

RECENT ADVANCES IN SURGERY*

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The newer developments in the field of general surgery of recent years have received added impetus from the present war conditions. These developments may be conveniently divided into two groups, first, operative surgery and second, and perhaps more important, preoperative and postoperative management of patients. It is in the latter group that war medicine and surgery have made themselves felt much more prominently.

In the field of operative surgery there have been many developments which are reflected as refinements in well-established technics. The application of well-known principles and the rediscovery of innovations which may have been suggested in former years have been further augmented by application of much more thorough postoperative methods. One of the largest steps forward has been in the field of thoracic surgery. It is a well-known observation now that carcinoma of the lung is being seen much more frequently than at any time in the past. Surgical methods are being extended to tumors of the lung so that they are now becoming well recognized surgical procedures. Since it is established that pulmonary operations can be carried on without prohibitive risk, the logical conclusion has been the application of the new-found principles to other types of disease within the thorax. Thus bronchiectasis, formerly regarded as strictly a medical problem and a rather hopeless one at that, is now responding well to the properly applied surgical removal in a certain group of cases. In addition, tumors of the cardiac end of the stomach, formerly regarded as inaccessible to the surgeon, are being approached at the present time by an intrathoracic route with an ever increasing degree of success. It is possible in this way to create an opening in the diaphragm, resect the upper portion of the stomach in a fairly wide manner and anastomose the esophagus directly to the remaining portion of the stomach. With application of a combination of new-found chemotherapeutic agents it is now possible to keep the degree of sepsis at a minimum. There have been many isolated reports of successful operations of this type, including those of Jonas, Holman and McSwain, Walters, Clagett (5, 6) and Garlock. In fact, the principles of surgical management are now developed to the point where series of cases are being reported from some centers with promising results.

Blalock and his co-workers awakened wide interest in the thymus gland in their studies on myasthenia gravis. After their reports of successful removal of thymic tumor (or thymectomy in cases in which no tumor existed), in which cases the patients experienced marked relief of symptoms, other surgeons have applied this method and obtained highly satisfactory results. The cases reported by Clagett (5) may be mentioned.

Factors which are lending the thoracic surgeon far greater confidence than he was able to assume in the past are directly associated with the present day development of positive pressure anesthesia. In this manner highly selective agents, such as cyclopropane, can be administered under complete control at all times and complex physiologic factors can be maintained in as nearly a normal balance as possible.

The more or less routine bronchoscopic examination of patients immediately following operation and at any time in the postoperative course, with aspiration of secretions as indicated, has greatly reduced the morbidity and mortality. A comprehensive essay on this field of surgery has been prepared by Adams.

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In the field of abdominal surgery, carcinoma of the biliary tract has been taken from the absolutely hopeless state in which it long reposed by the application of the Whipple operation or various modifications. Whereas no one surgeon has yet collected a large series of cases, reports are now making their appearance which indicate that, although the operation still leaves something to be desired as far as final results are concerned, at least the patients are being given the benefit of the most that present day science has to offer (Trimble, Parsons and Sherman). In brief, the operation consists in removal of the malignant growth, usually situated in or near the ampulla of Vater, or in the head of the pancreas, followed by some type of anastomotic procedure between the biliary system and the gastrointestinal tract since it is necessary to occlude the cut end of the common bile duct completely. This anastomosis takes the form of a cholecystogastrostomy, cholecystenterostomy or choledochenterostomy. Resection of the proximal portion of the duodenum and the distal portion of the stomach is usually necessary because of disturbance of the blood supply in this area. The greatest hindering factor at the present time is the complete cessation of the flow of the pancreatic juices. At first it was thought best merely to ligate the pancreatic duct and prevent any flow from that organ. This was successful for the immediate postoperative course but it has now been found that patients who survive, for the first few months have considerable difficulty with proper digestion. Work is proceeding at the present time in an attempt to transplant the pancreatic duct successfully into some point in the gastro-intestinal tract. Great interest in this work has been stimulated by the studies of Paine, Wangenstein and Dennis.

