

the laparoscopic group, which reflects the diminished pain seen with laparoscopic surgery. One of the main advantages seen in the laparoscopic group, however, was the recovery after discharge from the hospital. All patients were instructed to resume full activities 2 weeks postoperatively. Patients who had laparoscopic appendectomies resumed full activities 14 days postoperatively, whereas patients who underwent open appendectomies did not do so until 25 days postoperatively.

This study confirmed the safety and efficacy of laparoscopic appendectomy. It can be performed in a high percentage of patients, even in the presence of perforation. In addition, however, it demonstrated the superiority of laparoscopic *versus* open appendectomy in terms of diminished postoperative pain and length of recovery. We conclude that laparoscopic appendectomy is the procedure of choice for patients with suspected acute appendicitis.

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## Discussion

DR. R. SCOTT JONES (Charlottesville, Virginia): First, I want to compliment Dr. Roberts and Dr. Frazee for approaching this question with a randomized clinical trial. This is, obviously, the optimal method for answering the questions about difference in therapies, and this was a well-designed, well-conducted, and well-presented clinical study. I will begin by commenting that the results of this work and overall effectiveness of the therapies, morbidity, and so forth, certainly reflected the same kinds of outcomes reported by Drs. Schirmer and Hanks and others in a previous nonrandomized study from our department, as well as other work. I have a couple or three questions I wanted to ask. But first, I would mention at the outcome of this, there was a statistically significantly reduced consumption of analgesics in the laparoscopic group and that there was a faster return to work in the laparoscopic group, were conclusions that I believe were clearly supported by the data and certainly would influence our judgment about choosing the two operations. Now I'd like to ask a couple of questions, or I should say invite the presenters to elaborate on some of their data if they can. And the first point would be to ask if they could comment on how often the correct diagnosis was made when the patients didn't have appendicitis. In other words, a patient had a normal appendix and you've got a McBurney incision *versus* laparoscopy, could you tell us how effectively those situations permitted the correct diagnosis when it wasn't acute appendicitis? The second question was that they had 8% morbidity in the laparoscopic group and a 5% in the open group. Perhaps, you could share with us qualitatively what the nature of the complications were in both of those groups. Lastly, I would like to know whether you thought that the laparoscopic technique permitted a decrease in morbidity when the patients had a normal appendix. In other words, was the morbidity of the operation less if there was a normal appendix?

DR. HUNTER HOLMES MCGUIRE (Richmond, Virginia): Thirty-five years ago, I had my own appendix removed in a 15-minute operation, and I was on the tennis court a week later. It

was poor tennis. I lost the set to a girl, but I won the girl, and so a 15-minute operation continues to be a great success. My surgeon was trained by my great-uncle, Stuart McGuire, who in 1907, reported 500 appendectomies with an operating time between seven and twelve minutes when the appendix was not ruptured. I would like to think that surgery gets better with each generation. But I'm sad to admit that in my own VA surgical service our average time for an appendectomy by our residents like those of the authors is slightly over an hour. When I go to the operating room to find why residents are taking too long, what I usually find is an assistant hauling up on retractors and making the appendix hard to find and requiring a larger incision. Pushing down on retractors is one of many tricks of our forefathers that seems to have been forgotten. So I would like to ask if we shouldn't try to rediscover and reemploy classical, technical economies before investing longer times and much more money in videoscopic and robotic surgery.

**DR. RICHARD J. FIELD, JR.** (Centreville, Mississippi): If we accept the fact that change is high on the list of absolutes in our life, then we shouldn't be surprised when someone recently stated that in 10 years, 70% of abdominal surgery will be done laparoscopically. I think this may be a landmark paper. I think from the sentiment I've just heard most of you are not convinced of this, and I'm not completely convinced of it. I'm thinking of a homily I heard recently, which said, "When one has a new hammer, everything looks like a nail." I will say to Dr. Roberts that this may be a real significant contribution coming from Scott White because all of us have watched this and felt like Dr. McGuire, that we could do an appendectomy in about the same time that they could do it laparoscopically. But I would like to tell you something else plus this paper that may change my mind. Our youngest son is one of the team doctors of the University of Mississippi football team. That's not as glamorous an athletic team as Duke's, as Dr. Jones just mentioned. But as fall football practice started in August of this year, two of his big linemen developed appendicitis. One had a laparoscopic appendectomy; one had an open appendectomy. The one with the laparoscopic appendectomy was back in 1 week's time. I'm not sure he did as well as your man, Scott, did, but he was back. The one with the open appendectomy took 3 weeks before he could come back to full practice. I think these are the things that are going to drive laparoscopic appendectomy, and it may well be that we better learn how to do it and do it proficiently.

