Canadian Association of General Surgeons
Association canadienne de chirurgiens généraux

SYMPOSIUM ON THE MANAGEMENT OF INGUINAL HERNIAS

2. OVERVIEW. THE REPAIR OF INGUINAL HERNIA: 110 YEARS AFTER BASSINI

Marvin J. Wexler, MD CM, MSc

Groin herniorrhaphy is one of the oldest and commonest operations in the surgeon's technical armamentarium. It is appropriate and timely that this procedure is the subject of a Canadian Association of General Surgeons symposium.

Modern-day inguinal hernia repair has been dominated by an anterior extraperitoneal approach, initially proposed by Bassini, who introduced the revolutionary concept of reconstruction of the inguinal canal floor in 1887. This reconstruction has undergone many technical modifications over the past 110 years, including sewing various combinations of the transversalis fascia, conjoined tendon, internal oblique muscle or transversus abdominis muscle to either the inguinal ligament or Cooper's ligament. All of these modifications were intended to increase the strength and long-term durability of the repair of the posterior inguinal canal without causing injury to the nerves or affecting the blood supply to the spermatic cord or testicle. Until recently, the value of the various procedures was measured solely in terms of recurrence

rates (average 10% worldwide), with little or no appreciation of other surgical outcome measures.

Investigators at the Canadian Shouldice Clinic have described one of the most successful posterior canal reconstructions with the use of natural tissues. Through the untiring efforts of Earl E. Shouldice (1890–1965) and numerous clinical associates, the Shouldice repair has become one of the most respected techniques of primary groin hernia repair.

Shouldice wrote sparingly, and it was not until 1969 that Edwin Shearburn, a frequent visitor to Shouldice's original clinic in Toronto, and Richard Myers of Philadelphia described the actual operation in detail,[1] giving the repair international attention.[2] The Shouldice Clinic technique, well described in this symposium by Bendavid (pages 199 to 207), is a modified form of Bassini repair.

The Shouldice technique stresses meticulous anatomic repair of the transversalis fascia, the basic principle being the imbrication of a double layer of transversalis fascia to Poupart's ligament. This is followed by reinforce-

ment of this layer by an overlying double layer of conjoined tendon and internal oblique muscle sutured to the undersurface of the external oblique fascia just superficial to the first suture line. Shouldice Hospital surgeons are true hernia specialists, with practice restricted to the care of hernia patients, and the art of herniorrhaphy has been highly refined. Although their results are among the best described for a primary sutured anterior repair, with a recurrence rate of under 1%, these results have not been duplicated by the general surgical community, as demonstrated in several recent prospective randomized trials. Kingsworth, Gray and Nott[3] reported a 4.6% recurrence after the Shouldice repair and 2.3% after the Bassini repair, with a median follow-up of only 24 months. Panos and colleagues[4] had a 6.6% recurrence rate with the Shouldice technique compared with 8.8% with Cooper's ligament (McVay) repair. The median follow-up was 36 months. In a recent multicentre French study,[5] which reported the repair of 1647 hernias over 5 years with a median follow-up of more than 5 years, actuarial recurrence

at 8 years occurred less often after a Shouldice repair than a Bassini or a Cooper's ligament technique (6.1% v. 8.6% v. 11.2%) but was many times greater than that of the Shouldice Clinic.

"Besides the surgical and anesthetic techniques used, the rate of recurrence also depends on the quality of follow-up of patients including duration of follow-up (median and range), rhythm and modality of follow-up examinations, qualifications of the person performing the examination and percentage of patients lost to follow-up."[5] A surgeon is more likely to detect recurrence than is a family physician or the patient, since many recurrences are asymptomatic. The differences in recurrence rates may, therefore, be explained by the large percentage of patients who are followed up through questionnaire only by the Shouldice Clinic, where almost 50% are lost to follow-up at 5 to 7 years.[6,7] Obese or seriously ill patients who might require in-hospital consultation are also excluded. Further, to use Bendavid's own words in reference to laparoscopic repair, "the average general surgeon performs 50 herniorrhaphies a year, a number that is not likely to endow anyone with expertise in a challenging technique."