In the field of urology, total cystectomy for carcinoma of the urinary bladder is now approached with far less misgiving than was common in the past. Bilateral transplantation of the ureters into the sigmoid colon can now be done in one stage with total removal of the urinary bladder at a second stage with considerably lower mortality. Also in this field is the problem of hypertension associated with unilateral renal disease which has undergone very close scrutiny. In these cases, especially in cases of unilateral atrophic pyelonephritis, the blood pressure after nephrectomy has shown rather promising trends, at least in the first few months after operation. A complete outline of the progress made in this regard is offered by Abeshouse.

One field of surgery that has directly reflected the progress stimulated by war surgery has been the application of skin grafts to wide burned areas. With the principles now applied to burns, the complete débridement and cleansing of the area, the newer types of apparatus for satisfactory removal of large grafts (especially the Padgett dermatome) and in the presence of newer chemotherapeutic agents, it is now possible to apply grafts to these burned areas very early so that far more satisfactory results are being obtained.

When we turn to the developments in the field of preoperative and postoperative management we find that it is here that the greatest strides have been made. Perhaps most important of all these developments has been the wide application of chemotherapy to surgical practice. The logical development of sulfanilamide and its allied derivatives in powdered form has rendered these agents available as a most powerful weapon against impending or actual infection. Open wounds, compound fractures, surgical incisions and operative fields are now subjected to local applications of these powders wherever such types of conditions might prevail. The drug is absorbed from the large serous cavities of the body rather completely and frequent reports indicate that intensive study is being carried on to perfect a method of administration. The local implantation can be supplemented postoperatively by properly regulated oral doses of the drug. If this is impossible, parenteral administration is easily maintained by intravenous or sub-

cutaneous routes. Complete control can be maintained over the patient's course by proper studies of the concentration of the drug in the blood, careful attention to the blood counts and the urinary output as well as studies of the urine itself. A thorough knowledge of the toxic manifestations of the drug will assist in avoiding any untoward result.

We are now able to approach the problem of peritonitis, especially that associated with gangrenous appendicitis, in a more adequately equipped manner. Allied drugs have been developed for the treatment of other conditions frequently seen postoperatively. Sulfapyridine, which formerly had been used widely in pneumonia, is now giving way to sulfadiazine which is a less toxic and much more easily tolerated derivative. The early administration of these agents has sharply reduced the morbidity and mortality of this complication. Sulfadiazine has also been put up in a form suitable for spraying upon wide burned areas and it can now be applied so that a very thin eschar is formed. In this manner, the sepsis formerly associated with burns is remarkably reduced. This spray has been developed especially by Pickrell. Sulfathiazol is still the drug of choice in staphylococcal infections and is used extensively in infections such as osteomyelitis. In septicemia, the chemotherapeutic agents offer more than has any single agent in the past. In infections of the urinary tract, which are common after operation, especially after operations on the gastro-intestinal tract, these chemical compounds have found a wide use. Their results are consistent and perhaps more gratifying than those obtained with any agent heretofore known. For some time, work has been proceeding in an attempt to develop an agent which would more or less completely sterilize the intestinal canal. Some hope was held for sulfaguandine for a time but the consensus now appears to be that this drug has been disappointing in that regard (Fior). Long, Marshall and their associates have now become most enthusiastic regarding succinyl sulfathiazol in the production of a relatively sterile intestinal tract. In their experimental work they found that after the administration of massive doses of this drug to dogs, the colon could be widely incised without resuturing it and that the dog still had a high degree of protection against fatal peritonitis. Succinyl sulfathiazol is now being applied as a preoperative and postoperative agent in operations on the large and small intestine. It requires changes from the old methods of preoperative preparation in that purgatives and irrigations of the intestinal canal must be discontinued several days before operation is to be undertaken. The drug can be administered in large doses as it is tolerated well and a high concentration of the drug in the blood is perfectly compatible with good health. It is given by mouth for application directly to the intestinal mucosa and in this way the bacterial count of the stool is sharply reduced. After an intensive course of this treatment, anastomotic procedures can be carried out and the belief is expressed by those who have had experience with the method that the threat of peritonitis from contamination from infection is now largely removed. A thorough discussion of some of the chemotherapeutic agents used in surgical practice and the inhibiting mechanism of these agents is offered by Lockwood.

