SURGICAL SHOCK AND HEMORRHAGE, WITH REFERENCE TO PREVENTION AND TREATMENT.

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Among the serious complications of surgical operations shock and hemorrhage are frequent and ofttimes serious accompaniments. A clear conception of the manifestations, prevention, and treatment of these conditions is of the highest importance, both as regards the safety of the patient and the success of the surgeon. Shock may be defined as loss of innervation, dependent on either physical or mental causes, or the two operating simultaneously, induced by profound irritation of the sympathetic nervous system. A reflex of this irritation is witnessed in depression of the cerebro-spinal nerve centres. In a paper presented by a former Fellow of this Society, Dr. Eugene Boise, at a late meeting, a concise and rational distinction was made between the symptoms of vital depression attending shock and those resulting from hemorrhage. While in this discussion I may not, from a clinical standpoint, follow with nicety the scientific distinctions there laid down, I shall endeavor to formulate the rules for treatment of the two conditions, so far as they can be differentiated.

Shock results from serious traumatic injury, as seen in contusions, lacerations, fractures, injury to the vital organs either accidental or inflicted by the surgeon.

In the article to which I have referred the writer justly attaches the highest importance to the quality of the pulse as the means whereby the difference between shock and hemorrhage may be clearly defined. This includes a critical study of the pulse prior to, at the time of, and subsequent to operation.

There is doubtless difficulty in distinguishing between rapid hemorrhage and shock, but between shock and ordinary hemor-

rhage the distinction can be made. The rapidity of cardiac contractions, with small pulse and low arterial tension, slow and irregular breathing, coming on before the operation is completed, points to the presence of shock. Under hemorrhage (not rapid) these symptoms manifest themselves gradually and progressively. In shock there is usually tendency to reaction, while in hemorrhage no such rallying power manifests itself, and the pulse grows weaker and more frequent. Another diagnostic point of great value in differentiating between the symptoms of shock and hemorrhage immediately subsequent to an operation is this: if a previously good pulse becomes rapidly weak and compressible the patient is suffering from shock; whereas if, under similar conditions, the heart gradually loses its power and volume, hemorrhage is present.

In shock there is pallor with lividity, and the intellectual faculties are sluggish in their operation. The pallor of hemorrhage is more pronounced and the patient is apprehensive as to the consequences. One other distinction should be noted: in hemorrhage both arterial and venous anemia are present, while in shock the anemia is arterial with more or less venous stasis.

So, too, the shock from injury to certain organs is more pronounced than from injury to others. Traumatism to nerve-trunks, injuries in the immediate vicinity of the solar plexus, injury to the testicle or compression of the ovary, as well as opening of the peritoneal cavity, serve as illustrations.

From the surgical standpoint, especially after celiotomies, doubt as to the presence of shock or hemorrhage is not often present, but in the tubal ruptures of ectopic gestation and accidental hemorrhages into the peritoneal and other cavities, and extravasation of blood into yielding structures, the suggestions already made will be of the highest value.

In the clinical study of most cases of celiotomy and the surgery of other closed cavities of the body, and in capital operations generally, the symptoms are composite, due to both shock and hemorrhage; so that while the procedures suggested hereafter apply to either the one or the other condition, as may be present, yet in many cases the effort of the surgeon must be directed to the combined influences of both causes operating simultaneously. The treatment of shock divides itself into those measures which are preventive and curative. The physical and mental condition of

the patient bears a constant and close relation to the degree of shock likely to be induced by a given operation, so it is a self-evident proposition that whatever will fortify the patient in bodily and mental health, either by dietetic, therapeutic, or hygienic measures, is worthy of the most careful consideration, and in elective operations time thus spent *is well spent.* The physical condition, functional activity of all the organs of the body, should be a matter of careful and conscientious study. Bodily secretions and excretions must, as far as possible, be known, especially with reference to lithemic and uremic conditions. Failure, by quantitative and qualitative tests, to know all that is knowable in these particulars, may not only place the surgeon under serious embarrassment, but do the patient grievous injury. To estimate the recuperative power of a given patient study his heredity, his expected longevity; learn his powers of vital resistance and recuperative energy as manifested in recovery from serious injury or dangerous illness. By so doing an intelligent judgment can be given as to the advisability and risk of operation in grave conditions, and this knowledge should be communicated to the patient or friends, as policy and justice may demand.