**DR. JOHN P. WILSON** (Atlanta, Georgia): First of all, I'd like to compliment Dr. Roberts on his paper. It's an excellent study, and I think it does point up the advantages of laparoscopic appendectomy. I would like to suggest though that the use as a means of removing the appendix is only part of the picture that we're really dealing with here because I think most of us would admit that we don't make a correct diagnosis on every patient who has appendicitis. I'd like to, first of all, say that my comments are my personal comments, but my observations are based on the institutional experience of Georgia Baptist Medical Center, where we have done a great deal of laparoscopic

surgery. First of all, I don't know of anything that's occurred in better than 40 years that I've practiced surgery that has been a greater potential for enormous benefit and at the same time a potential for harm that laparoscopy has. I think one of the problems is the very rapid dissemination of the procedures without an adequate experience or evaluation. So I would like to simply tell you how we approach this at our institution. First of all, virtually every patient who has a diagnosis of acute appendicitis, and for that matter, many of the acute abdomens period, are subjected to laparoscopy. We start off, first of all, by making that decision—is this patient probably going to surgery? If that decision has been made, then the next step is simply to do those diagnostic procedures which will be of benefit or impossible to do with a laparoscope, such as evaluate the urinary tract. Having introduced the laparoscope, which is a very safe, a very simple, and a very inexpensive procedure, at that point we can decide what we need to do. If we find something other than the acute appendix, we can deal with it appropriately. If it's a diverticulitis, if it's a ruptured ulcer, we are obviously better off with a laparoscope in there than we are with a right lower quadrant incision. And so we find that this is the first step. The second step is to look at that appendix and see if it can be removed technically with ease with a laparoscope. I would guess that our operating time is an average of about 30 minutes laparoscopically in the uncomplicated appendix. The uncomplicated, acute appendix or the very modestly complicated appendix, we remove with a laparoscope. If we have a more complex problem, that is, significant adhesions of the small bowel to the area or if we have abscess, then we have to evaluate that a little bit differently. We may very well open the patient, but at that point we can decide what is the appropriate incision, the location of it, how big it needs to be, where we need to go. So that we feel that there's an advantage in every circumstance that we enter into when we approach these patients with the acute appendix. One thing I would say from my experience that I think would be worth mentioning, first of all, I think that one has to appreciate the fact that if you're working with midline trocar incisions, you're better off than you are with laterals. The complication rate is significantly less. The second thing is, and the worrisome thing is, that if you have an abscess or if you have free pus in the abdomen—those of us who remember the preantibiotic days and the days when the Ochsner treatment for ruptured appendix was one of the essential elements—was to put that patient in a semi-Fowler position so that you wouldn't have an abscess under the diaphragm in the upper abdomen. You have that patient in a Trendelenburg with a little list to port as you begin to do your appendectomy and see the pus run, you know that that's a bit of a problem. And our experience with adequate lavage of abdomen with a laparoscope has not been completely satisfactory. So these are the elements I think that enter into laparoscopy as simple a new technical application of good, sound surgical principles. If you use it that way, I think it's excellent.

**DR. CHARLES A. HERBST** (Chapel Hill, North Carolina): It might have gone past many of us, as we listened to the paper, but one of the aspects in laparoscopic appendectomy is, of course, the cost. I would compliment the authors on using the

endoloop rather than the stapler and in using clips rather than the clip applier, which of course cost a great deal. One question I would have is did they look at the cost. I suspect that they're fairly close together. The other question that I would have to make—were all of these patients coordinated with the GYN service? For example, were there patients admitted to GYN with possible PID that might have turned out to have appendicitis later? Could you give us a little bit of information about the patients that turned out not to have appendicitis? What other diseases did you find, and did laparoscopy help you in the management of those other diagnoses?

DR. LESTER F. WILLIAMS, JR. (Nashville, Tennessee): I hadn't planned to discuss this, but as others didn't ask these key questions, I have two questions based on observations made by Bill Richards when he did a similar review of our cases. When he separated the normal appendix from the diseased appendix, it made a difference in the interpretation of the use of medications. I wonder if you did that? Second, all data that I'm currently aware of shows the laparoscopic appendectomy to be substantially more costly than the open. Do you have those data before you suggesting that this would be a procedure that would be proper for all patients with appendicitis?