In preoperative and postoperative care, perhaps there is no single agent more appreciated by the surgeon than the method of intestinal decompression now possible. Since the work of Wangensteen, Miller and Abbott, and others, this method has now become a standard procedure in almost all hospitals. To be able to remove the swallowed air and much of the gas trapped in the intestine by such a simple procedure is indeed not only gratifying but of great benefit to the surgeon. Preparation of patients for operation is now much more complete and its field of application has been greatly extended. The number of stages that the operation requires has been reduced as much more extensive operation can be

undertaken at the primary session. Postoperatively, decompression apparatus not only affords a great increase in comfort to the patient but protects all suture lines whether they be in the intestinal tract or the abdominal wall. Paralytic ileus can be overcome with a great deal less distress to both patient and surgeon. There are many ingenious devices for the rapid passage of the tubes into the small intestine, perhaps the most logical one at the present time being employment of the roentgenoscope. In this way, the progress of the tube can be watched. By threading a piano wire stylet to act as a stiff guide for the tube, much valuable time can be saved in this maneuver. Certain investigators are now attempting to localize points of obstruction along the small intestine after the tube is in place by injecting small amounts of barium through the tube prior to making a roentgenogram.

In the field of vitamins, the use of vitamin K has now become well established. Synthetic compounds of the vitamin, at least its antihemorrhagic property, are now available. These can be administered by intravenous injection so that the hemorrhagic manifestations associated with the deeply jaundiced patient who has been unable to assimilate this vital factor are now much less of a problem. Large clinics (where patients suffering from obstructive jaundice formerly died in a fairly high percentage of cases) now find that it is extremely rare to have serious difficulty from bleeding. Not only is the vitamin employed in those cases in which the liver disease and obstruction of the biliary tract upset this vital relationship but also in many different types of conditions, whether operative or nonoperative, in which the vitamin deficiency results from inadequate absorption or loss of important factors, as might be seen in extreme diarrhea or in fistula high in the small intestine. Recently a great deal of work has been done, especially by Hartzell and Crowley, which tends to show that large doses of vitamin C are of value in promoting proper healing of wounds. This knowledge is being applied in those cases in which the proper vitamin intake has been inadequate or impossible, as is readily visualized in the case of the debilitated, extremely ill, elderly patient.

The subject of surgical and traumatic shock has been accorded a tremendous amount of thorough study and investigation. This is far too extensive to permit going into any degree of detail here. Perhaps the best review of all the theories and important ramifications has been compiled by Harkins. This subject is of paramount importance at the present time in military practice. Since we now know a great deal more about the exact changes occurring in the blood itself, it has been possible to develop some replacement agents which combat this condition much more quickly and effectively. The demonstration by many investigators that the important loss has been in effective circulating blood volume and not in the formed elements of the blood has led directly to the development of transfusion of blood plasma and blood serum in these conditions. The extreme degrees of shock seen in extensive burns have supplied adequate material for complete study. Prompt and continued administration of blood plasma has saved many lives not only in military but also in civilian practice. Development of well established blood and plasma banks in the various centers has facilitated the method of administration. Studies of the changes in the protein content of the blood in allied conditions have shown that transfusion of plasma is one of the most direct ways of treating deficiency of serum protein. This type of therapy is now extending to other conditions such as those associated with extreme loss of protein, as in intestinal obstruction or prolonged, severe diarrhea. The necessity for maintaining an adequate supply of the fluid elements of the blood by administration of material which need not be of the same blood group as the patient has led to attempts to treat the human beings with plasma and serum obtained from the animal kingdom. Work with bovine plasma has revolutionized this situation. It has been demonstrated that the elements present which were toxic to the human

being were associated with the globulin fraction and that by extracting the globulin and administering only the albumin one is able to supply this material in a form suitable for human use. Cohn has been the leader in the separation of these fractions. His work has been augmented by the studies of Kremen, Wangenstein and others (16) who pioneered the administration of the material to human beings. The military surgeon is now able to supply some of these agents at a moment's notice. With the developments of dried and frozen forms, a large amount of material can be transported in relatively small spaces and can be kept until needed when it is quickly changed to liquid form by dissolving it in physiologic salt solution. The future possibility of this great advance is obvious.