The deleterious influence of shock is chiefly manifested upon the nervous system and the heart. To fortify these latter organs, if below good maximum standard of health, strychnine should, if practicable, be administered a few days prior to the operation to the extent daily of one-twelfth to one-sixth grain. This drug is particularly applicable in cases of fatty and atheromatous degeneration of the heart and bloodvessels. If the arterial tension is low, with small volume, and fatty and atheromatous degeneration of the circulatory organs is absent, digitalis fulfils the indication and should be given with moderation until its physiologic effect is apparent. In muscular weakness of the heart the administration of sparteine sulphate in one-eighth grain doses every two or three hours for twenty-four or forty-eight hours before an operation is indicated. Like strychnine, it is not contra-indicated in degenerative changes of the heart and bloodvessels.

If surgeons would make it an invariable rule to have the alimentary canal absolutely empty in all elective abdominal operations, they would escape much annoyance and improve the patient's chances by obviating to a large degree the liability to

nausea, flatulence, and the abolition or impairment of intestinal peristalsis.

In operations involving the peritoneal cavity it is wise to have the patient maintain a horizontal position for a period of two or more days prior to operation. If the abdominal and pelvic viscera are known to be in a condition of hyperemia, the necessity of maintaining this position is the more imperative, thereby giving dilated bloodvessels opportunity to regain, and as far as possible to retain, a normal caliber. In fact, if chronic inflammations are known to occupy the field of operation, it is often best to elevate the foot of the bed a few days before operation. If the use of a cathartic to open the bowels depletes the watery constituents of the blood, insist on the patient taking an extra allowance of pure spring-water for this period.

Doubtless full bloodvessels favor immunity from the distressing thirst so often present after opening the peritoneal cavity, and thereby aid in diminishing shock. If the rule was enforced to compel every patient submitting to a capital surgical operation to drink freely of pure spring-water a week before operation, I am confident the mortuary records would show increased recoveries.

The practice, when not contra-indicated, of leaving in the peritoneal cavity after celiotomies from one to three pints of normal salt solution, acts in a most salutary manner in allaying and oftentimes preventing that distressing thirst which is itself a source of great discomfort and shock.

No doubt the degree of shock, other things being equal, depends in some degree on abnormal reflex irritation of the cerebro-spinal nerve-centres, so that if there is a hyperesthetic condition of these centres it may be wise to reduce this reflexity by administration for two or three days of the bromides, in doses per diem of eighty to one hundred grains.

Shall opium or its derivatives be used to prevent or allay shock?

In celiotomies, as a rule, *no*. While there are narrow limitations to its administration, it may under some conditions be used. If from positive knowledge that its administration does not provoke nausea, one objection to it would be removed. After celiotomies one serious objection to it is, that it diminishes peristalsis, checks secretions, and masks the patient's condition. Its power to allay shock, in small doses, cannot be doubted. Codeia has less

of the perturbing and objectionable influence, and is the most valuable. The better way to administer it is by the hypodermatic method. It reduces shock by obtunding the cerebro-spinal irritation and consequent sympathetic disturbance. Experience amply confirms the belief that the use of a high rectal enema of a pint of hot normal salt solution and an ounce of whiskey, given forty minutes before a capital operation, aids in fortifying the system from the influence of shock and the syncope of hemorrhage. A judicious selection of the anesthetic, and its administration by one thoroughly skilled in its use, *must always be provided for*. As regards shock, the time an operation occupies is of the utmost importance. Such rapidity of work as will not impair the technique should be the aim of every operator. Everything which facilitates rapid work should be studied and adopted. The anesthetizer, or some other person, should closely watch the pulse, respiration, and color of the skin, so as to anticipate the first symptoms of shock, and have every facility and appliance for the administration by hypodermatic use of the appropriate remedy. Oxygen gas may prove of great service during anesthesia and shock.

If evidence of shock appears during operation the use of remedies already named, on the lines here laid down, will meet the indications.

One other cause of shock claims our attention—viz, that induced by fear. Doubtless many a patient has succumbed to an operation who would have survived could the pernicious influence of fear have been eliminated. Apart from the mental suffering which dread of the knife incites, its baleful influence should be a source of profound solicitude to the operator.