The sacrosanct principles of inguinal hernia repair by a conventional anterior extraperitoneal approach (i.e., through use of a groin incision and sutures to repair the posterior abdominal wall defect) are increasingly being challenged as are some of the fundamental concepts of the etiology of inguinal hernia and the basic principles inherent in all classic anterior repairs. Numerous investigators have refuted the notion that long-term durability and late recurrence are related to technical error or choice of procedure and have championed the theory that hernia is a metabolic defect resulting from an im-

balance between normal collagen synthesis and normal collagen degradation.[8] In this theory, factors such as decreased collagen turnover, increased collagen degradation or genetic predisposition (in which few or no collagen fibres from the transversus abdominis aponeurosis extend into the fascia) predispose to tissue deterioration and hernia formation. Thus, suggests Peacock,[9] the traditional distinction between indirect and direct herniation should be replaced by the designations congenital, as seen in children, and acquired, as seen in adults, the latter being metabolic in etiology. When herniation is created by a metabolic defect of the musculofascial abdominal wall, covering the defect with endogenous neighbouring tissue results in the suturing together of structures that normally are not in apposition, and usually this procedure subjects these structures to tension. Suture lines under tension stimulate an inadequate fibroblastic response for healing, resulting in a weak scar that may contribute to hernia recurrence, especially when the suture lines are subject to the same degenerative process and the same dynamic forces that resulted in the initial herniation.

Because these concepts have been given increasing consideration, a new school of hernia repair has gradually emerged that deliberately avoids bringing down tissue to join the inguinal ligament or Cooper's ligament. Instead, prosthetic mesh is used to fill in the gap for a tension-free approximation of tissues, often with a preperitoneal approach or in a preperitoneal position. The mesh acts as a permanent scaffold through which the ingrowth of new collagen occurs.

The modern era of prosthetics began in the late 1950s with the introduction of polypropylene mesh by Usher and colleagues,[10,11] now available commercially as Marlex or Prolene

mesh. Over the past 35 years, extensive experimental data and clinical expertise have been acquired on the use of prosthetic materials for repair of hernias. Initial concern over the possibility of such complications as wound sepsis, sinus-tract formation, prolonged healing, erosion into intra-abdominal organs, and bowel fistula and extrusion proved to be unwarranted. No evidence exists that polypropylene mesh, when properly implanted in the groin, is associated with an increased wound infection rate, protracted wound healing or even breakdown of the hernia repair in patients with wound infections. Wound abscesses that have occurred with polypropylene mesh have been treated with incision, drainage and antibiotic administration, and seldom has the mesh ever been a cause of a draining sinus, nor has it been necessary to remove the mesh. Granulation tissue will continue to grow through the mesh.

Although attributed to Lichtenstein and popularly referred to as the Lichtenstein tension-free hernioplasty,[12] the technique and use of synthetic mesh for primary hernia repair was first described and employed 20 years earlier. In 1967, Collier and Griswold[13] described the routine use of polypropylene mesh for tension-free inguinal hernia repair and reported 212 consecutive successful repairs. Bellis[14] reported a recurrence rate of less than 0.5% in more than 3000 repairs done with Dacron mesh in which patients returned to unrestricted activity levels immediately. In 1983, Martin and Shureih[15] reported on a 15-year experience with 299 primary mesh repairs. Polypropylene mesh was placed over the entire inguinal canal floor and around the cord. In a similar favourable experience by Barnes,[16] again no attempt was made to determine the strength of the inguinal canal floor but, in-

stead, all canal floors were made stronger. Recently, Lichtenstein[17] reported no recurrence (follow-up 1 to 5 years) and no prosthetic infection in 1000 consecutive cases. Other recent reports by Lichtenstein's group have included more than 3000 patients from 5 diverse surgical sources in which the recurrence rate was only 0.5%.[18] In their own series of 3125 consecutive patients whose follow-up ranged from 1 to 8 years,[19] the following were noted: only 4 recurrences, a rejection rate of 0%, negligible infection, minimal pain and a rapid return to unrestricted activity. Unfortunately, the symposium presentation by Shulman is unavailable and the reader is referred to that group's extensive publications for details of technique and recent modifications.[12,17–19]

