

Where it is possible the mucous membrane of the roof of the canal should not be destroyed and the ends of the urethra will thus be prevented from retracting excessively. In the worst cases, where the urethra has been practically destroyed, transverse division may be necessary. In many of the inflammatory strictures, however, it is possible to leave this strip on the roof which does not in any way interfere with the free mobilization of the anterior segment. For convenience of description, the steps of the operation will be given in order.

(1) With the patient in the lithotomy position a free median incision is made down to the urethra, dividing the structures of the bulb in the median line and turning them aside. It is important that this incision should be carried well backward so that the membranous urethra can be exposed.

(2) The stricture is then divided by a longitudinal incision upon a guide, if one has been passed; without a guide, if its insertion has been impossible. The whole incision should be about one and one-half inches in length. The condition at the point of stricture is then examined. All excess of scar tissue should be removed; the whole strictured portion excised if necessary, and hemostasis obtained. (Fig. 2.)

(3) The anterior segment of the urethra is then freely mobilized by separating the corpus spongiosum from its attachments until it can be joined to the posterior segment without tension. Upon this part of the operation particular stress is laid.

(4) Suture. If it is necessary to completely divide the urethra, suturing should be begun upon the roof, the sutures being passed from without inward, including all the structures of the corpus spongiosum and the urethra. We have generally used number zero chromicized catgut and a fine full-curved needle. Where it has been found possible to leave the roof of the canal intact, suturing is begun at the sides in such a way that the longitudinal incision in the urethra is brought together transversely, somewhat after the method of a pyloroplasty. (Figs. 3 and 4.) After about one third of the circumference of the canal has been sutured, a No. 28 sound is passed into the urethra and the suture is completed about this so as to be sure that the canal is given full caliber. As the dilated urethra behind the stricture generally yields more readily than the anterior segment, the line of suture will be found at the end of the operation to occupy a position further forward than the original stricture. The last suture closing the wound unites the two extremities of the longitudinal incision in the urethra, and by lengthening this incision the caliber can be increased to any reasonable extent.

(5) The suture having been completed, the urethra is opened upon the sound at a point as far behind the stricture as possible. This opening should be small, just sufficient to admit a No. 12 (English) soft rubber catheter, which is passed to the bladder and left in position. (Fig. 5.)

(6) The wound is then sutured in layers, bringing together the muscular structures of the bulb as accurately as possible with interrupted sutures,

and the skin is closed, except for a point at the lower angle through which the catheter is brought out. When the closure of the wound is complete, the patient is placed in a horizontal position, the catheter is adjusted at the proper point and is then fastened in position by a suture in the skin.

After-treatment. — The important points in the after-treatment are the care of the anterior urethra and the retention of the catheter until the wound is completely healed. The care of the anterior urethra has been described above, and the essential thing is that the urethra should be kept entirely clean with some solution which will not produce undue irritation, and by some method which will not traumatize the suture. It has seemed to us that injection with a small syringe is preferable to irrigation, either with a catheter or with a reservoir and nozzle.

The catheter should be left in position for from ten to fourteen days. In one case we removed it at the end of a week and slight leakage occurred at the point of suture. In more recent cases it has been retained for two weeks and no leakage has taken place. The perineal *bouttonnière* closes, as a rule, in two or three days after withdrawal of the catheter. No instrument should be passed through the stricture until complete healing has taken place, which will be during the third week.

Cases to which the operation is suited. — Resection is applicable to all strictures of the bulbomembranous portion of the urethra not amenable to gradual dilatation and not complicated by infiltration of urine or fistulæ. It is thus applicable to a considerable group of cases, both of traumatic and inflammatory origin.

Since healing practically by first intention is essential, it cannot safely be employed while the inflammatory process is active or in some cases of traumatic rupture of the urethra with extensive tissue destruction. It may more properly be used in the less severe cases of traumatic rupture in which the superior wall is still intact, tissue destruction is not great, and which are seen before infiltration of urine has begun.

To the more severe traumatic ruptures of the urethra and for inflammatory strictures complicated by infiltration of urine or fistulæ, the operation of fistulization as described by Pasteau and Iselin is better suited.

We have done the operation of resection more or less as above outlined in twelve cases during the last eighteen months. In none of them has the time elapsed been sufficient to warrant any conclusions as to the ultimate result, and they will not, therefore, be reported now.

