Rev Gastroenterol Méx 1996; 61(2):113-118

Current Status in Laparoscopic Colorectal Surgery

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SUMMARY Background: *Laparoscopic techniques are being applied with increasing frequency to surgery of both small and large intestines.* ***Purpose:*** *This review article was undertaken to analyze the current direction of laparoscopic colorectal surgery.* ***Results:*** *The most feasible procedures are diagnostic laparoscopy, construction of intestinal stomas, rectopexy, and limited resections for benign conditions. Resections for Crohn's disease, especially extensive resections, and colorectal cancer are complex and should be considered investigational.* ***Conclusions:*** *The role for use of laparoscopic techniques in colorectal surgery will expand greatly in the next several years.*

Key words: Colorectal surgery, laparoscopic.

RESUMEN Antecedentes: *Las técnicas laparoscópicas se están aplicando con mayor frecuencia para la cirugía del intestino delgado y del colon y recto.* ***Objetivo:*** *Este artículo de revisión se hizo para analizar la dirección actual de la cirugía laparoscópica del colon y recto.* ***Resultados:*** *Los procedimientos más factibles son laparoscopia diagnóstica, construcción de estomas intestinales, rectopexia, y resecciones limitadas para enfermedades benignas. Las resecciones para la enfermedad de Crohn, especialmente las extensas, y cáncer colorrectal son complejas y deben considerarse bajo investigación.* ***Conclusiones:*** *El papel de las técnicas laparoscópicas en cirugía colorrectal crecerá en forma importante en los próximos años.*

Palabras clave: Cirugía colorrectal, laparoscopia.

INTRODUCTION

General Surgery has undergone major changes over the past decade because the rapid acceptance of laparoscopic techniques in therapeutic intraabdominal intervention. Although laparoscopic techniques were first used early in the 20th century[1,2], use of this technology for many years was restricted to diagnostic rather than therapeutic indications. The laparoscopic cholecystectomy first described by Muhe of Germany[3] in 1985 has become the accepted method for gallbladder removal. Laparoscopic cholecystectomy touched off a drastic change in the ideology and technology of today's intraabdominal surgery.

The potential for laparoscopic surgery to bring substantial advantages to patients requiring intestinal surgery encouraged us to apply laparoscopic techniques to colorectal surgery in late 1991. Now, several years later, this field is still in its early phases of development. Whereas laparoscopic techniques for biliary surgery quickly evolved, such techniques for effective and efficient colorectal surgery have developed slowly.

In this brief report we discuss what we consider the current direction of laparoscopic colorectal surgery. We hope it will fuel discussion in the Mexican surgical community that will produce further advances.

BACKGROUND

Today, the advantages of laparoscopic cholecystectomy are well established, and have been supported by several studies[4,5,6]. Fewer pulmonary complications[7], more rapid return of normal gastrointestinal function, shorter postoperative stay[8], less postoperative pain and disability[9], better cosmesis, decreased cost and more rapid return to work[10] are only some of the benefits reported from laparoscopic cholecystectomy compared to conventional cholecystectomy. Further-

more, it has been shown that the laparoscopic operative technique in gallbladder surgery nearly abolishes the postoperative hemodynamic, respiratory and metabolic changes seen with the "open" procedures[11,12]. Because of these advantages of laparoscopy as a therapeutic tool for the treatment of gallbladder disease, general surgeons were encouraged to extend these techniques to other common intra-abdominal operations such as intestinal surgery. Anecdotal case reports and small retrospective series suggested that laparoscopic colorectal surgery was technically possible[13,14]. However, the theoretical advantages reported at that time in terms of the ease, efficacy, and safety of colonic mobilization, resection, and anastomosis were not well established. Furthermore, concerns about the laparoscopic role in the staging and treatment of colorectal cancer remain controversial.

