women of child-bearing age or obese patients, diagnostic laparoscopy may be useful, but based on our findings, we cannot recommend this procedure routinely.

References

1. Meyers W. Southern Surgeons Club. A prospective analysis of 1,518 laparoscopic cholecystectomies performed by southern U.S. surgeons. N Engl J Med 1991; 324:1073–1078.
2. Soper NJ, Bartean JA, Layman RV, et al. Comparison of early postoperative results for laparoscopy *versus* standard open cholecystectomy. Surg Gynecol Obstet 1992; 174:114–118.
3. Stoker ME, Vose J, O'Mara P, Maini BS. Laparoscopic cholecystectomy: a clinical and financial analysis of 280 operations. Arch Surg 1992; 127:589–595.
4. Semm K. Endoscopic appendectomy. Endoscopy 1983; 15:59–64.
5. Sosa JL, Sleeman D, McKenney M, et al. A comparison of laparoscopic and traditional appendectomy. Laparoendosc Surg 1993; 2: 129–131.
6. Whitworth CM, Whitworth PW, Sanfillipo J, Polk HC. Value of diagnostic laparoscopy in young women with possible appendicitis. Surg Gynecol Obstet 1988; 167:187–190.
7. Spirtos NM, Eisenkop SM, Spirtos TW, et al. Laparoscopy: a diagnostic aid in cases of suspected appendicitis. Am J Obstet Gynecol 1987; 156:90–94.
8. Nakhegivany KB, Clarke LE. Acute appendicitis in women of childbearing age. Arch Surg 1986; 121:1053–1055.
9. Pier A, Gotz F, Bacher C. Laparoscopic appendectomy in 625 cases: from innovation to routine. Surg Laparosc Endosc 1991; 1: 8–13.
10. Nowzaradan Y, Westmoreland J, McCarver CT, Harris RJ. Laparoscopic appendectomy for acute appendicitis: indication and current use. J Laparosc Surg 1991; 1:247–257.
11. Gangal HT, Gangal MH. Laparoscopic appendectomy. Endoscopy 1987; 19:127–129.
12. Geis PW, Miller CE, Kokoszka JS, et al. Laparoscopic appendectomy for acute appendicitis: rationale and technical aspects. Contemp Surg 1992; 40:13–19.
13. Saye WB, Rives DA, Cochran EB. Laparoscopic appendectomy: three years' experience. Surg Laparosc Endosc 1991; 1:109–115.
14. Condon RE, Telford GL. Appendicitis. *In* Sabiston DC, ed. Textbook of Surgery. 14th ed. Philadelphia: WB Saunders; 1991:884–898.
15. Leape LL, Ramenosky ML. Laparoscopy for questionable appendicitis: can it reduce the negative appendectomy rate? Ann Surg 1980; 191:410–413.
16. Dunn EL, Moore E, Eldering SC, Murphy JR. The unnecessary laparotomy for appendicitis: can it be reduced? Am J Surg 1982; 48:320.
17. Deutsch A, Zelikowsky A, Reiss R. Laparoscopy in the prevention of unnecessary appendectomies: a prospective study. Br J Surg 1982; 69:336–337.
18. Pier A, Gotz F. Laparoscopic appendectomy. Probl Gen Surg 1991; 8:416–425.
19. Reddick EJ, Saye WB. Laparoscopic appendectomy. *In* Zucker KA, ed. Surgical Laparoscopy. St. Louis: Quality Medical Publishing; 1991:227–239.
20. Olsen DO. Laparoscopic appendectomy using a linear stapling device. Surg Rounds 1991; 14:873–883.
21. Richards W, Watson D, Lynch G, et al. A review of the results of laparoscopic *versus* open appendectomy. Surg Gynecol Obstet 1993; 177:473–480.
22. Scott-Conner CE, Hall TJ, Anglin BL, Muakkassa FF. Laparoscopic appendectomy: initial experience in a teaching program. Ann Surg 1992; 215:660–668.
23. Frazee RC, Roberts JW, Symmonds RE, et al. A prospective randomized trial comparing open *versus* laparoscopic appendectomy. Ann Surg 1994; 219:725–731.
24. Vallina VL, Velasco MD, McCulloch CS. Laparoscopic *versus* conventional appendectomy. Ann Surg 1993; 218:685–692.
25. Schirmer BD, Schmieg RE Jr., Dix J, et al. Laparoscopic *versus* traditional appendectomy for suspected appendicitis. Am J Surg 1993; 165:670–675.
26. Ortega AE, Hunter JG, Peters JH, et al. A prospective, randomized comparison of laparoscopic appendectomy with open appendectomy. Am J Surg 1995; 169:208–213.
27. Reginer H. Reports of laparoscopic injuries lead New York state to issue guidelines. Gen Surg Laparosc News 1992; 1:32–33.
28. Bonanni F, Reed J, Hartzell G, et al. Laparoscopic *versus* conventional appendectomy. J Am Coll Surg 1994; 179:273–278.
29. Attwood SE, Hill AD, Murphy PG, et al. A prospective randomized trial of laparoscopic *versus* open appendectomy. Surgery 1992; 112:497–501.
30. Daniell J, Gurley L, Kurtz B, Chambers J. The use of an automatic stapling device for laparoscopic appendectomy. Obstet Gynecol 1991; 78:721–723.

Discussion

PROFESSOR ALAN G. JOHNSON (Sheffield, England): I would like to congratulate you on doing this trial. A few years ago, we were being told that it was "unethical" to do trials because it was so obvious that the laparoscopic approach was better. I think you put your finger on the reason why patients stayed so long in hospital after perforation—just tradition.