A NEW TREATMENT FOR ABDOMINAL SURGICAL SHOCK.*

BY JOHN R. HOPKINS, M.B., DENVER, COLO.,
Surgeon to St. Anthony's Hospital.

As the problem of the cause of shock now stands, there are many contradictory theories.¹

It is best for me to state at the beginning of this paper that the case that I will report later, to-

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gether with my investigations, have proven to my satisfaction that in surgical shock the peripheral vessels are contracted and the vessels in the splanchnic area are dilated. And the vasomotor nerve mechanism is not paralyzed, but is injured sufficiently to lose its reason or function instead of acting in its long-accustomed extremely intelligent and prompt manner in distributing the right amount of blood to the right places at the right times, which is essential to life. There is not nearly enough blood in the body to fill all the blood vessels at once if they were all dilated. Goltz, in his famous experiment, showed that if a frog be suspended in the upright position and its heart exposed, a blow upon the abdomen has a twofold action: (1) It stops the heart reflexly through the vagus; but, after this effect has passed off, (2) the heart beats again, but is empty and sends on no blood into the vessels, because the blow has caused dilation of the abdominal vessels and all the blood becomes stored up in them, so that none reaches the heart.

Besides the chief vasomotor center in the medulla, there are subsidiary centers in the spinal cord, and Goltz² and Ewald have shown that the ganglionic chain of the sympathetic can assume the function of the vasomotor centers.

When the centers or nervous trunks of the vasomotor nerves are irritated, the vessels contract.³

Section of the splanchnic nerves causes an immediate and sharp fall of blood pressure.⁴ The intestinal arteries, veins and portal vein are dilated and overfilled with blood. As a necessary consequence of their immense capacity the rest of the vascular system is underfilled and the blood pressure falls accordingly. Stimulation of the peripheral end of the splanchnic nerves causes a great rise of blood pressure owing to the constriction of the vessels in the intestinal area. This shows that the vasomotor fibers in the splanchnic nerves are mainly of the constrictor type; also that the splanchnic area serves to a great extent as a regulator of blood pressure.

Mall⁵ has shown that the splanchnic nerves contain vaso-constrictor fibers for the portal vein, and Ludwig and Lauder Brunton have shown that the liver in the living is much like a sponge, i. e., can accommodate much blood.

Almost all the cells of the solar plexus are included in the course of the fibers of the splanchnic nerves (Landois).⁶ Elevation of temperature, also fever, causes irritation of the splanchnic nerves (Landois).

One of the principal functions of the vasomotor nerve mechanism is the proper distributing of the blood in order to preserve the normal temperature of the body. Eighty per cent of the heat expenditure of the body is through the skin. So when for any reason more than the normal heat or temperature occurs in the body, it is a function of the vasomotor nerve mechanism to at once correct it, but it does not always do it. The elevation of temperature causes irritation of the splanchnic nerves, sympathetic ganglia and vasomotor centers so that orders are usually sent at

once to correct the situation; the heart beats faster and peripheral vessels dilate; thus more blood is gotten to the surface to radiate and evaporate heat.

This treatment which I advocate is especially suitable for shock during the few hours or days following an abdominal operation, when the patient is not under an anesthetic, although it is probably beneficial when the patient is anesthetized, but not to so great a degree. It is as follows:

Take out two skin sutures as near the umbilicus as the wound will permit, then pry apart the continuous sutures in the fascia and peritoneum. You can now see if hemorrhage is present. This procedure is not difficult nor very painful, because when patients are in shock they are more or less insensible to the causes of ordinary pain. See that a nurse has ready very hot and cold normal salt solution, reservoir with four feet of rubber tubing, together with a glass tube or canula six to eight inches long. Both rubber and glass tubes should have a diameter of one third to one half inch. Have a quart of saline solution at temperature of 112° F. in reservoir, which should hang three feet higher than abdomen. Now have wound held open so that you can see omentum or intestines; also see that the tube and the canula are now full of the hot solution; then insert the long canula beneath the omentum, if possible pushing it upward so that your glass tube penetrates to the posterior peritoneum up behind the transverse mesocolon to the neighborhood of the posterior wall of the stomach, getting as near to the solar plexus as possible. The solution still at 112° F. is now allowed to run in as rapidly as it will. Probably a pint will fill the abdomen and be enough. This will take only five or six seconds. Now during the first two or three seconds of this time the patient feels little or no pain, only feels that the hot solution is permeating among the intestines, but the remaining two or three seconds is much different; the pain is very severe, for then the splanchnic nerves, the solar and hypogastric plexuses are being strongly irritated by the heat and pressure of the hot salt solution. They are well known to be very sensitive. The patient not being under an anesthetic, the reflexes are not depressed by it. Now the irritation of the splanchnic nerves and sympathetic ganglia produced by the heat and pressure at once causes contraction of the intestinal arteries, veins and portal vein, and thus a marked rise in blood pressure. Really a shock is produced by the sudden pressure of this hot solution on this great and important part of the vasomotor nerve mechanism, but this shock is a sudden reversal of the phenomena of surgical shock. The radial pulse returns or its pressure is markedly increased. The glass tube is taken out quickly, a small piece of gauze laid over the wound and a strip of adhesive plaster applied, then a tight abdominal binder to sustain the pressure. If this treatment should not succeed, I strongly advise repeating it in one or two hours. In addition to the above treatment I advise hot salt solution per rectum, 10 oz. every

two hours, principally on account of getting the heat near the hypogastric plexus and splanchnic nerves; also full glasses of hot water to drink for similar purposes; otherwise do not disturb the patient with hypodermics or even raising the foot of the bed; just keep her warm and as comfortable and peaceful as possible.

During the last two years before I conceived this treatment of abdominal surgical shock I had no faith in any of the drug treatment unless, perhaps, atropine for the profuse sweating. I had faith only in salt solution under the breast or per rectum by the drop method, or filling the abdomen at the end of abdominal operations and heat to the external surface of the body, together with physiological rest, i. e., mental and physical repose.

I wish to state some more physiology to show you that this treatment is more nearly directed at the real cause of surgical shock than the ordinary methods of giving salt solution which I had most faith in heretofore. It is generally accepted knowledge that, by virtue of the amazing power of accommodation possessed by the vascular system as controlled by the vasomotor and cardiac nerves, the total quantity of blood may be greatly diminished or greatly increased without endangering life, or even causing more than a transient alteration in the arterial pressure. It is not until at least a quarter of the blood has been withdrawn that there is any notable effect on the pressure, for the loss is quickly compensated by a constriction of the smaller arteries and the activity of the heart. An animal may recover after losing considerably more than half its blood. Conversely, the volume of the circulating liquid may be doubled by the injection of blood or normal salt solution without causing death, and increased by 50% without any marked increase in the pressure. This excess is promptly stowed away in the dilated vessels, especially those of the splanchnic area; the water passes rapidly into the lymph and is then more gradually eliminated by the kidneys.⁷ These known facts when considered show plainly, I believe, that the putting of more liquid into the circulation, as normal salt solution, by any of the customary routes is not aimed at the real cause of shock. It is of little value as compared with the heat or heat and pressure stimulation of the splanchnic nerves, which produces constriction of the abdominal arteries, veins and portal vein. Also it is to be remembered that the heat applied to these abdominal sympathetic nerve structures, on account of the part they play in the regulation of the body temperature, produces a dilatation of the peripheral vessels, thus relieving the resistance to the heart and also making the heart beat faster and stronger to get the blood or heat to the surface. If it were not for the heat given off, the body would be heated to the boiling point in thirty-six hours.

I will now give you the history of the case on which I finally used this treatment after I had almost abandoned hope.

Mrs. W., age fifty-three, entered St. Anthony's Hospital Nov. 29. Operation, abdominal hysteromyec-