ANIMAL MODELS FOR LAPAROSCOPIC INTESTINAL SURGERY

In 1991, using animal models, we attempted to establish basic techniques for intestinal resection and anastomosis[15]. Although we encountered significant challenges in the animal model, in which the mesentery is thin and the bowel relatively mobile, we successfully demonstrated the feasibility of several different types of laparoscopic intestinal resections with intraperitoneal anastomotic techniques. Colorectal techniques such as right hemicolectomy with ileocolic anastomosis and left colectomy with ileorectal anastomosis were able to be performed in animal models[16,17,18]. The canine model is especially useful in laparoscopic colorectal surgery, since the anatomy of the dog large intestine and right mesocolon is very similar to human anatomy. In addition, the isolation and safe proximal ligation of the right colonic vessels in the dog seems to be an excellent training model for surgeons performing laparoscopic oncologic bowel surgery. The results of our studies have demonstrated that a laparoscopic oncologic-type of colectomy with intraperitoneal anastomosis in a dog model can be performed with low morbidity and in accordance with clearly defined surgical oncologic principles[17,18].

We believe that the use of animal models in laparoscopic intestinal surgery is a valuable training tool to augment the skills of surgeons prior to the performance of laparoscopic procedures in patients. We recommend the acquisition of proficiency in such animal models before conducting large bowel resections in humans (especially for malignant disease).

PRELIMINARY STUDIES IN HUMANS

Initial reports concerning the use of laparoscopy in colon and rectal surgery demonstrated that these procedures could be done safely and effectively in a selected group of patients. In 1991, Redwine and Sharpe[13] detailed the transanal extraction of an endometrioma of the sigmoid colon with stapled end to end anastomosis. In the same year Cooperman et al.[14] published a case in which a villous adenoma of the ascending colon was removed with a laparoscopically-assisted technique (mobilization of the colon by laparoscopy, then performing bowel and mesenteric transection extracorporally through a small incision). Fowler and White[19] described the use of a laparoscopic linear stapler to divide the large bowel and mesentery. One of the earliest series of patients undergoing laparoscopic was reported in 1991 by Jacobs et al.[20] of Miami, Florida, who described 20 large intestinal procedures using laparoscopic techniques with excision of the intestine and reanastomosis through a small (up to 10 cm) abdominal wall incision or through the rectum. Since then, several series documenting experience in laparoscopic bowel surgery performed by general surgeons have been reported[21,22]. In most of them, the "perceived" advantages of laparoscopic procedures have been in terms of faster recovery, need for less postoperative analgesia, decrease in postoperative ileus, shorter hospitalization and faster return to work[23]. Nevertheless, no studies have been reported that actually address these issues using rigorous scientific methods. Furthermore, there have been no prospective randomized trials that have proven the superiority or even equivalence of laparoscopic colectomy as compared to "standard" colectomy using a laparotomy.

In 1991 The American Society of Colorectal Surgeons (ASCRS) stated that laparoscopic colorectal surgery should only be undertaken in a setting in which meaningful prospective data retrieval will occur[24]. In accordance with this statement, many centers across the United States, including our Institution[25], have begun to prospectively assess the safety and efficacy of laparoscopic colon and rectal surgery by establishing registries or prospective studies to collect patient data.

CURRENT PROCEDURES IN LAPAROSCOPIC COLORECTAL SURGERY

General indications for laparoscopic surgery essentially do not differ from those of conventional surgery because the only major difference between laparoscopic and

conventional surgery is the access of the operative site. A laparoscopic colorectal procedure is never indicated solely because it can be done laparoscopically. For the purposes of this review, laparoscopic intestinal operations will be divided into procedures that have been accepted by most surgeons as reasonable to perform, and those that are gaining acceptance but that still in an evaluation phase.