Gilbert and Graham have extended the concept of tension-free hernioplasty to the use of a combination mesh plug and sutureless onlay mesh patch. Gilbert initially utilized his procedure only for the treatment of small to moderate-sized indirect inguinal hernias or for a punched out or primary diverticular type direct hernia in a very elderly patient.[20] The canal floor was reinforced with either an overlay or underlay sutureless patch graft of Marlex but covered with the first two layers of the Shouldice repair. The "second version" (pages 209 to 212) presented at the symposium extends the plug repair to type III hernias (indirect, admitting two fingerbreadths or larger at the internal ring) and abandons the patch for all plug repairs. In my opinion, this is folly, particularly if one accepts the concept that a groin hernia in the adult is an acquired defect of collagen metabolism in the inguinal canal. This metabolic deficiency of connective tissue, therefore, requires tension-free repair of the entire musculo-aponeurotic canal floor for long-term durability.

This subject has been recently addressed by Shulman, Amid and Lichtenstein.[21]

I believe the major contribution of Gilbert and Graham is their promotion of the concept of the sutureless umbrella-shaped plug and the fact that it spawned the Rutkow sutureless plug and patch repair.[22] This latter plug and patch technique is amazingly simple, can be learned rapidly and can be used in standardized fashion in the repair of virtually any groin hernia. There is no disturbance of normal anatomy and, as emphasized by Gilbert, the sphincter mechanism of the internal ring and the sling and shutter mechanism of the inguinal canal floor are preserved. Our experience at the Royal Victoria Hospital has led us to concur with Gilbert and Rutkow that the utilization of a simple mesh plug and sutureless patch is preferable to a sutured mesh patch. It is simpler and easier to secure to the surrounding tissues and easier to work with. It requires less dissection, so hematoma and seroma formation and patient discomfort are reduced, and the chance of nerve injury is decreased. Needle and suture holes, which may gradually enlarge or tear through, are completely eliminated. Inadvertent puncture of blood vessels by a needle is avoided. A preformed polypropylene mesh plug that maintains a permanent open cone-like shape is now commercially available in various sizes and readily conforms to the configuration of most defects. Results to date are extraordinary.[23]

Over the past 5 years, laparoscopic procedures have revolutionized the practice of general, thoracic and gynecologic surgery. Many commonplace general surgical procedures have been thrust into the laparoscopic arena without formal, prospective, randomized comparison to the conventional "open" approach. This has been the

case for inguinal herniorrhaphy. Results of anecdotal reports, many large case series including a recent series of 1000 consecutive repairs,[24] and even a phase II multi-institutional trial[25] of the laparoscopic repair of inguinal hernias support the feasibility of this approach and suggest a possible role for laparoscopic herniorrhaphy in the armamentarium of a general surgeon. To date, however, benefits remain unproved and controversial. This is particularly so with the dramatic shift to the tension-free, often sutureless, mesh repair under local anesthesia as the conventional open alternative and in the face of uncommon but occasional serious complications[25–27] with the laparoscopic approach, as exemplified by the bowel obstructions and bladder injury reported by Litwin and colleagues (pages 192 to 198). Their presentation really answers none of the contentious issues regarding the desirability or putative advantages of a laparoscopic approach.