While it may not be, and is not always, possible to withhold the information from the patient, *for moral and other considerations*, the rule remains that discretion and care should be exercised in these particulars, as they tell mightily in the outcome.

If an operation, either elective or mandatory, is to be done and the patient must be advised of it, defer the information to the patient to the latest possible moment. Experience demonstrates not only its feasibility but practicability. Sometimes the patient should know nothing of a proposed operation. A young lady in New Jersey was suffering from a rather large ovarian cyst. She was anesthetized, the cyst removed, and she has never known she had

an operation performed. By aid of the skilful administration of chloroform I circumcised a boy, aged ten years, and he remains altogether ignorant that anything was done. During last month I amputated by cautery a carcinomatous cervix at the eighth and a half month of pregnancy, on account of present hemorrhage and the liability to dangerous hemorrhage at confinement. The patient knew nothing of the operation until she started for the hospital, and the operation was done on her arrival, without any injurious effect, and her confinement two weeks later was without incident. Not long since I removed a macerated, decomposing fetus at the fifth month of pregnancy from a woman of extremely nervous temperament, and her knowledge of what was to be done only antedated the operation forty-five minutes—long enough only to enable the nurse to make the patient ready. I appeal to the experience of every Fellow present to recall the suffering and injury which fear has excited in patients anticipating operation. Every scientific and humane consideration demands that this evil should be reduced to the minimum.

When the dynamic powers of the system are at a low ebb from the influence of shock or the threatened syncope of hemorrhage, strychnine is a remedy of the greatest value. In the condition last alluded to, by placing the patient in the Trendelenburg posture relief from cardiac and cerebral anemia is facilitated. The value of hypodermatic injections of brandy is too well known to require more than mention. In the administration of these several remedies the time required for them to produce their effect and the period this influence is maintained should be carefully estimated. Nitroglycerin, by its influence on the vasomotor nervous system, is quickest in its operation, but transitory in its effect. Next in point of promptitude is sparteine, and its effect seems to last about two hours.

The relative permanency and cumulative effect of strychnine and digitalis should be borne in mind. It should be remembered that in anemic states of the nerve-centres the physiologic effect of strychnine is more readily manifested, and its dosage should be regulated accordingly.

In the cardiac failure of hemorrhage I desire to add special emphasis to the necessity of a prompt supply of fluid to the circulation by sterile salt solution. This may be accomplished by high rectal

enema, intercellular injection, and intravenous supply of this solution. Facilities should always be in readiness whereby a trocar can be introduced into a vein and the hot normal (sterile) salt solution promptly allowed to enter by gravity. I had occasion quite recently to witness its magic influence and saving power. It was an operation for the ruptured tube of an ectopic gestation at the tenth week, in which I found the peritoneal cavity distended with blood. The fetus, placenta, and sac were easily removed and hemorrhage promptly controlled, but when the operation was completed the patient was so depressed from loss of blood and shock that she failed to respond to stimulants and cardiac tonics, and she appeared to be *in articulo mortis*. The median basilic vein was opened and twenty-four ounces of normal warm (105° F.) sterile salt solution were introduced into the circulation; the patient rallied promptly and made an excellent recovery. While blood is doubtless thicker than water, in certain exigencies salt water will take the place of blood, for the reason that an empty auricle refuses, for physiologic reasons, to contract. When syncope threatens during an operation, if possible keep your patient in the Trendelenburg position until the heart regains its power. If cerebral anemia is markedly present elevate the foot of the bed to an angle of 20° to 35° on removing the patient from the table. If cerebral congestion obtains reverse the procedure and elevate the head.

In this somewhat disconnected and fragmentary way I have endeavored to formulate some of the methods whereby shock may be prevented and remedied. Other forms of shock associated with or dependent on operation or mental impressions, especially masked shock and that due to sepsis and anesthetics, are worthy of careful study, but the limits of this paper forbid their notice here.

Résumé. 1. The treatment of shock should be preventive and curative, and to a large degree the indications for the former define the lines of treatment in the latter.

2. The proper exhibition of preventive measures includes a careful study into the functional activity and organic status of all important organs, and such treatment of hygienic, dietetic, and therapeutic measures as will elevate the standard of bodily and mental health to a degree in which the maximum power of resistance may be produced and maintained.