1 CURRENTLY ACCEPTED PROCEDURES

1.1 Diagnostic laparoscopy

Laparoscopy has been underutilized as a diagnostic modality in general surgery: in less than 1 hour the surgeon can perform a diagnostic laparoscopy, obtaining tissue biopsies as indicated[26]. A major diagnostic application of laparoscopy is to evaluate blunt and penetrating trauma or acute abdomen. The overall diagnostic accuracy of laparoscopic examination has been reported[27] to be 80 to 99%. The success rate is similar in the diagnosing and staging of intraabdominal tumors. Laparoscopic visualization can detect lesions less than 1 mm in diameter, although only the surfaces of intraperitoneal structures are evaluated. The recent development of laparoscopic ultrasound probes[28] may further improve this diagnostic accuracy, especially in liver disease. Other applications of laparoscopy in malignant conditions include "second look" procedures to assess whether there is a recurrence of cancer after therapy.

1.2. Laparoscopic techniques for fecal diversion

Diversion of the fecal stream may be necessary in the management of a wide variety of disease states. Until recently, fecal diversion generally required laparotomy. More recently, trephine stoma formation, performing the diversion procedure entirely through the ostomy site, has been advocated[29]. Both conventional laparotomy and trephine stoma formation have been shown to be effective but have inherent deficiencies[30,31]. Many of these deficiencies are avoided by using laparoscopic techniques for fecal diversion. A laparotomy incision is avoided, tissue trauma is minimized and a thorough abdominal exploration can be performed. We have successfully used a "two cannula technique" (with one of these placed through the stoma site) for laparoscopic stoma procedures[32]. This procedure has three attractive features. First, it is technically simple, only two cannulas are needed in most cases. Secondly, our initial experience suggests that the procedure is safe. Use of the stoma site for open entry into the abdomen avoids the small danger associated with blind placement of needles and cannulas. More importantly, the surgeon is able to very precisely identify the appropriate segment of bowel and pull it to the stoma site in the proper orientation. The third and most attractive feature of laparoscopic stoma formation is the avoidance of a laparotomy. The laparoscopic procedure allows the patient to recover from a procedure that can be physiologically traumatic, and also results in prompt return of postoperative bowel function (our average ileostomy patient had return of normal bowel function on postoperative day one and on postoperative day three for the average colostomy patient). The laparoscopic approach is even more appealing for palliative diversion in the patient with advanced malignancy. These situations call for minimal interventions in patients with minimal lifespans.

1.3 Laparoscopic rectopexy

Procedures for treating rectal prolapse may constitute one of the best applications for colorectal laparoscopic techniques. It can achieve all of the merits of transabdominal rectopexy without a conventional laparotomy wound which may contribute to significant postoperative morbidity, especially in elderly patients[33]. The laparoscopic treatment of rectal prolapse is especially feasible because often no anastomosis is performed[33,34] (unless the patient has intractable constipation and is a candidate for bowel resection[35]), and the position of the rectum in the pelvis allows it to be readily mobilized laparoscopically in patients of nearly all shapes and sizes. In the surgical management of rectal prolapse we prefer sutured rectopexy because of its inherent simplicity and equivalent effectiveness compared with other methods of preventing recurrent prolapse[36]. Thus, we use sutured rectopexy laparoscopically, offering the patient the same kind of repair of this functional condition without a major abdominal wall incision. We add a sigmoid resection only if the patient has a severe underlying bowel motility disorder coupled with intractable constipation as proven by intestinal transit studies. Postoperative course is usually benign with an early discharge home on the 4th or 5th postoperative day[37]. We have seen satisfactory results after up to 2 years of following up these patients, with a complete recovery of their symptoms.

1.4 Laparoscopic intestinal surgery in benign conditions

Several benign intestinal diseases have been treated successfully using a laparoscopic approach. Colonic

polyps and diverticular disease are the most common indications reported in preliminary registries of laparoscopic intestinal surgery[38,39]. Colonic or rectal polyps that cannot be safely removed by colonoscopic or transanal techniques can be resected using a laparoscopic approach. Before surgery, their location must be precisely identified using preoperative colonoscopic injection of dye into the intestinal wall adjacent to the lesion[14], or by using intraoperative colonoscopy. Some laparoscopic surgeons may consider performing limited resections for polyps by first localizing the tumor-bearing segment laparoscopically, mobilizing the intestine intraperitoneally, and then completing the procedure through a small laparotomy (laparoscopic assisted surgery). But we do not advocate anything less than a formal resection, since a polyp may always harbor a malignancy.

