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#### DISCUSSION

DR. JOHN L. SAWYERS (Nashville, Tennessee): Dr. Stone is known for his prospective, randomized studies, and he certainly has not failed us today. We are indebted to him for performing a prospective, randomized study on injuries to the colon, comparing closure with exteriorization of the colon. He has had an enormous experience with injuries to the colon in a relatively short period of time. He has carefully defined the criteria that must be established to consider a patient for primary closure of a colonic injury, and he has certainly demonstrated that in these patients primary closure can be performed safely and with lower morbidity than exteriorization.

We have also studied different methods of managing injuries to the colon in civilians, comparing primary closure with colostomy, and also with a third method, exteriorized primary repair. Our knife and gun club is smaller than that in Atlanta, so we have a smaller number of patients than Dr. Stone, but we also found that 50% of our patients can have primary closure of the injured colon performed safely and effectively. Dr. Stone found a similar percentage.

In fact, in a report from the Tulane service in New Orleans a few years ago, and in a recent report from Jacksonville, Florida, exactly 50% of the civilians with injuries to the colon had a primary repair. This is an amazingly consistent percentage in Southern cities.

Exteriorized primary repair is a method that can be applied to some of the patients in the other half of that group. I would like to show you a slide about this method, which is not new; it was described by Mason in 1945.

(slide) These are the results in patients who had exteriorized primary repair and show our first 23 patients. Eighteen of these patients had an uneventful recovery, with interiorization of the primary repaired colon in six to ten days. Only three patients had major complications, with no deaths. Five patients had to have the loop opened as a colostomy, in three because the wound broke down, and in two because in our early experience we had exteriorized the colon too tightly over the glass rod.

(slide) If the exteriorized repaired colon remains intact, it can be put back into the peritoneal cavity in seven to ten days. If the repaired colon breaks down, then a formal colostomy can be done. We believe this method can be applied to the treatment of some of the patients about whom the surgeon is concerned about primary closure. This method of exteriorized primary repair offers a safe alternative to colostomy.

DR. FRANCIS C. NANCE (New Orleans, Louisiana): Dr. Stone has contributed greatly to the dialogue on the proper treatment of colon injuries. (slide) In a prospective way he has confirmed data that have been repetitively reported, not only from Charity Hospital, but from many other institutions: the complication rate among patients treated without colostomy, with primary repair, is lower.

(slide) The hospital stay is shorter, not even considering the readmission for colostomy closure. (slide) Even the mortality is lower among those patients.

All of the previous studies suffer from the defect of not being prospective and randomized studies. Dr. Stone's study does help to identify those patients who can be treated safely by primary suture.

This problem of using colostomy for colon injury started with Ogilvie in the Western Desert. If you read Ogilvie's report, the

mortality for those patients who had primary suture was, in fact, lower than for the patients who had colostomy. That same observation can be made about the data collected by the United States Army in World War II, but surgeons came back from World War II enthusiastically using colostomy for all colon injuries. Dr. Alton Ochsner was the first to point out that the enthusiasm had gone too far.

We can all be grateful to Harlan Stone for finally showing that there is a group of patients who can be managed safely by suture.

I have some questions I would like to ask Dr. Stone. First, I would like to quibble a little bit with his technique of randomization. Using an odd and even number system allows the surgeon to decide in advance whether or not he will enter the patient in the study, because he will know what the randomization procedure will be; that can be used as a criticism.

I wonder why Dr. Stone did not break right and left colon injuries apart. Some people feel there is a difference, and I wonder if he would address that issue.

I would like to know specifically what Dr. Stone's skin wound management was. The incidence of infection here is high, as it is in all services, and I wonder how the skin wound was managed.

Finally, I would like Dr. Stone to speculate on what the results of a randomized study of this excluded group of patients would have been. Would there have been the same difference in mortality and morbidity among those patients if all patients had been entered into the study?

DR. ROBERT J. FREEARK (Maywood, Illinois): Our experience is somewhat in conflict with those reported today. These differences may reflect a special population which was certainly not randomized on the basis of the favorable circumstances reported by the authors. I would like to comment in regard to the treatment of the nonrandomized group.

(slide) I apologize for submitting old data, but I think the opportunity to learn from such cases will never again occur. This is in an era, 1965 to 1970, in a rather large series at the Cook County Hospital, in which the average time interval from injury to the colon to arrival in the operating room was something over five hours. Virtually none of these patients received any preoperative antibiotics.

The study involves 415 patients with injuries to the colon, two-thirds of whom sustained gunshot wounds. Taking out those who died in the first 24 hours, in which the management of the colon wound could not really be evaluated, and eliminating those with injuries below the peritoneal reflection, in which there is general agreement in regard to management, we ended up with (slide) this group of 391 patients. Relative to the various areas of the colon, 55% of the 93 injuries to the right colon were repaired and dropped back with only the addition of intraabdominal drains. The other 45% had some form of exteriorization, either a proximal colostomy, exteriorization, or repair with a proximal colostomy.