3. Special emphasis should be given to lithemic and uremic ex-

cretion and to the condition of the circulatory and nervous systems.

4. Knowledge as to inherited power of resistance to, and recovery from, serious diseases and accidents, is of the highest value in determining the course of procedure and estimating the chances for recovery after capital operations.

5. A supply of facilities and drugs for meeting all emergencies should be in constant readiness, with exact knowledge for the indication, dosage, physiologic and therapeutic effect of special heart tonics and stimulants, which include strychnine, digitalis, sparteine, nitroglycerin, brandy, and codeia.

6. Limit the time of an operation to the shortest period compatible with thorough work and proper technique.

7. Save your patient from the shock of fear to the utmost, and in selected cases proceed to operation without informing the patient of your purpose.

8. In shock with hemorrhage supply the volume of venous and arterial loss by direct transfusion of normal salt solution into the patient's veins.

9. Bear in mind the influence position has on the circulation under both shock and hemorrhage, especially in anemic conditions of the cerebro-spinal nerve-centres and the heart.

DISCUSSION.

Dr. Walter B. Dorsett, of St. Louis.—Mr. President: We are indebted to the essayist for the line of demarcation that he draws between the symptoms of shock and those of hemorrhage possibly more than anything else in the paper. I regard the treatment of shock by strychnine previous to operation as a very important matter. The prophylactic use of strychnine is worth a great deal more than the injection of strychnine, codeia, nitroglycerin, digitalis, or anything else; and it has been my custom for some time to place my patients upon strychnine previous to an operation. A few minutes before the patient is put under the anesthetic, either the phosphate, nitrate, or sulphate of strychnine is given hypodermatically, and after the patient has been placed under the anesthetic thoroughly, a high enema of hot

water or normal salt solution is given. By so doing we can control hemorrhage as well as shock.

His experience, however, does not agree with mine in regard to the use of codeia. My experience with the hypodermic injection of codeia is not a pleasant one; in fact, most of my patients have been excited by its use. There is a stage of excitement that commences half an hour after the injection, and sometimes lasts for the same length of time afterward, and even additional doses do not seem to control it. It was my first impression in the use of it, that possibly I had given too small a dose, and had only given enough to excite the patient; but a repetition of its use did not bear me out in this suspicion.

Dr. Charles G. Cumston, of Boston.—I have very little to add to the excellent paper we have heard from Dr. Chase, but I would like to mention two facts regarding the use of artificial serum in hemorrhage and shock. It is a question that has interested me considerably, and I have taken a good deal of pains, both experimentally and clinically, to perfect a serum which could be used in emergency cases, and these cases are emergency ones where everything would be sterile, and where prompt action can be derived from the serum. I experimented first with the plain salt solution, then I tried Hayem's formula, which consists of five grams of the chloride of soda and ten grams of the sulphate of soda to the litre of water. This worked very well, but it occurred to me that something could be added to the solution which would act directly on the nervous system. If you added tincture of digitalis to the salt solution it could not be sterilized, because it would decompose. After looking over the literature somewhat I found that Cheron, of Paris, had used the phosphate of soda in a solution, which I have found experimentally on animals has a direct action on the nervous system when injected under the skin. But it seems to irritate the subcutaneous cellular tissue when injected into it, and in order to avoid this and the possible formation of abscess I changed the plain phosphate of soda to the glycero-phosphate of soda, which, as we all know, is becoming a very important remedy in the treatment of nervous diseases in general, particularly when given subcutaneously once or twice a day. The formula I have now arrived at for my serum is this: One gram chloride of soda, and two grams each of the glycero-phosphate and the sulphate of soda, and 300 c.c. of distilled water.

I have had a little apparatus made which will allow me to carry it to any operation. It contains the sterilized solution, and the solution can be used immediately. (Here Dr. Cumston illustrated and described the apparatus that he had devised.) The apparatus can be put

in a round pasteboard box, it can be filled with the solution, stoppered as tightly as it should be, put into the sterilizer and packed. You need not take it out of the box until it is to be used. I have kept a solution in my office for six months, and in no way has it shown any disposition to decompose. I think the three ingredients in the solution will remain in a soluble condition without decomposing for an indefinite length of time. I have used these injections with benefit in obstetric practice when there has been hemorrhage or infection. I use as many as four injections of 300 c.c. in twenty-four hours, if necessary. The site of the injection is either the retro-trochanteric fossa or in the anterior aspect of the thighs. Usually one injection of this concentrated serum will have a remarkable effect when shock is present, whether due to hemorrhage or of nervous origin. I can safely recommend its use. I have tried it experimentally more than I have clinically, but clinically I have used it in about ten or a dozen cases, and it certainly works well.