The elective resection for chronic diverticular disease may be a good indication for laparoscopic surgery[40], but clinical judgement at the time of diagnostic laparoscopy plays a large part in the decision. Contraindications for elective laparoscopic surgery in this condition would include a large intra-abdominal abscess with peritonitis, complex fistulization to other parts of the intestine, or complex adherence to the retroperitoneum or other vital abdominal or pelvic structures.

2 PROCEDURES WHICH SHOULD BE CONSIDERED INVESTIGATIONAL

2.1 Laparoscopic surgery for Crohn's disease

Laparoscopic surgery is possible in inflammatory bowel disease if the patient is in stable medical condition. We have performed laparoscopic-assisted resections in patients with Crohn's ileocolitis or ileitis[41]. Although an entirely intracorporeal procedure may be feasible in selected group of patients, the extracorporeal division and ligation of the inflammed mesentery with an intestinal anastomosis currently seems safer using conventional techniques. However, extraordinary inflammation in the mesentery of Crohn's disease of the large and small bowel may be encountered, and any inability to identify vital structures should lead to conversion to a completely conventional technique[42].

Severe anal sepsis requiring fecal diversion is a good indication in Crohn's disease for laparoscopic surgery, because an ileostomy or colostomy can rapidly be constructed and the diversion, coupled with adequate drainage of any anal infection, permits the patient to recover without the need for a formal laparotomy.

At present time there are not published prospective controlled studies about laparoscopic intestinal surgery that test whether laparoscopic surgery for Crohn's disease has any advantages over conventional methods. Published series to date, have evaluated only the feasibility and safety of laparoscopically assisted intestinal resections, or in an uncontrolled fashion have reported shorter recovery time or shorter length of hospital stay in a small series of patients[42]. That is why a prospective randomized study evaluating the advantages of laparoscopic versus conventional ileocolic resection is currently underway at our institution.

2.2 Laparoscopic surgery in familial polyposis

Patients with familial polyposis may be candidates for laparoscopic total abdominal colectomy, in some instances with proctectomy[43]. This disease is a good indication for laparoscopy because adhesion formation may be diminished in laparoscopic surgery and a long abdominal wall incision that may predispose a patient to later development of an abdominal desmoid tumor[44] is avoided. If the presence of a malignancy is a concern, an oncologic resection should be considered.

2.3 Laparoscopic surgery for colorectal malignancies

Within the last several years, various articles have reported the use of laparoscopic techniques in the "curative" surgical management of colorectal malignancies[45,46]. None of these reports, however, has convincingly demonstrated that use of laparoscopic techniques can accomplish a resection according to accepted surgical oncologic principles[47]. In accordance with these principles we have defined a curative oncologic resection as 1) wide en bloc resection of the tumor-bearing bowel segment with adjacent soft tissue and mesentery, with 2) proximal lymphovascular ligation and complete lymphadenectomy, and 3) occlusion of the bowel above and below the tumor to minimize the possibility of intraluminal spread[48]. In addition, it is mandatory to protect the peritoneal cavity from contamination, to assess the peritoneal cavity for metastatic disease, and to perform a well constructed anastomosis or stoma.

We felt that prior to attempting these laparoscopic techniques in patients with colorectal cancer, it was essential to prove that an adequate laparoscopic cancer operation was feasible. We developed a standardized approach for accomplishing a series of laparoscopic right colectomies, proctosigmoidectomies, abdominal colectomies, and abdominoperineal resections in fresh

cadavers. In these studies we determined the length of each specimen and number of removed lymph nodes, and then performed an autopsy. We then evaluated the anatomical extent of the laparoscopic resection in situ: the lengths of the remaining named mesenteric vessels were measured, the number of remaining lymph nodes counted, and the overall extent of mesenteric and pelvic resection assessed. An extremely high ligation of the inferior mesenteric artery was used in all laparoscopic operations to demonstrate that radical removal of the lymphatic drainage is feasible[48,49]. We were able to show that the anatomical extent of a laparoscopic oncologic resection does not differ from that obtained by conventional oncological resection in the cadaver model.