In their introduction, Litwin and associates suggest that "laparoscopic groin hernia repair is an important operation for the general surgeon because it offers an opportunity to enhance laparoscopic experience and skills by increasing the volume of laparoscopic cases of greater technical difficulty than laparoscopic cholecystectomy." I agree wholeheartedly that the operation is more difficult and, therefore, should not be performed "to enhance laparoscopic experience and skills" and I would strongly argue against the inclusion of emergency operations for incarceration and strangulation. The technical aspect requires more detailed procedural description, discussion of the possible pitfalls and specific technical guidelines for prevention of complications. Whether the telescope is in the umbilical or lateral port, whether the surgeon stands on the same or opposite side as the her-

nia, whether the side of the hernia is elevated or not depend on the preference of the surgeon, right or left handedness and the presence and designated role of the assistant as either camera operator or experienced surgical assistant. Certainly a large sheet of mesh is needed to avoid recurrence as noted, but so also is secure staple, tack or suture fixation to the tubercle, Cooper's ligament, ileopubic tract and transverse arch without injury to vessels or deep nerves. The reader is encouraged to read one of the more in-depth, detailed descriptions devoted specifically to laparoscopic hernia anatomy, technique and complications.[28–32]

Litwin and associates echo the admonitions of Rutkow[33] that at least 5 relevant outcome measures should be incorporated into any evaluation of modern-day hernia surgery. To re-emphasize, these factors include: technical difficulty; overall complication rate and seriousness of possible complications; overall rehabilitation, including short- and long-term postoperative discomfort and return to daily activities and work; recurrence rate and formidability of repairing a recurrence; and socioeconomic factors, notably cost. To this we would add objective quality of life measurements, since our own institutional studies[34] suggest that the postoperative presence of complications alone is not sufficient to account for observed quality of life. Litwin and associates have itemized only complications and recurrences (mean follow-up 14 months), but have tabulated the results of 6 selected comparative trials of open versus laparoscopic herniorrhaphy to support the virtues of a laparoscopic repair. This approach is invalid. Recently, I critically reviewed[35] the major reports comparing laparoscopic and open herniorrhaphy in the North American literature up to 1995, including several

absent from Litwin's tabulations.[36,37] A flawed control over patient selection, preoperative patient expectation and outcome measurement, a poor definition of end points and an unclear impact on patient quality of life for the most part render inconclusive or invalid the results of many of the comparative trials published to date. For example, Lukaszczyk and associates[38] recently reported a nonrandomized study, over 2 years, of 151 consecutive patients who underwent either a laparoscopic or a traditional open hernia repair repair in a community hospital setting. However, although prospective, the operations performed were selected on the basis of patient and physician preference. Indeed, by the authors' description those who had a very large hernia, those who were poor risk for general anesthesia and those who felt more comfortable undergoing an open procedure, based on its longer track record, were assigned to the open group. Patients who were anxious to be back at work sooner and those who had small hernias were assigned to the laparoscopic group. Only 50 were chosen for laparoscopie herniorrhaphy, and obviously this highly selected group of younger, aggressive, healthier patients anxious to return to work sooner, did so.

Multiple baseline patient and hernia variables should be recorded to ensure that both groups are truly similar in important variables, including stratification for work type (desk job, manual, strenuous manual, retired). An attempt should be made to measure, and control for, any inherent patient bias in the expectation of convalescence, which is often tainted by differential patient information acquired through health professionals and the media. This was illustrated in a study by our group[39] in which, preoperatively, patients who underwent laparoscopic herniorrhaphy were of the

opinion that they would return to full activities on average 5.5 days earlier than their open herniorrhaphy counterparts. This set the stage for an inherent bias in the subsequent postoperative behaviour of patients in both groups. Such a bias may well have been responsible for the convalescence results in one of the largest comparative trials to date by Stoker and colleagues.[40] Their results favoured the transabdominal preperitoneal (TAPP) group (14 v. 28 days to return to work). Only one half of their patients were employed, and the referring general practitioners instructed all patients as to when they could resume activities. It is quite probable that the observed difference reflected inherent physician bias rather than any truly observable biologic response to the type of hernia repair. Duration of convalescence was similar for both laparoscopic and open groups (10.9 v. 9.6 days) in our study, where efforts were made to control such bias. Multiple, precisely defined, cross-validating, objective outcome measurements are essential. These should be performed by independent and unbiased third party assistants through direct patient interviews. The importance of this was emphasized in the McGill randomized controlled trial of laparoscopic versus minicholecystectomy.[41] When the "duration of convalescence" of the laparoscopic cholecystectomy patients as measured by the study nurses and the treating physicians was compared, the surgeon's estimates were 4 days (15%) shorter than those of the nurses ($p < 0.01$). Such observed bias must be considered if outcomes are measured by the treating surgeon.