I have had it put up by a firm in Boston, so that the same amount of salt can be contained in about fifteen or sixteen grams of water. I have had it put up in small tubes for the country practitioner especially. The firm puts it up in a box of six tubes. The country practitioner probably has an aspirating needle at his office; he carries it; in almost all houses he will find a bag through which he may be able to pass a strong solution of corrosive sublimate before introducing the salt solution, and all he would have to do is to filter the water through a piece of absorbent cotton and add one of these tubes of serum.

Dr. J. Henry Carstens, of Detroit.—The paper so thoroughly covers the ground that there is very little to be added. It seems to me, however, we must make a distinction between the different kinds of shock. One kind of shock is purely of nervous origin, and the author has dwelt on a point which is not sufficiently prevented, and that is the constant fear of the patient. There is a great deal in the way in which patients are managed during an operation. I have seen great preparations made and the patient informed of what was to be done. Here is an important point: The less we tell a patient, as a rule, the better. I do not believe in making all the preparations in the presence of patients. Very often they do not know what the operation is going to be ; they hardly think of where the incision is going to be made. Many of these things could be left until the patient is under the influence of chloroform, after which the patient could be shaved, etc., and she would not have as much mental shock.

There are two kinds of shock. One is due to depression of the nervous system, or long-continued sickness beforehand ; and the other kind

of shock, which occurs in strong, robust people, is where there has been great loss of blood. One kind requires a little different treatment from the other. When we have a patient with great loss of blood, the bloodvessels demand some blood, and we should inject something into the bloodvessels; it makes no difference whether it be the normal salt solution or phosphate solution, or anything else. If you give the patient plenty to drink and injections per rectum, the bloodvessels soon fill and respond. This treatment will not do in that kind of shock which is of nervous origin, due to long-continued sickness or sepsis.

There is one other point I would like to dwell upon. There seems to be a kind of secondary shock that comes on in twenty-four hours, where the patient recovers from the anesthetic, is conscious, has a fair pulse, but becomes depressed. It is not the kind of shock that comes from internal hemorrhage, but there is another kind of shock, it seems to me. I have seen a number of patients who, after getting over the anesthetic, etc., would sink away, and nothing seems to have any effect. If there is any one who has had experience with this form of shock I would like to hear it.

Dr. H. W. Longyear, of Detroit.—I observed the essayist did not enlarge upon the subject of the conservation of the body heat. So far as my observation goes, I believe this has more to do with the production of shock than any other one thing in operations inside the abdomen. Some two or three years ago, when the American Surgical Association met in Detroit, Dr. D. P. Allen, of Cleveland, Ohio, read a paper on this subject, and to my mind it was an extremely valuable contribution. At great expense and time he had conducted some experimental work along this line. Since that time I have been using largely rubber water-bags, filled with warm water at a temperature of about 110°, upon which the patient lies during the operation. I believe this measure will prevent, to a large extent, the shock in these operations. It is not alone the operation that produces shock; it is also the refrigerating effect of the anesthetic.

Dr. Allen showed conclusively from experiments upon animals that the prolonged administration of the anesthetic had a very marked effect in reducing body heat, and by conserving the body heat in this manner I believe we go a great way toward the prevention of shock.

For my part, I am averse to the long-continued use of drugs of a highly stimulating character for several days before operation, for I believe by so doing we will frequently get the kind of shock mentioned by Dr. Carstens. The heart will be stimulated for as long a time as it can be kept going; then the operation takes place, and there

is a sudden falling off that cannot then be influenced by the stimulant. I believe in using strychnine immediately before operation, and I do it systematically, using one-fortieth grain. After the operation, where shock is present, the use of strychnine should be the principal remedy.