The questions I would like to ask are: Who decided when the patients went home? Was it the doctors, the nurses, or the patients? Did they know which operation was being done? Nurses, for example, may determine the outcome by telling patients who are having the "new" operation that they can go home the next day but those having the "old" operation should stay for 9 days. Time in hospital is strongly influenced by patients' expectations and the instructions they are given.

We have just finished a similar trial of open small incision *versus* laparoscopic cholecystectomy. To eliminate the psychological influence, we "blinded" the patients, the surgeons and the nurses, beforehand, by randomizing in the operating room. Afterward, we "blinded" the nurses and patients to which operation had been done by covering the abdomen with identical dressings. We told the patients that they could eat, get out of bed and go home as soon as they felt like it. We found no difference between the two groups in hospital stay (the median postoperative being 2 nights for each) or time back to full activity but the laparoscopic operation took longer in the operating room. From our experience, I would endorse your results and conclusion. The apparent benefits of the laparoscopic approach for appendicectomy and cholecystectomy are mainly due to old-fashioned attitudes after open surgery.

DR. CAROL SCOTT-CONNER (Jackson): Laparoscopic appendectomy has gained acceptance more slowly than laparoscopic cholecystectomy, perhaps because the advantages are much less clear-cut over the open procedure. Dr. Sheffield has pre-

sented in a masterful way the observer effect and some of the placebo effect that may have dominated previous studies in this area. The authors are to be commended for subjecting this operation to the benefit of a randomized clinical trial.

We have been doing the procedure since 1990 and, like the authors, are cautiously optimistic. However, I have noticed that as the procedure has gained acceptance, people have tended to extend its indications away from the equivocal case in which there is an obvious benefit in terms of doing the laparoscopic examination to look for other pathology and are now using the operation in cases where the preoperative diagnosis of appendicitis is quite clear.

I have some areas of concern in this respect and I would like to ask you to comment on a couple of these issues.

What is the role of laparoscopic appendectomy in the case of complicated, gangrenous, or perforated appendicitis? Anecdotally, some have suggested that the rate of intra-abdominal abscess formation may actually be higher after laparoscopic appendectomy than it is after the comparable open procedure in this setting.

Although you had similar numbers of intra-abdominal abscesses in both groups in your series, it is interesting that two of your abscesses in the laparoscopic group appeared in uncomplicated cases of acute appendicitis. One recent nonrandomized series reported a 45% rate of readmission to hospital for infectious complications after laparoscopic appendectomy for complicated appendicitis.

It seems likely that the biology of the peritoneal cavity is altered by both laparoscopic and open appendectomy, but in different ways. Is it possible that the 100% carbon dioxide insufflating medium that we work under not only does not inhibit the growth of anaerobes but may in fact encourage their growth after closure? Clearly, we are no longer letting the air in, and the same biology may not obtain. Are there cases for which open appendectomy is clearly better?

Finally, I wonder if there is a risk that we may miss another intra-abdominal inflammatory cause of pathology, such as diverticulitis, Crohn's disease, or the rare case of cecal carcinoma masquerading as an appendiceal mass. Even with the years of experience that I have in laparoscopy, I still worry that my perception through the scope may not be as accurate as that which I would have obtained during an open procedure.

Like you, we remain optimistic. And we find the procedure useful, particularly in the obese patient or in the patient in whom the diagnosis is unclear. I thank you for doing this randomized trial and for presenting this interesting paper.

DR. LARRY C. MARTIN (Closing Discussion): I would like to thank the discussants for their comments. I really expected a lot more comments, based on my experience with community surgeons who are doing a lot of laparoscopic appendectomies. However, just to answer the questions:

Who decided when the patient will be discharged? The surgeon who did the operation decided when the patient would be discharged from the hospital. As we have heard, tradition does play a role because in the past, patients were kept in the hospital for an extended length of stay, based on the impression that if the patient had a perforated appendix they required 10 days of hospitalization, 7 days of antibiotics, and had to be afebrile for 48 hours before discharge.

I think one thing that we showed was, that in the laparoscopic group, we did not wait for any of those things. We just sent the patients home, but only because they had had laparoscopic surgery, not for any scientific reason, we just thought they should go home sooner.

To answer the question about the role of laparoscopic appendectomy in complicated appendicitis—this can be a very difficult question. There are numerous other topics which arise, such as do you spread contamination throughout the abdominal cavity doing it laparoscopically when you insufflate the abdomen and drag the appendix across the peritoneal cavity? To answer that, I think that if you keep the operation local, put the appendix in some type of sterile receptacle for removal, you can minimize the abdominal contamination. Further, others have shown that the incidence of wound infection is definitely lower with laparoscopic appendectomy over the open technique because the appendix is placed in either a trocar or a receptacle for removal.

There may be a higher abscess rate, however, because the open end of the appendix is exposed while we are trying to get it into a receptacle, and this may add to the abdominal contamination. Perhaps the use of a stapling device to divide the appendix, rather than Endoloops, may prevent some of the contamination by sealing the end of the appendix.

To answer the question of which patients would benefit best from procedure—the patient with equivocal findings, especially females and those in which the diagnosis of appendicitis may be questionable. At times during an open appendectomy, it is hard to see into the pelvis to make the diagnosis of pelvic inflammatory disease or another ideology for the abdominal pain for which you are operating. With laparoscopy, it is relatively easy to see throughout the entire abdominal cavity. This is especially true in cases of diverticulitis in the 40- to 60-year-old patient group, when a laparoscopy can be used to plan an incision if the appendix appears normal and you see quite a bit of inflammation in the area of the sigmoid colon. So, one thing we found useful is to laparoscope the patient and confirm that the appendix is normal, and that the patient really has perforated diverticulitis and go ahead and make a midline incision to perform the appropriate operation. If we see that it is appendicitis, we can go to right lower quadrant incision directly.

I would like to thank the Association for the privilege of presenting our data.