It may be years before the true efficacy and place of laparoscopic herniorrhaphy are known. Techniques continue to evolve with a rapidly growing interest in an extraperitoneal approach.[42,43] Totally extraperitoneal (TEP) laparoscopic

inguinal hernia repair is a technically more demanding procedure because of the more limited working space between the abdominal wall and the peritoneum. However, it has some attractive features over the TAPP procedure described by Litwin and associates, as the abdominal cavity is not violated, thus avoiding the uncommon but potentially serious complications of viscus or major vessel perforation, the possibility of intra-abominal adhesions with resultant bowel obstruction and the difficult process of establishing a tight peritoneal coverage at the end. In a recent series of 1115 laparoscopic hernioplasties in 866 patients comparing TAPP and TEP repairs, Felix, Michas and Gonzalez[44] showed that the TEP approach did indeed reduce the incidence of intraperitoneal complications and suggested it may be the laparoscopic procedure of choice in most situations. TEP has recently been the subject of a prospective randomized trial with an open tension-free repair.[45] In the endoscopic group, 10% of patients required intraoperative conversion. Extraordinary 33% wound and 13% scrotal hematoma rates in the open group and an 8% wound infection rate in the endoscopic group compared with 5% in the open group defy explanation!

Careful classification, documentation and quality-of-life and cost assessment are mandatory for every repair performed, be it in an academic or community setting. Unlike technical complications occurring during laparoscopic cholecystectomy that could necessitate an open laparotomy, this consequence in the performance of laparoscopic herniorrhaphy, however infrequent, is not an acceptable alternative to open repair.

In the 1960s and 1970s, inguinal hernia was a simple problem; herniorrhaphy was done either by the Bassini or the Cooper's ligament (McVay) repair. As surgeons and patients became dissatisfied with these repairs, a plethora of new techniques evolved. In the absence of data, dogma and opinion have prevailed. It is clear that randomized clinical trials with appropriate outcome measures and independent evaluators are required to sort out the best approaches to this common problem.

References

1. Shearburn EW, Myers RN. Shouldice repair for inguinal hernia. *Surgery* 1969;66:450-9.

2. Rutkow I. A selective history of groin herniorrhaphy in the 29th century. *Surg Clin North Am* 1993;73:408-9.

3. Kingsworth AN, Gray MR, Nott DM. Prospective randomized trial comparing the Shouldice technique and plication darn for inguinal hernia. *Br J Surg* 1992;79:1068-70.

4. Panos RG, Beck DE, Maresh JE, Harford FJ. Preliminary results of a prospective randomized study of Cooper's ligament versus Shouldice herniorrhaphy technique. *Surg Gynecol Obstet* 1992;75(4):315-9.

5. Hay JM, Boudet MJ, Fingerhut A, Poucher J, Hennet H, Habib E, et al. Shouldice inguinal hernia repair in the male adult: The gold standard? A multicenter controlled trial in 1578 patients. *Ann Surg* 1995;222(6):719-27.

6. Glassow F. The surgical repair of inguinal and femoral hernias. *Can Med Assoc J* 1973;108(3):308-13.

7. Glassow F. Inguinal hernia repair. A comparison of the Shouldice and Cooper ligament repair of the posterior inguinal wall. *Am J Surg* 1976; 131(3):306-11.

8. Peacock EE Jr, Madden JW. Studies on the biology and treatment of recurrent inguinal hernia. II. Morphological changes. *Ann Surg* 1974;179(5):567-71.