Dr. M. Rosenwasser, of Cleveland.—It seems to me that both in the paper and in the discussion a vague idea comes to the surface that there are various kinds of shock. My friend, Dr. George W. Crile, of Cleveland, has conducted a series of experiments on dogs in about 200 cases, and has written a competitive paper which has recently received the Cartwright prize of the College of Physicians and Surgeons of New York, in which he demonstrates the fact that shock is not an entity, but that it varies with the organs which are being disturbed. The shock varies in degree of intensity in the cranial cavity; it is different in the thoracic cavity, in operations on the throat and larynx, in the abdominal cavity, in the male and female genital organs, and again in the extremities. He has further shown by the same experiments that the remedies which will prevent one kind of shock may not be good for another variety. Morphine, cocaine, atropine, or strychnine, either may be indicated or contra-indicated, as the case may be. He has reduced this matter to such scientific precision that in the future we shall be better prepared to prevent, as well as to treat by the various remedies indicated, the class of shock we are dealing with. I allude to these experiments and their outcome, as I see there is a clinical presentiment foreshadowing the recognition of various kinds of shock.

In reference to the differentiation between shock and hemorrhage, of course, the various symptoms are well known. I rely mainly upon the exsanguination of the mucous membranes in distinguishing between shock and hemorrhage. In hemorrhage we find a blanched appearance of the lips and conjunctivæ, which is not notably present in shock.

Dr. Thomas J. Maxwell, of Keokuk, Ia.—Just a word or two in reference to the differential diagnosis of shock and that resulting from hemorrhage. I have noticed that in cases of hemorrhage there is extreme thirst. There is mental shock, and this form of shock is to be cured by mental processes. I remember the case of a young man who was shot by a small pistol, the ball entering near the umbilicus. The accident occurred during the war, while the army was en route for Vicksburg. I found him lying under a tree. His pulse was 150 and thready; he had sighing respiration; perspiration standing on his face. I asked him what was the matter, and he said, "I am shot in

the abdomen." I drew up his clothing, and found he had two army shirts on. There was a cul-de-sac in which the ball had entered. I took a probe, passed it in probably half an inch, but could not locate the ball. I then examined his garments, and found an eighteen-calibre pistol bullet in his shirt. I told him that I had found the bullet, and that he had received simply a skin wound. The man thought he was fatally shot. I believe he might have been frightened to death had I told him his wound was fatal; but, on learning that his injury was slight, he exclaimed: "I thought, sure, I was shot through the bowels and that I was a *goner*." Reaction was prompt. He immediately arose, mounted his horse, and was as lively as ever.

Dr. Chase (closing the discussion).—I shall occupy but a few moments in my closing remarks. While this is a large subject, and one about which a good deal might be said, I shall refrain from saying some things on account of time.

Dr. Longyear alluded to the value of the conservation of body heat, and very properly so. The influence of anesthesia is to lower bodily temperature, and the surgeon should make the most careful preparations and provisions to maintain the bodily temperature of his patient during an operation. I regard this as one of the common provisions which should be made by every surgeon in every case.

Allusion was made to the value of atropine in certain conditions. While I did not refer to it, it is peculiarly applicable in one condition, that of shock where we get abnormally slow pulse. In this condition the one remedy which is applicable is atropine. It has the power of paralyzing the inhibitory nerve, and the heart resumes a more normal activity.

With reference to the experiments that were alluded to by Dr. Rosenwasser, I have no doubt that when the paper is published it will be of great value and enable us to act with more precision than we have been able to do in times past.

Regarding the propriety of informing a patient what is to be done, it devolves on the surgeon whether he shall notify his patient or not as to what is to take place. Every conscientious surgeon must recognize the fact that in most conditions the patient should be informed of the probable outcome of the operation to be undertaken. It is a matter, however, of individual judgment with the surgeon, after consultation with the family. There are many women who will face any danger, but if you tell them what you are going to do they will think more of you. There is another class of cases that we have to deal with, and the less we say regarding what is to be done the better.

There is only one other point to which I wish to allude, and that is

with reference to the value of intracellular injections. But there are times in the experience of every surgeon when he cannot wait for the absorption of the normal salt solution when injected under the mammary gland. In fact, in conditions of extreme depression, I question very much whether the absorbent vessels are able to properly carry on their work, and in those conditions we derive the greatest benefit from intravenous transfusion.