operation, it may disappear when the collateral lymphatic circulation is established; but when a late edema results it is frequently because the lymphatics have become plugged with cancer cells; and such an edema is ominous. Resection of the axillary vein if the lymphatics are in satisfactory condition is followed by but little if any swelling in the arm, and that of a temporary nature. A phlebitis causes edema only when the lymphatics around the vein are involved in the inflammation.

Drainage of wounds after radical operations for carcinoma in solid soft tissue should always be done. This is not so much in order to carry off the fluids that may accumulate in the wound, as an effort to reverse the circulation of the lymphatics which may be induced to pour out their contents in the direction of the drainage tube and so to discharge through this drainage cancer cells that have been left in the wound or that may have lodged in the open lymphatics. This is an important step in many radical operations for cancer, as after operations in the neck or on the mammary gland.

Drainage of bone (1 d) involves problems of a somewhat different nature, because of the structure of bone. Bone is compact, rigid tissue in which lime salts are arranged in an orderly way. On account of the rigid structure it is impossible for either the blood vessels or the lymphatics to form, or for the lymph current to reverse as readily as in soft tissue. Before drainage can be accomplished or any effective stand against infection can be made, the lime salts must be removed, so converting bone into what is practically soft tissue. For this reason, in areas of inflammation bone is always soft. Around an irritating substance in bone, whether accompanied by infection or not, lime salts are absorbed. When this is accomplished the offending material becomes loose and is prepared for extrusion. If, for instance, a piece of iron, as a screw used in plating bone, is inserted into a bone, the lime salts in the neighborhood of the screw and of the plate are absorbed. The screws, which may have been very tight and firm when inserted, gradually become loose. This induced osteoporosis around the screws and the metal plate is just the reverse of what is desired when a fracture is to be repaired, and it accounts for the frequency of nonunion after the plating of bones.

The numerous so-called abscesses at the roots of teeth are probably often the result of the reaction of the bone in the neighborhood to some material that was used in filling the cavities in the roots of the teeth. Undoubtedly apical abscesses frequently occur, but it is probably equally true that an osteoporosis sometimes interpreted as an apical abscess may be sterile and due

to the reaction of the bone to the material with which the root of the tooth has been filled.

Because of the poor lymphatic supply of bone and its rigid walls which protect its vessels, a bone abscess may be more readily disinfected by means of strong antiseptics, such as phenol (carbolic acid), than if the abscess were in soft tissue. Here, as disinfection can be more thorough, the necessity for full drainage in the milder chronic infections of the bone is not so great if the diseased bone has been removed as it would be in soft tissue. Consequently, "fillings" or "bone plugs" are utilized.

2. DRAINAGE OF INFLAMMATORY PRODUCTS FROM INFECTED EPITHELIAL LINED HOLLOW VISCERA, AS THE GALLBLADDER OR THE URINARY BLADDER

Drainage here involves principles different from the drainage of an abscess that has formed in solid tissue. This drainage not only is for removing the products of infection, but serves a double purpose of also giving physiologic rest to the infected organ. The drainage of a septic gallbladder that may be filled with pus carries off the products of the bacteria and at the same time gives rest to the gallbladder by preventing distention, and this removes both a stimulus for contraction and the tension that would occur on the distended walls. Drainage of this type does not have to be gravity drainage. If a sufficient opening is provided in the general axis of the peristaltic current, it is all that is necessary. In draining an infected urinary bladder, for instance, an opening made at the top of the bladder is as satisfactory in securing results as an opening at the bottom.

When these hollow muscular organs are contracted, a small opening will insure the viscera keeping empty if it is made in due regard to the action of peristalsis. Even in such instances, however, the beneficial action of the drainage is not solely removal of the contents of the hollow viscera or the giving of physiologic rest. It seems highly probable that reversal of the lymphatic current is also of importance here. This appears to be borne out by the results of drainage of the bile tracts in inflammation of the pancreas. It is well known that chronic pancreatitis can best be treated by prolonged drainage of the bile tracts; and drainage of the common bile duct for this affection seems to be particularly effective.

The work of Deaver and Pfeiffer² on pancreatic and peripancreatic lymphangitis is interesting in this connection. They call attention to the anatomy of the lymphatic supply of the pancreas and its ultimate connection with the lymphatics of the bile tracts and gallbladder. They say:

To the objection that infection to be carried into the pancreas must stem the efferent lymph current and force the valves, the answer can be made that every one has seen infection in cellular tissues proceeding in a reverse direction to the lymph current. Thrombolympangitis readily diverts the normal lymph course, and infection easily destroys valves. The force of pathology here, as in so many other instances, perverted the normal function.

If infection of the pancreas can be through the lymphatic supply from the gallbladder or the galltracts, as Deaver and Pfeiffer assert, it seems that the method of relieving this infection is to reverse the lymphatic current and cause it to be diverted toward the drainage tube and the incision in the gallbladder or in the com-

2. Deaver, J. B., and Pfeiffer, D. B.: Pancreatic and Peripancreatic Lymphangitis, *Ann. Surg.* 58: 151-163, 1913.

mon duct, just as the lymph flow is reversed in the drainage of an abdominal abscess. Septic products that would be carried in the lymphatics from the infected gallbladder to the pancreas are thus diverted to the drainage tube in an effort to extrude it. If this diversion can be maintained sufficiently long to permit nature to build up the resistance of the pancreas to the infection and repair the damage already done, the patient may be considered cured. But if the drainage tube is removed too soon, there is no further stimulus for a reversal of the lymph circulation, and the pancreatitis recurs.