9. Peacock EE. Here we are: behind again! [editorial]. *Am J Surg* 1989; 157(2):187.

10. Usher FC, Gannon JP. Marlex mesh: a new plastic mesh for replacing tissue defects: I. Experimental studies. *Arch Surg (Chicago)* 1959;78:131-7.

11. Usher FC, Fried JG, Ochsner JL, et al. Marlex mesh: a new plastic mesh for replacing tissue defects: II. Clinical studies. *Arch Surg (Chicago)* 1959; 78:138-45.

12. Lichtenstein IL, Shulman AG, Amid PK, Montllor MM. The tension-free hernioplasty [see comments]. *Am J Surg* 1989;157(2):188-93. Comments in: *Am J Surg* 1990;160(1): 139-41; *Am J Surg* 1990;160(5): 540-1.

13. Collier HS, Griswold RA. Repair of direct inguinal hernia without tension. *Am Surg* 1967;33(9):715-6.

14. Bellis JC. Immediate unrestricted activity after inguinal herniorrhaphy. 9,727 Personal cases with specific reference to local anesthesia and polyester fiber mesh. *Int Surg* 1969;52(2):107-10.

15. Martin R, Shureih S. The use of Marlex mesh in primary hernia repairs. *Surg Rounds* 1983;6:52-62.

16. Barnes JP Jr. Inguinal hernia repair with routine use of Marlex mesh. *Surg Gynecol Obstet* 1987;165(1):33-7.

17. Lichtenstein IL. Herniorrhaphy. A personal experience with 6,321 cases. *Am J Surg* 1987;153(6):553-9.

18. Shulman AG, Amid PK, Lichtenstein IL. The safety of mesh repair for primary inguinal hernia: results of 3,019 operations from five diverse surgical sources [review]. *Am Surg* 1992;58(4):255-7.

19. Amid PK, Shulman AG, Lichtenstein

IL. Critical scrutiny of the open "tension-free" hernioplasty. *Am J Surg* 1993;165(3):369-71.

20. Gilbert AI. Sutureless repair of inguinal hernia. *Am J Surg* 1992;163: 331-5.

21. Shulman AG, Amid PK, Lichtenstein IL. Patch or plug for groin hernias: Which? *Am J Surg* 1994;167:331-6.

22. Rutkow IM, Robbins AW. "Tension-free" inguinal herniorrhaphy: a preliminary report on the "mesh plug" technique. *Surgery* 1993;114:3-8.

23. Rutkow I, Robbins AW. Mesh plug hernia repair: a follow-up report. *Surgery* 1995;117:597-8.

24. Birth M, Friedman RL, Melullis M, Weiser HF. Laparoscopic transabdominal preperitoneal hernioplasty: results of 1000 consecutive cases [review]. *J Laparoendosc Surg* 1996;6(5):293-300.

25. Fitzgibbons RJ Jr, Camps J, Cornet DA, Nguyen NX, Litke BS, Annibali R, et al. Laparoscopic inguinal herniorrhaphy: results of a multicenter trial [see comment]. *Ann Surg* 1995; 221(1):3-13. Comment in: *Ann Surg* 1995;221(2):212-4.

26. MacFadyen BV Jr, Arregui ME, Corbitt JD Jr, Filipi CJ, Fitzgibbons RJ Jr, Franklin ME, et al. Complications of laparoscopic herniorrhaphy [see comment]. *Surg Endosc* 1993;7(3): 155-8. Comment in: *Surg Endosc* 1993;7(3):149.

27. Phillips EH, Arregui M, Carroll BJ, Corbitt J, Crafton WB, Fallas MJ, et al. Incidence of complications following laparoscopic hernioplasty. *Surg Endosc* 1995;9(1):16-21.

28. Wexler MJ. Laparoscopic inguinal herniorrhaphy. In: Wilmore DW, Brennan ME, Harken AH, Holcroft JW, Meakins JL, editors. *Scientific American Surgery (Care of the Surgical Patient) — Technique Supplement 5.*

New York: Scientific American Medicine; 1994:1-30.