Laparoscopic surgery must next be shown to confer some advantages in curative colorectal cancer surgery. Therefore, we advocate prospective randomized phase II studies to compare morbidity, mortality, rapidity of recovery, and quality of life between laparoscopic and conventional colorectal cancer surgery. Only if clinically relevant short-term advantages are found after laparoscopic colorectal cancer surgery, should a multi-institutional phase III study be pursued. This cautious approach in assessing the value of laparoscopic techniques in curative colorectal cancer surgery is necessary for several reasons: 1) it is a new technique with unknown morbidity, mortality, and long-term results; 2) it is technically more challenging, more time-consuming, and more expensive than conventional surgery; and 3) early cannulation site recurrences have been reported after laparoscopic surgery for gastric, gallbladder, pancreatic, ovarian, and colorectal malignancies. The precise pathogenesis of these early recurrences (several weeks to several months after laparoscopic surgery) is not known. Experimentally, viable tumor cells have been recovered at various sites in the peritoneal cavity and the bowel lumen following conventional and laparoscopic colon cancer surgery[50,51]. In the setting of laparoscopic colon cancer surgery, our results thus far suggest that this risk remains low. We believe that tumor seeding might be prevented with a standardized oncologic approach that involves 1) minimal manipulation of the tumor-bearing segment, 2) occlusion of the proximal and distal ends of the intestinal segment, and 3) placement of the specimen, as soon as possible, into an endoscopic bag before delivery through the abdominal wall.

At this time, we recommend that surgeons trained in curative laparoscopic colorectal cancer surgery be able to prove with video documentation in each case that an oncologic resection has been performed, which should clearly satisfy the anatomical criteria of the oncologic resection. The documentation, coupled with the pathological examination of the specimen (tumor margin and number of removed lymph nodes), should be sufficient to show that an oncologic resection has been accomplished using the same criteria as those used in conventional surgery.

CONCLUSIONS

Laparoscopic techniques in colon and rectal surgery are still in their early phases of development. Although several theoretical advantages have been "perceived" with the use of laparoscopy in colorectal surgical procedures, currently there is no study proving these advantages in any rigorous scientific fashion. However, there are several procedures which appear reasonable to consider, such as diagnostic laparoscopy, fecal diversion, rectopexy, and limited resection of benign conditions. Other applications of laparoscopic surgery in colorectal diseases such as in Crohn's disease (where there is extensive inflammation), and colorectal cancer (where extent of resection is a concern), should be considered investigational. Developments of new technologies in laparoscopic surgery over the next several years will play an important role in making laparoscopic colon resections more feasible for many surgeons.

REFERENCES

1. Nadeu, O. Endoscopy of the abdomen; abdominoscopy. *Surg Gynecol Obstet* 1925; 51:259-265.
2. Davis, C. A history of endoscopic surgery. *Surg Laparosc Endosc* 1992; 2:16-23.
3. Mouret, P. Laparoscopic cholecystectomy. Historic perspective and personal experience. *Surg Laparosc Endosc* 1991;1:52-7.
4. The Southern Surgeons Club. A prospective analysis of 1518 laparoscopic cholecystectomies. *NEJM* 1991;324:1073-1078.
5. Neugebauer, E, Troidl, H, Spangenberger, W, *et al.* Conventional laparoscopic cholecystectomy and the randomized controlled trial. *Br J Surg* 1991;78: 150-154.
6. Klane, R, Lurie, N, Borbas, C, *et al.* The outcomes of elective laparoscopic and open cholecystectomies. *J Am Coll Surg* 1995; 180:136-145.
7. Delaunay, F, Bonnet, D, Cherqui, JM, *et al.* Laparoscopic cholecystectomy minimally impairs postoperative cardiorespiratory and muscle performance. *Br J Surg* 1995; 82: 373-376.
8. Grace, P, Quereshi, A, Coleman, J, *et al.* Reduced postoperative hospitalization after laparoscopic cholecystectomy. *Br J Surg* 1991;78:160-162.
9. Gadacz, T and Talamini, M. Traditional versus laparoscopic cholecystectomy. *Am J Surg* 1991; 161:336-338.