DR. RICHARD C. FRAZEE (Closing Discussion): I'd like to thank the different discussants for their comments and questions and would like to elaborate a little bit on their comments and then address their questions specifically. Over the past several years, with the expansion of laparoscopic surgery, we've seen a number of reports describing the types of operations that can be performed with the laparoscopic technique. To the extent that, within the last year, we have seen a laparoscopic Whipple procedure described. I think that in the coming years we're going to see a shift in the focus of laparoscopic surgery research from what type of operations can be performed to what type of operations should be performed. We have attempted to do that in our current series. When attempting to do these types of analyses, it's important to have comparable groups. When we first starting doing laparoscopic appendectomy in early 1990, we were pleased to see a reduction in average hospital stay from approximately 4½ days in historical controls to around 2 days in our laparoscopic appendectomy group. This time frame, however, coincided with a trend toward shorter hospitalization in general, and, in fact, if we were to compare the open appendectomy patients from our current study with those same historical controls, we would have been able to demonstrate a statistically significant decrease in average hospital stay. We set up this study as a prospective randomized study in an attempt to eliminate these types of biases. Dr. Jones, I appreciate your comments, and let me address your questions. You asked about the correct diagnosis when the patient had a normal appendix. In fact you've touched on one of the advantages of the laparoscopic technique. With the laparoscope, it is possible to visualize the entire peritoneal cavity, and this is something that is often quite difficult through a right-lower-quadrant, muscle-splitting incision. The occasional patient where you have upper abdominal pathology that presents with right-lower-quadrant pain, the laparoscope is a distinct advantage. You also asked us to elaborate on the specifics of our

morbidity. The patients who had complications following laparoscopic appendectomy included one wound infection, one intraabdominal abscess in a patient with an appendiceal rupture, and one urinary tract infection. This compared to two patients with complications in the open appendectomy group: one wound infection and one bleeding complication. One of the differences in wound infection between the two groups, however, is that with a trocar infection, you're talking about a 1-cm wound infection. This responded very well to antibiotics alone. Whereas the wound infection in the open appendectomy patient required open drainage and presented with a much longer recovery period. You asked also is there less morbidity in the patients who have laparoscopic appendectomy with a normal appendix. It's my belief that this is true, but unfortunately the patients who come in presenting with acute appendicitis but have other disease conditions would usually staying in the hospital about the same length of time while they're recovering from whatever their disease process was, whether it be gastroenteritis or some type of gynecologic condition. Dr. McGuire, you asked about the operating time. In fact, we did demonstrate that it is longer with the laparoscopic technique. I think we'd have a hard time approaching the 7- to 12-minute time that you've set as a standard. We found that as we were analyzing our results—we began the study in January of '92, which coincided with about the middle of the chief resident year—our operating time continually dropped as the year went on. Then suddenly in July, again we saw a jump in the average operating time. So I'd like to think that this is a learner-dependent sort of thing and that with additional experience that surgeons can bring their operating time to compare with an open appendectomy. Dr. Field, you and Dr. Jones mentioned experience with athletes. I have a similar less distinguished experience. One of the first laparoscopic appendectomies I performed was on my next-door neighbor's son. He happened to be a soccer player on the Temple High School team and was very eager to get back to activities. So we did his laparoscopic appendectomy, and he was able to return to the soccer field the following week. Dr. Wilson, you brought up again one of the major advantages of laparoscopy in the acute abdomen, particularly when the disease process is not known. Diagnostic laparoscopy can be used to help you determine what type of incision the patient needs should he require an open procedure. Doing the exploration with the laparoscope makes this much easier than doing the exploration through a right-lower-quadrant incision. Again, I agree that the laparoscope does not replace the use of sound surgical principles. Dr. Herbst, you touched on the cost considerations, and Dr. Williams mentioned this also. We did a very informal cost analysis. The main differences that were seen in the two groups while they're in the hospital is an average of 0.8 days hospitalization, which comes out to about \$200, and an average longer operating time of about 22 minutes, which translates to about \$150. So these two effects, for the most part, cancel each other out. An area where cost can be risen considerably is intraoperative equipment. If you look at the cost of disposable equipment, disposable trocars for three trocars averages about \$300. The disposable clip applier will add another \$230. If the linear stapler is utilized, it adds another \$325 per application. For these reasons, we advocate the routine use of reusable trocars, including the reusable trocars and the reusable

clip applier. We also use the chromic endoloops to secure the base of the appendix. But another consideration in doing cost analysis is in fact the cost to society. I think it's important to remember the cost of 11 additional days of lost production to society, and it's important these considerations be done when comparing the open laparoscopic techniques. Dr. Williams,

you also mentioned about pain in the patient with a normal appendix. In fact, many of the patients who had a normal appendix at the time of laparoscopic appendectomy were able to leave the same day as their laparoscopic appendectomy when we were confident of the disease process that caused their underlying condition.