Oxygen therapy has advanced by the use of the oxygen mask, especially the one developed by Boothby, Lovelace and Bulbulian. By means of this apparatus, very high concentrations of oxygen can be administered over a prolonged period without danger to the patient. Not only is this of value in aviation medicine and in postoperative pneumonia but it shows promise in surgical and traumatic shock, in which conditions the amount of oxygen in the circulating blood is greatly reduced. Then too, in cases in which nitrogen is trapped within the body (such as cases of intestinal obstruction and possibly in anaerobic conditions such as gas gangrene) the application of a high concentration of oxygen by means of the mask theoretically at least holds great promise. Perhaps the greatest value of this method is in the prophylactic treatment of many of these conditions, especially surgical shock, where the mask can be applied, and in cases in which the nature of the operation leads one to anticipate shock. This has been pointed out repeatedly by C. W. Mayo.

The use of roentgen therapy in infectious conditions has continued in many centers and has been employed especially by Kelly and co-workers. Roentgen therapy has been applied in cases of gas gangrene or threatened gas gangrene and the exponents of the method are enthusiastic. This has led to a wider use of roentgen rays in many types of obstinate or perhaps obscure infection in surgical conditions. The exact mechanism and exact significance of this method of treatment remain to be explained. Apparently, in certain infections it is well founded.

The proper selection of anesthetic agents has contributed a great deal to the advance of present day surgery. Anesthesia has now become specialized to the point where almost any agent, combination of agents or method can be applied so that the anesthesia is highly individualized as regards the special needs of the patient. Continuous spinal anesthesia, fostered especially by Lemmon and Paschal, has made possible the injection of a relatively small initial dose, the addition of small serial doses as indications arise, and the withdrawal of part of the anesthetic agent as deemed necessary or at the conclusion of the operation. This has meant that in many operations, especially on the lower part of the abdomen and pelvis, in which a spinal anesthetic formerly would have been used but for the fact that the surgeon feared that a single dose of the anesthetic agent would not produce anesthesia of sufficient duration or that if a large enough dose were given the amount of shock would be excessive, he is now able to proceed with prolonged operation with his mind relatively at ease. As mentioned previously, development of positive pressure anesthesia as applied to thoracic surgery has practically revolutionized that field of work. Not only can heretofore impossible operations be carried out under ideal circumstances but newer developments are now being added to many of the older operations.

Perhaps of less importance to the surgeon but nevertheless of great value to anyone encountering obstetrical work, the recent development of Edwards and Hingson of continuous caudal anesthesia in obstetric practice shows great promise. After the introduction of the inlying needle or flexible catheter into the caudal canal, the anesthetic agent may be injected as necessary without appreciably

affecting the uterine contractions but at the same time removing the terrifying pangs of childbirth. The anesthetic agent apparently has no effect upon the fetus and in the few cases thus far reported, results have been most gratifying.

Intravenous anesthesia is rapidly assuming a permanent position in almost every surgical field. In comparatively minor operations, it serves as a quick, convenient and pleasant agent which is safe when administered properly. It is especially applicable in those instances in which the cautery is necessary. In major operations, the intravenous agent is especially appreciated as an adjunct to spinal anesthesia. Here the psychic factor is entirely overcome, nausea is minimized and (in the opinion of certain surgeons) shock is less likely to develop. The drug of choice is pentothal sodium, but anesthetists most familiar with the method stress the fact that careful, experienced control must be exercised throughout. (Lundy and associates) (19).