tomy, Dec. 1, 1908. Tumor measured 6½ by 8½ by 7 inches. Took chloroform well. Operation lasted forty minutes. Sigmoid flexure was adherent to tumor to the extent of 4 or 5 inches. Tumor was well supplied with enlarged veins and arteries; however, she lost very little blood through the operation. Raw surfaces were all covered with peritoneum. Intestines were not allowed out of abdominal cavity and were kept covered with hot salt solution pads. Patient was in good condition during all the time of the operation and was put to bed in the same condition at 11 A.M. with pulse 80, full and normal strength. About twenty minutes later, when she began to become conscious, she received a hypodermic of morphine, ½ gr., and atropine, 1-150 gr. She rested quietly with good pulse, warm extremities, very little nausea and not much pain until 3.45 P.M., when the nurse noticed the pulse getting weaker; at 4 P.M. pulse 100 and very weak. When I arrived at 5 P.M. pulse was 116 and very weak. Patient was bathed in cold perspiration, temperature 97. This patient had had none of the ordinary causes of shock as loss of blood, prolonged operation, handling or exposure of intestines, but she had a large uterine fibroid removed, causing more or less negative pressure in the abdominal cavity, and she had been subject to nervous weak spells for years. I had been exceptionally particular about keeping the patient's legs warm after the operation and ordered the morphine and atropine, at the same time remarking to the nurse that I thought it beneficial to prevent shock as well as making the patient more comfortable. But notwithstanding the warmth and morphine, she passed into the condition of shock.

It was very difficult in this case to differentiate between shock and hemorrhage. The foot of the bed was elevated about sixteen inches. Eight ounces of hot, black coffee was given by rectum every four hours, alternating it with 8 oz. of salt solution; digitaline 1-100 gr. was given hypodermatically every four hours; extremities were kept warm as possible. Some fear that it might have been due to hemorrhage deterred me from giving salt solution intravenously or subcutaneously.

I had to leave the hospital at 8.30 P.M., at which time her pulse was more faint, scarcely perceptible, but rate 124, and respirations were more rapid and distressing. Patient felt very faint and asked for heart stimulants; she continued to fail and by midnight pulse could only occasionally be felt at the wrist. Dr. Treadway, the house surgeon, was called to see her at 2 A.M. and again at 4 A.M. and could not find any pulse in either wrist at either time. The nurses could not find any pulse at 6 or 7 A.M. and patient's face was blanched and respirations were entirely costal and very distressing. Patient was vomiting some green bile. The nurses and house doctors were looking for her to die any time after midnight. I arrived at the hospital at 8 A.M. and found her barely alive; no pulse could be found at either wrist, and breathing was very difficult and rapid. Her face and lips were blanched. The foot of the bed was still on chairs; I had almost given up hope. I ordered a pint of normal salt solution subcutaneously under the breast and at once took two silkworm-gut sutures out of abdominal wound, and with sharp-pointed scissors and probe pried open the fascia and peritoneum and could see the glistening omentum and intestines, showing no hemorrhage or peritonitis. I at once, with sterilized glass tube of one-third inch diameter inserted into the abdominal cavity to the distance of four or five inches up behind the omentum and transverse colon, allowed one pint of hot normal salt solution to run in rapidly (time about six seconds). She did not have much pain during the first few seconds of the time, but had a great deal during the last few

seconds. Abdominal cavity now seemed full. The glass tube was removed quickly and no solution allowed to run out. A narrow strip of gauze and adhesive plaster was applied. I quickly felt the wrist and found a distinct regular pulse of full strength, but radial artery had only one third normal caliber after an absence of the radial pulse for seven or eight hours. This pulse did not disappear or weaken again, but the radial arteries gradually increased in caliber all day, and at 5 P.M. were of normal size. The abdominal binder was kept tight all day. The salt solution under the breast was apparently not absorbed until after the pint of hot salt solution was put in the abdomen nor until after the pulse returned. The return of the pulse was instantaneous or must have been within one or two minutes of the shock and pressure of the hot solution run into the abdomen. Foot of bed was put down on the level, off the chairs, just before the salt solution was put under the breast and the hot solution in the abdomen, showing that elevation of the foot of the bed was probably of little or no use.

Lawson Tait in 1887 advanced the introduction of large quantities of sterile water into the peritoneal cavity before closing the abdomen while the patient was still under the anesthetic. This has been done since that time by many surgeons. Crile states that this method is equivalent to introducing saline solution by subcutaneous infusion. Crile also states that this is a good thing to do at the end of an abdominal operation that is attended by profound shock. But this putting salt solution into the abdominal cavity when the patient is under the anesthetic, the reflexes being depressed, is an entirely different matter from the treatment I recommend. Nowhere can I find in the literature any suggestion or intimation of this treatment of abdominal surgical shock. Although I have as yet only tested it on one case, the reaction was so marked, so immediate and permanent, and the best and latest knowledge of the physiology of the vasomotor nerve mechanism together with the clinical picture of the case I reported, convince me that this treatment is more rational than any yet advocated. But the surgeon must see that every detail of the treatment is carried out accurately and recovery not prevented by too many hypodermics.