Similar percentages in the other areas of the colon are shown. The relatively low percentage (25%) of primary repairs in the transverse colon is a reflection of the high incidence of associated injuries that go with a gunshot wound through the transverse colon. Such wounds result from missiles that frequently injure the duodenum and pancreas, and the resident staff who operated upon these patients was quite clearly interested in getting those colons out of the abdomen and not "chancing" a primary repair.

You will notice that the resident staff did not really believe there was any great difference between right and left colon, dropping back approximately 50% on both sides. The total percentage of primary repairs for all segments was 40%.

When we looked at these two groups of patients, those who had primary repair and those who had a staged procedure, there was not any significant difference in most of the customary measurements. There was not any real difference in the mortalities, and I think mortality rate is not a valid criterion. These patients do not really die of the colon wound under most circumstances; they die of the other injuries.

Even if you looked at infection rates and the like, the only real difference between these two groups (slide) was in the incidence of intra-abdominal abscess formation. (Incidentally, we left all subcutaneous wounds open, so wound infection should not be a significant problem in either group.) Much to our surprise, in the patients that had primary repair, so-called definitive surgery, whether you were talking about the right, transverse, or left colon, the incidence of intra-abdominal abscesses was in the range of 20%, almost three times the rate of intra-abdominal abscess formation in those that had some form of exteriorization or colostomy.

When you consider that this group of primary repairs was, presumably, a much more favorable group—the resident saw fit to drop it back—this incredibly high incidence of abscess formation makes the case that, in the patient who has had a five to six hour time interval, since injury, and the groups were not randomized in this current report, when in doubt, pull it out.

I enjoyed this paper very much. And I have one question for Dr. Stone. I share Dr. Nance's concerns about the wound infection rate, which struck me as being awfully high, and it suggests to me that they have not learned the lesson of leaving these wounds open. I wanted to ask about your conclusions in regard to drainage. I believe on the basis of our studies that the addition of a drain into the abdomen of a patient with intraperitoneal injuries probably increases the likelihood of intra-abdominal abscess formation. In our group in which primary repair was undertaken and a drain inserted "just in case it leaks," the drain may be the principal factor in the high incidence of intra-abdominal abscess formation.

**DR. OWEN H. WANGENSTEEN (Minneapolis, Minnesota):** A year ago I read a small monograph of Frederick Fox Cartwright, well-known anesthesiologist at King's College Hospital, on Development of Modern Surgery. Therein he related that a Vera Gedroitz, a famous Russian and affluent princess, was the first to operate successfully in the Russo-Japanese War of 1904 for abdominal gunshot injuries.

I contacted Dr. Cartwright, but he could add no information, so I took the matter up with Dr. Boris Petrovsky, the distinguished Minister of Health in Moscow. After a long interval, Boris wrote me he had looked into the record, and noted that Vera Gedroitz had operated upon 183 patients, many successfully. He could not provide accurate factual data; the recital does give a new view of the origins of military surgery in wounds of the abdomen in warfare.

We know that P. Lockhart Mummery, of London, was advising non-operative treatment during the first years (November 1914) of World War I, that Drs. Eugen Enderlen and Ferdinand Sauerbruch in July 1915 urged operating, and in a controlled study, the mortality in the group not operated upon was 94%, and in the group that was operated upon 44.4%, demonstrating that when such wounds were treated conservatively only 6% of the patients survived; of those operated upon reasonably early, 44.4% recovered.

Historically, therefore, it is important to note that a Russian princess engaged ambulances, took them to the front, brought patients back quickly to the hospital, and operated quite successfully in 1904, when it was not the vogue to do it.

**DR. H. HARLAN STONE (Closing discussion):** Dr. Sawyer's patients have had a success when a primary repair of the colon is exteriorized and subsequently returned because of the extra care given by the house staff as well as the nursing staff. Such is not always available in most city-county hospitals.

Dr. Nance was extremely benign with his comments. I was expecting a few more striking differences, but I find that we almost entirely agree. However, I do not think that I could bring myself to close all colon wounds primarily. I have not been impressed by any differences between the right and left colon with respect to healing capacity, just in the amount of feces that spill into the abdomen. In addition, those of the right colon are frequently associated with liver injuries and a bloody ooze thereafter.

We use Neosporin® aerosol spray in the incision and carry out a primary closure. A delayed closure has seldom been successful if a colostomy is present, because of an overflow of feces into the wound.

Dr. Freeark, I noticed that your review was retrospective, not randomized, and that patients were not given antibiotics until as late as five hours after injury. Those data are not comparable with our experience, as our patients receive antibiotics on entry to the emergency room after a rapid evacuation by ambulance.

With respect to the use of drains, we do not drain anything that we do not want to disrupt and subsequently to efflux to the outside; by this, I especially refer to suture lines, that is, unless we want that suture line to fail.