29. Skandalakis LJ, Gadacz TR, Mansberger AR Jr, Mitchell WE Jr, Colborn GL, Skandalakis JE, editors. *Modern hernia repair: the embryological and anatomical basis of surgery.* Pearl River (NY): Parthenon Publishing Group; 1996.

30. Bailey RW. *Complications in laparoscopic surgery.* Baltimore: Williams & Wilkins; 1996.

31. Arregui ME, Fitzgibbons RJ Jr, Kalkhouda N, McKernan JB, editors. *Principles of laparoscopic surgery: basic and advanced techniques.* New York: Springer-Verlag; 1995.

32. Olsen D, Corbitt JD, Jensen SL, Ferreres A. *Textbook of videoscopic surgery.* Newark (NJ): Gordon & Breach Science Publishers (Harwood Academic Publishers); 1996.

33. Rutkow IM. The recurrence rate in hernia surgery. *Arch Surg* 1995;130: 575-6.

34. Barkun JS, Wexler MJ, Berttleff S, Meakins JL. Quality of life after hernia repair. *Surg Forum* 1996;47:664-6.

35. Wexler MJ. Laparoscopic versus open inguinal herniorrhaphy: a critical appraisal. *J Laparoendosc Surg* 1996; 6:209-11.

36. Cornell RB, Kerlakian GM. Early complications and outcomes of the current technique of transperitoneal laparoscopic herniorrhaphy and a comparison to the traditional open approach. *Am J Surg* 1994;168:275-9.

37. Vogt DM, Curet MJ, Pitcher DE, Martin DT, Zucker KA. Preliminary results of a prospective randomized trial of laparoscopic onlay versus conventional inguinal herniorrhaphy [see comment]. *Am J Surg* 1995;169 (1):84-90. Comment in: *Am J Surg* 1995;170(4):406.

38. Lukaszczyk JJ, Preletz RJ, Morrow GJ, Lange MK, Tachovsky TJ, Krall JM. Laparoscopic herniorrhaphy versus traditional open repair at a community hospital [see comment]. *J Laparoendosc Surg* 1996;6(4):203-8. Comment in: *J Laparoendosc Surg* 1996;6(4):209-11.

39. Barkun JS, Wexler MJ, Hinchey EJ, Thibeault D, Meakins JL. Laparoscopic versus open inguinal herniorrhaphy: preliminary results of a randomized controlled trial. *Surgery* 1995;118(4):703-10.

40. Stoker DL, Spiegelhalter DJ, Singh R, Wellwood JM. Laparoscopic versus open inguinal hernia repair: randomised prospective trial [see comments]. *Lancet* 1994;343(8908): 1243-5. Comments in: *Lancet* 1994; 344(8914):54-6.

41. Barkun JS, Barkun AN, Sampalis JS, Fried G, Taylor B, Wexler MJ, et al. Randomized controlled trial of laparoscopic versus mini cholecystectomy. The McGill Gallstone Treatment Group [see comments]. *Lancet* 1992;340(8828):1116-9. Comments in: *Lancet* 1993;341(8836):47-8; *Lancet* 1993;341(8839):249;*Lancet* 1993;341(8854):1214-5.

42. McKernan JB, Laws HL. Laparoscopic repair of inguinal hernias using a totally extraperitoneal prosthetic approach. *Surg Endosc* 1993;7: 26-8.

43. Massaad AA, Fiorillo MA, Hallak A, Ferzli GS. Endoscopic extraperitoneal herniorrhaphy in 316 patients. *J Laparoendosc Surg* 1996;6:13-6.

44. Felix EL, Michas CA, Gonzalez MH Jr. Laparoscopic hernioplasty: TAPP vs TEP. *Surg Endosc* 1995;9:984-9.

45. Wright DM, Kennedy A, Baxter JN, Fullarton GM, Fife LM, Sunderland GT, et al. Early outcome after open versus extraperitoneal endoscopic tension-free hernioplasty: a randomized clinical trial. *Surgery* 1996;119 (5):552-7.