Too early resumption of function after drainage of inflamed hollow viscera frequently results in a recurrence of the inflammation. This may be due to one of three causes, or more probably to a combination of these causes: 1. There may be an accumulation of secretion that is not free from the products of the inflammatory process. 2. There is an interruption of physiologic rest. 3. There is a change in the lymph current from that which had been instituted by the drainage.

3. DRAINAGE OF HOLLOW VISCERA FOR PHYSIOLOGIC REST

In enterostomy, the operation may be done to sidetrack the normal contents of the hollow viscera and so to afford less work for the diseased tissue below the point of opening, as in colostomy for disease of the large bowel farther down. Drainage may be instituted to prevent distention of a hollow viscus and so induce rest in order that an operative wound may heal. This principle is put into practice in such operations on the bladder as for vesicovaginal fistula when a self retaining catheter is placed in the urethra, and in the introduction of a tube through the rectum and through the site of resection of the sigmoid or left colon in order to draw off the gas and prevent distention in the region of the operation. This principle of drainage is often utilized after the removal of stones from an uninfected gallbladder.

DRAINAGE MATERIAL

The material for drainage must be considered not only with regard to transporting the products that are to be drained, but also with regard to the biologic influence of the drain on the local lymphatics. Certain substances call for a more pronounced flow of lymph than others. Rubber, for instance, is not so irritating to tissue as gauze. When gauze is placed over a raw surface, the local lymphatics pour into the gauze quantities of lymph. This is nature's effort to extrude an irritating foreign substance. When the lymph has coagulated, the meshes of the gauze become entangled with the wound; and an effort to remove the gauze before this fibrin has softened results in tearing the delicate tissues of the wound and injures its granulations, causing bleeding. An ideal drainage material would be one which, on the one hand, is a pronounced stimulus for the lymph to be poured out along the drain, and, on the other hand, would not be sufficiently attached to the raw surface of the wound to injure it. This material has not yet been found.

Rubber drainage tubes are frequently used, and have the advantage of draining off inflammatory products readily; but they do not provoke such an outpouring of lymph as gauze would. Naturally, however, the larger the tube the greater the irritation, and the more pronounced the stimulus for a reversal of the circulation of the local lymphatics. Consequently, for draining an

abdominal abscess, it is often found that a large tube does better than a smaller one, not because the smaller one is insufficient to carry off the serum or the pus, but because the small tube is not large enough to provoke a sufficient amount of reaction among the local lymphatics. Frequently the advantages of both gauze and rubber are combined by placing a gauze strip inside the tube or by wrapping strips of gauze in rubber tissue or rubber dam, which is called a "cigaret drain," and using this in addition to a tube. In this way the gauze which is exposed at the end of the cigaret drain causes a more pronounced flow of lymph than the rubber tube alone could produce, and the tube drains away the lymph that is thrown out to extrude the gauze and the tube. Drainage material should not remain too long in a wound, else it will act as the infected splinter mentioned above.

Combinations that are effective have been worked out to a large extent empirically. Sometimes strands of catgut, silkworm-gut, or strips of rubber tissue are inserted into a wound in which it is anticipated that there may be a collection of serum or broken down fat on account of the nature of the wound. This foreign substance, the drainage material, directs the current of the lymphatic flow toward itself and so prevents an accumulation in the tissues which might later become a culture medium for bacteria. An opened superficial abscess often needs no drainage material, for the necrotic products of the inflammatory process are a sufficient stimulus for drainage.

• ENCAPSULATED FOREIGN BODIES IN THE PERITONEUM

If such foreign materials as gauze or cork are left in the abdominal cavity under sterile conditions, they are rapidly surrounded by a deposit of fibrin, as shown by Hertzler.³ This fibrin, which is coagulated lymph, soon is covered with endothelium and takes on the characteristics of peritoneum. If the gauze is left for a number of weeks or months, it may intrude into a neighboring hollow viscus and be expelled, as this may be the point of least resistance and, consequently, of greatest pressure. Instances are recorded in which gauze that has been accidentally left after a surgical operation has been expelled by the bowel or by the bladder months or years later. Sometimes, however, the gauze is completely encapsulated with a cystlike wall and becomes so thoroughly infiltrated with fibrin that partial organization takes place. Portions of the gauze may be disintegrated and removed by phagocytes, and the connective tissue penetrating the rest of the gauze is so intimate that it may have to be dissected away with much difficulty.

3. Hertzler, A. E.: *The Peritoneum*, St. Louis, C. V. Mosby Company, 1919, 1: 251-253.

Mental Hygiene.—As far as treatment and care of mental abnormalities are concerned, it is necessary in each locality to determine the number of feeble-minded, epileptic, insane and psychopathic among the population, to inquire into their individual needs, and finally to provide facilities for scientific care and treatment. In connection with prevention the public must be informed concerning certain salient facts relating to mental disorders and taught through newspaper and magazine articles, leaflets, and public addresses, what is practical in the way of preventive measures. Prevention and treatment are intimately bound together, because when the feeble-minded, for example, are segregated in institutions and farm colonies, they are prevented from reproducing their kind.—C. M. Hincks, *Am. J. Pub. Health* 9:353, 1919.