REFERENCES

1. Abeshouse, B. S.: Hypertension and unilateral renal disease: review of literature and report of 16 cases. *Surgery*. 10: 147-200 (July) 1941.
2. Adams, W. E.: Recent progress in the surgical treatment of lung tumors. *Surgery*. 10: 1005-1026 (Dec.) 1941.
3. Blalock, Alfred, Harvey, A. M., Ford, F. R. and Lilienthal, J. L., Jr.: The treatment of myasthenia gravis by removal of thymus gland; preliminary report. *J. A. M. A.* 117: 1529-1533 (Nov. 1) 1941.
4. Blalock, Alfred, Mason, M. F., Morgan, H. J., and Riven, S. S.: Myasthenia gravis and tumors of the thymic region: report of a case in which the tumor was removed. *Ann. Surg.* 110: 544-560 (Oct.) 1939.
5. Claggett, O. T.: Unpublished data.
6. Claggett, O. T. and Wiig, L. M.: Transthoracic resection for carcinoma of the cardiac end of the stomach: report of two cases. *Proc. Staff Meet., Mayo Clin.* (In press.)
7. Cohn, E. J.: The properties and functions of the plasma proteins, with a consideration of the methods for their separation and purification. *Chem. Rev.* 28: 395-417 (Apr.) 1941.
8. Edwards, W. B. and Hingson, R. A.: Continuous caudal anesthesia in obstetrics. *Am. J. Surg.* 57: 459-464 (Sept.) 1942.
9. Firor, W. M.: Intestinal antisepsis with sulfonamides. *Ann. Surg.* 115: 829-831 (May) 1942.
10. Garlock, J. H.: Radical surgical treatment for carcinoma of the cardiac end of the stomach. *Surg., Gynec. & Obst.* 74: 555-560 (Feb.) 1942.
11. Harkins, H. N.: Recent advances in study and management of traumatic shock. *Surgery*. 9: 231-294 (Feb.); 447-482 (Mar.); 607-655 (Apr.) 1941.
12. Hartzell, J. B. and Crowley, R. T.: Vitamin therapy in the surgical patient. *Am. J. Surg.* 56: 288-299 (Apr.) 1942.
13. Holman, C. W. and McSwain, Barton: Transthoracic esophagostomy. *Surgery*. 11: 882-885 (June) 1942.
14. Jonas, A. F., Jr.: Transpleural esophagostomy: report of a successful case. *Arch. Surg.* 44: 556-561 (Mar.) 1942.
15. Kelly, J. F., Dowell, D. A., Russum, B. C. and Colien, F. E.: The practical and experimental aspects of roentgen treatment of *Bacillus welchii* (gas gangrene) and other gas-forming infections. *Radiology*. 31: 608-619 (Nov.) 1938.
16. Kremen, A. J., Hall, Howard, Koschnitzke, H. K., Stevens, Beatrice and Wangenstein, O. H.: Studies on the intravenous administration of whole bovine plasma and serum to man. *Surgery*. 11: 33-355 (Mar.) 1942.
17. Lemmon, W. T. and Paschal, G. W., Jr.: Continuous serial, fractional, controllable, intermittent—spinal anesthetic, with observation of 1,000 cases. *Surg., Gynec. & Obst.* 74: 943-956 (May) 1942.
18. Lockwood, J. S.: Sulfanilamide and its derivatives in surgical infections; a review: I. The mode of chemotherapeutic action of the sulfonamides. *Surgery*. 10: 493-503 (Sept.) 1941.
19. Lundy, J. S., Tuchy, E. B., Adams, R. C., Mousel, L. H. and Seldon, T. H.: Annual report for 1941 of the Section on Anesthesia: including data on blood transfusion. *Proc. Staff Meet., Mayo Clin.* 17: 225-238 (Apr. 15) 1942.
20. Paine, J. R.: Personal communication to the authors.
21. Trimble, I. R., Parsons, J. W. and Sherman, C. P.: A one stage operation for the cure of carcinoma of the ampulla of Vater and of the head of the pancreas. *Surg., Gynec. & Obst.* 73: 711-722 (Nov.) 1941.
22. Walters, Waltman: Transthoracic resection of the stomach and esophagus for carcinoma; report of case. *Proc. Staff Meet., Mayo Clin.* 17: 241-247 (Apr. 22) 1942.