10. Barkun, J, Barkun, A, Sampalis, J, *et al.* Randomized controlled trial of laparoscopic versus mini cholecystectomy. *Lancet* 1992; 340: 1116-1119.
11. Glerup, H, Heinderfoff, H, Flyvbjerg, A, *et al.* Effective laparoscopic cholecystectomy nearly abolishes the postoperative hepatic catabolic stress response. *Ann Surg* 1995; 221: 214-219.
12. Goodale, R, Beebe, D, McNevin, M, *et al.* Hemodynamic, respiratory and metabolic effects of laparoscopic cholecystectomy. *Am J Surg* 1993; 166:533-537.
13. Redwine, D, and Sharpe, D. Laparoscopic segmental resection of the sigmoid colon for endometriosis. *J Laparoendosc Surg* 1991; 1 :217-220.
14. Cooperman, A, Katz, V, Zimmon, D, et al. Laparoscopic colon resection: a case report. *J Laparoendosc Surg* 1991; 1: 221-224.
15. Bohm, B, Milsom, JW, Stolfi, VM. et al. Laparoscopic intraperitoneal intestinal anastomosis. *Surg Endosc* 1993; 7: 194-196.
16. Bohm, B and Milsom, JW. Animal models as educational tools in laparoscopic colorectal surgery. *Surg Endosc* 1994; 8: 707-713.
17. Bohm, B, Milsom, JW, Kitago, K, et al. Use of laparoscopic techniques in oncologic right colectomy in a canine model. *Ann Surg Onc* 1995; 2: 6-13.
18. Bohm, B, Milsom, JW, Kitago, K, et al. Laparoscopic oncologic total abdominal colectomy with intraperitoneal stapled anastomosis in a canine model. *J Laparoendosc Surg* 1994; 4: 23-30.
19. Fowler, DL, and White, SA. Laparoscopic assisted sigmoid resection. *Surg Laparosc Endosc* 1991; 1:183-8.
20. Jacobs, M, Verdeja, JC, and Goldstein, HS. Minimally invasive colon resection (Laparoscopic Colectomy). *Surg Laparosc Endosc* 1991; 1: 144-150.
21. Phillips, E, Franklin, M, Carroll, B, et al. Laparoscopic colectomy. *Ann Surg* 1992; 216:703-708.
22. Wexner, S, Johansen, O, Nogueras, J, et al. Laparoscopic total abdominal colectomy. A prospective trial. *Dis Colon Rectum* 1992; 35:651-655.
23. Peters, W, and Bartels, T. Minimally invasive colectomy: are the potentials realized? *Dis Colon Rectum* 1993; 36:753-756.
24. American Society of Colon and Rectum Surgeons. *Position statement on laparoscopic colectomy.* Approved May 15, 1991, Boston, MA.
25. Milsom, JW, Lavery, I, Church, J, et al. Use of laparoscopic techniques in colorectal surgery. Preliminary study. *Dis Colon Rectum* 1994; 37: 215-218.
26. Beart, R, Ballantyne, G, Fleshman, J, Milsom, JW, et al. Laparoscopic considerations in colon and rectal surgery. *Perspectives in Colon and Rectal Surgery* 1994; 7:245-263.
27. Soper, N, Brunt, M, and Kerbl, K. Laparoscopic general surgery. *NEJM* 1994; 330: 409-419.
28. Monson, JR, Hill, AD, and Darzi, A. Laparoscopic colonic surgery. *Br J Surg* 1995; 82: 150-157.
29. Senapati, A, and Phillips, R. The trephine colostomy: a permanent left iliac fossa end colostomy without recourse to laparotomy. *Ann R Coll Surg Eng* 1991; 73:305-306.