REFERENCES.

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- ³ Lauder Brunton: Therapeutics of Circulation, P. Blakiston's Son & Co., 1908, p. 45.
- ⁴ Stewart's Physiology, 1905, p. 144.
- ⁵ *Ibid.*, 1905, p. 147.
- ⁶ Landois Physiology. P. Blakiston's Son & Co., 1905, p. 288.
- ⁷ Stewart's Physiology, 1905, p. 154.

THE DIAGNOSIS OF ULCER OF THE DUODENUM.

BY E. A. CODMAN, M.D., BOSTON,

Assistant Visiting Surgeon, Massachusetts General Hospital.

(Continued from No. 23, p. 822.)

CASE XXIV. Mr. L. W. P., age fifty. Shoe store. Oct. 28, 1903. Massachusetts General Hospital. Vol. 474, p. 5; vol. 603, p. 104; vol. 593, p. 100.

First note at the hospital is on Oct. 28, 1903. He then stated he had had stomach trouble for past twenty-five years. The last fifteen months had been getting

worse. Most distressing symptoms were pain in the stomach at night, gas in the stomach and bowels and frequently vomiting "during distress spells," which usually occurred every week or so. Vomits from a quart to a pint yeasty sour material. Has seen such things as peas and blueberries in vomitus when he had not eaten them for several days. Four weeks ago passed a mucous cast by rectum 18 inches long. Was jaundiced for a whole year between July, 1902, and July, 1903. Two weeks ago he passed a pint of brown-black liquid feces. Had never vomited blood or passed it by rectum. Has lost 17 lb. during the last year. Has passed a number of mucous casts. Examination negative except for visible peristalsis. Gurgling and splashing. No blood in stomach contents.

Treated in medical wards by stomach washing and frequent feeding, so that on Nov. 8 he said he felt better than he had for two years. There was evident dilatation and the residue varied but tended to diminish. On Dec. 12 he was sent home relieved but not well and to consider operation. The diagnosis was dilatation and ptosis of the stomach.

He returned on April 1, 1904. "Since leaving the hospital has been fairly comfortable and improved considerably, gaining 26 lb. For the first three weeks washed his stomach out daily and has continued to do so at intervals since.

On April 16 a laparotomy was done, "stomach somewhat dilated, large plexus on greater curvature, marked cicatrization with adhesion in pyloric region; pylorus not patent to finger invaginating stomach wall." A 16-inch loop anterior gastro-enterostomy was done with a bone bobbin. A vicious circle followed.

Autopsy No. 1205, April 26, 1904.

Anatomical diagnosis.—General fibrinopurulent peritonitis; ulcer of the duodenum; slight fibrous endocarditis of the mitral valve; slight atheromatous endocarditis of the aortic valve; gastro-enterostomy; streptococcus septicemia; arteriosclerotic degeneration of the kidneys.

At a point about 25 cm. from the commencement of the jejunum there is an anastomosis established between the stomach and the jejunum. The anastomosis is situated in the lower portion of the anterior wall of the stomach a little above the median line of the greater curvature and 14 cm. from the pylorus. The anastomosis is tight to water under tap pressure. The outer row of sutures between the jejunum and the stomach in the situation of the anastomosis presents here and there minute collections of pus. The pus in these situations generally does not extend for any distance into the tissues, but at one point there is a small pocket of pus which extends a short distance into the tissues. The wall of the jejunum at this place shows a small, rather sharply defined area to which purulent material is adherent. The purulent material is present in well-marked amounts among the coils of the first portion of the jejunum. In making the anastomosis the jejunum is brought up over the transverse colon.

The stomach is not enlarged, but, on the contrary, is more or less contracted down. On section, the mucosa shows well-developed rugæ and otherwise is not remarkable.

The communicating opening between the stomach and the jejunum is about 3.5 cm. in greatest diameter and easily admits the passage of the middle finger. The pylorus is small and barely admits the passage of the closed blades of a small pair of scissors. The duodenum, on section, contains very little material and its mucosa is not remarkable except that at a point just below the pylorus, posteriorly and laterally to the right, there is an irregular, rather deep loss of substance about 1.5 cm. in greatest dimension. The margins of this