30. Winkler, M, and Volpe, P. Loop transverse colostomy: the case against. *Dis Colon Rectum* 1982; 25:321-326.
31. Wara, P, Sorensen, K, and Berg, V. Proximal fecal diversion: review of ten years experience. *Dis Colon Rectum* 1981; 24: 114- 119.
32. Ludwig, K, García-Ruiz, A, Milsom, J, *et al.* Laparoscopic techniques for fecal diversion. *Dis Colon Rectum*; article accepted for publication.
33. Berman, I. Sutureless laparoscopic rectopexy for procidentia. Technique and implications. *Dis Colon Rectum* 1992; 35:689-693.
34. Kwok, S, Carey, D, and Li, A. Laparoscopic rectopexy. *Dis Colon Rectum* 1994;32:947948.
35. Ballantyne, G. Laparoscopically assisted anterior resection for rectal prolapse. *Surg Laparosc Endosc* 1992;3:230-236.
36. Cuesta, M, Borgstein, P, Jong, D, et al. Laparoscopic rectopexy. *Surg Laparosc Endosc* 1993; 3:456-458.
37. Munro, W, Avramovic, J, Roney, W, et al. Laparoscopic rectopexy. *J Laparoendosc Surg* 1993;3:55-58.
38. Ortega, A, Beart, R, Steele, G, et al. Laparoscopic bowel surgery registry. Preliminary results. *Dis Colon Rectum* 1995; 38:681-685.
39. Quattlebaum, J, Flanders, D, and Usher, C. Laparoscopically assisted colectomy. *Surg Laparosc Endosc* 1993;3:81-87.
40. Wexner, S, and Johansen, O. Laparoscopic bowel resection: advantages and limitations. *Ann Med* 1992;24:105-110.
41. Milsom, J, Lavery, I, Bohm, B, *et al.* Laparoscopically assisted ileocolectomy in Crohn's disease. *Surg Laparosc Endosc* 1993; 3:77-80.
42. Bauer, J, Harris, M, Grumbach, N, et al. Laparoscopic-assisted intestinal resection for Crohn's disease. *Dis Colon Rectum* 1995; 38:712-715.
43. Wexner, SD, Cohen, SM, Johansen, OB, et al. Laparoscopic colorectal surgery: a prospective assessment and current perspective. *Br J Surg* 1993; 80: 1602-1605.
44. Goligher, JC. *Surgery of anus, rectum and colon.* London: Bailliere Tindall, 1984.
45. Franklin, M, Rosenthal, D, and Norem, R. Prospective evaluation of laparoscopic colon resection versus open colon resection for adenocarcioma. *Surg Endosc* 1995; 9:811-816.
46. Wexner, SD, Cohen, SM, Ulrich A, et al. Laparoscopic colorectal surgery -are we being honest with our patients? *Dis Colon Rectum* 1995; 38:723-727.
47. Milsom, J, Fazio, V. Extent of resection of rectal cancer. *Problems in General Surgery* 1992; 9:666-675.
48. Milsom, J, Bohm, B, Decanini, C, et al. Laparoscopic oncologic proctosigmoidectomy with low colorectal anastomosis in a cadaver model. *Surg Endosc* 1994; 8:1117-1123.
49. Decanini, C, Milsom, J, Bohm, B, et al. Laparoscopic oncologic abdominoperineal resection. *Dis Colon Rectum* 1994; 37:552-558.
50. Zirngibl, H, Husemann, B, and Hermanek, P. Intraoperative spillage of tumor cells in surgery for rectal cancer. *Dis Colon Rectum* 1990; 33:610-614.
51. Fusco, M, and Paluzzi, M. Abdominal wall recurrence after laparoscopic-assisted colectomy for adenocarcinoma of the colon. *Dis Colon Rectum* 1993;36:858-861.