MINIMALLY INVASIVE COLORECTAL SURGERY

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***Abstract** : The addition of laparoscopy in the armamentarium of surgeons dealing with surgical conditions of the abdomen led to the appreciation of reduction in the avoidable trauma of access while retaining the completeness of the required surgical procedure. This resulted in the understanding of the principles of Minimally Invasive Surgery done by all approaches – endoluminal, laparoscopic, laparoscopy assisted and reduced incisions for open surgery.*

Colorectal surgery includes all surgical procedures carried out to treat diseases of the colon and rectum and has benefited from the increasing application of the principles of minimally invasive surgery of which Laparoscopic colonic surgery is a part.

The training for becoming a colorectal surgeon includes acquiring skills in colorectal surgery and laparoscopic surgery and once the training has been adequately mastered, various surgical techniques are possible through minimal invasive colorectal surgery: Total laparoscopic colorectal surgery, Laparoscopic assisted colorectal surgery, Handport assisted colorectal surgery. Special instruments have been demonstrated which help in performance of minimally invasive colorectal surgery like: 30 degree 10 mm telescope, bowel graspers, newer energy delivery devices – ultracision, ligature etc, Endo GI staplers including circular staplers and handport. The procedures for benign diseases include segmental colonic resection, total abdominal colectomy, Hartmann's procedure and reversal, management of rectal prolapse, ileostomy / colostomy, adhesiolysis, malignant diseases like colonic carcinoma & rectal carcinoma,, endoluminal rectal surgery. The concept of minimal invasive colorectal surgery has led to an increase number of surgery performing for malignant diseases. Over the years, the concern of adequacy, harvesting of lymph node and port site metastasis have considerably dampened early enthusiasm for its role in malignant cases. Minimal invasive anal surgery has been the development of new technology of fistula surgery leading to biological glues and collagen plugs which are least traumatic. The most significant surgery in minimal invasive rectal surgery is the development of stapled anopexy on the basis of Longo's technique. In this technique, excision of mucosal prolapse and preservation of hemorrhoidal tissue had led to a new surgical procedure of stapled anopexy. This has revolutionized the underlying pathophysiology of hemorrhoidal disease with a paradigm shift.

INTRODUCTION

The addition of laparoscopy in the armamentarium of surgeons dealing with surgical conditions of the abdomen led to the appreciation of reduction in the avoidable trauma of access while retaining the completeness of the required surgical procedure. This resulted in the understanding of the principles of Minimally Invasive Surgery done by all approaches – endoluminal, laparoscopic, laparoscopy assisted and reduced incisions for open surgery.

Colorectal surgery includes all surgical procedures carried out to treat diseases of the colon and rectum and has benefited from the increasing application of the principles of minimally invasive surgery of which laparoscopic colonic surgery is a part.

Since its first described case in 1991, laparoscopic colon surgery lagged behind minimally invasive surgical methods for other intra-abdominal organs in terms of acceptability, dissemination and ease of learning.

Several factors account for this difference, including a steep learning curve for the surgeon, the need for laparoscopic intra-abdominal vascular control, the time required to perform the procedure, the need for larger incisions to retrieve specimens, and concerns over the oncologic safety of the procedure in malignant disease.

Only recently with the publication of several large, randomized controlled trials – notably COST and COLOR, trials, has laparoscopic surgery for colon cancer been demonstrated to be at least equivalent to traditional laparotomy in terms of adequacy of oncologic resection, disease recurrence and long-term survival.

Colon, like gall bladder is anatomically amenable to be dealt laparoscopically. The reasons may be the single pedicle or the peripheral location of the colon. The ease with which retroperitoneum or mesorectum is dissected due to presence of loose areolar tissue adds to anatomical justification for laparoscopic surgery.

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SKILLS & TRAINING

The number of cases that is needed to reach proficiency varies from 30 to 70 for laparoscopic colon resections. SAGES (The Society of American Gastrointestinal Endoscopic surgeons) have cited that performing 20 procedures is necessary to attain the level of expertise that is required to undertake laparoscopic resection of colon cancers on a curative basis. As many laparoscopic skills are common to all advanced laparoscopic operations, experience in a specific operation enhances the acquisition of skills that are necessary to perform others.

MASTERY OF MONOPOLAR CAUTERY

Inspite of availability of wonderful laparoscopic hemostatic devices (Harmonic scalpel, ligasure etc) it is essential for all laparoscopic surgeon to learn all aspects of safe electrosurgery for dissection and hemostasis, and practice cost containment .

ENHANCING USE OF THE NONDOMINANT HAND

The minimal use of the non dominant hand is a major

obstacle in advance MIS (minimally invasive surgery). The non dominant hand has to be trained for critical tasks (Eg. Dissection, cutting, tissue manipulation, suturing)

INTRACORPOREAL KNOTTING AND SUTURING

Tying of knots and intracorporeal suturing is considered an advanced skill in laparoscopy, even though it is basic in all types of open surgery. Empirically, some trainers suggest that learners must complete at least 50 sutures and knots before expecting decent intraoperative performance.

A. New hemostatic devices such as ultracision, Harmonic scalpel and the bipolar vessel sealer (ligasure) has probably helped the surgeons the most.
B. Second generation and access devices include a wound contouring system that maintains system in place. The self-sealing nature of these new constructs provides a functional "port" into the abdomen, allowing the surgeon to insert or withdraw a hand at will.
C. Recently, a new "chip-on-a-stick" video laparoscope have been introduced. These new designs of laparoscopic cameras involve the placement of a single CCD chip at the tip (patient's side) of the laparoscope, immediately behind the lens. It has several advantages, including improved image quality and resolution, reduced possibility of inadvertent camera damage, less cumbersome video cables, and potentially smaller laparoscope shaft diameter.
D. Another recent advancement in camera technology is the development of three-dimensional (3D) video imaging systems for minimally invasive surgery. Early experimental data have demonstrated that specific tasks such as laparoscopic suturing or knot tying can be performed faster and more accurately using a 3D video imaging system.

ADVANTAGES

Like other minimally invasive surgical procedures, minimally invasive colorectal surgery offers numerous short-term benefits, including reduced postoperative pain, potentially improved quality of life, shorter hospital stay, quicker recovery of bowel function, decreased analgesics requirement, and potential costs savings. Also early return to work, early initiation of chemotherapy/radiotherapy are added advantages.

MINIMAL INVASIVE COLORECTAL SURGERY – TECHNIQUES

Since the early days of laparoscopic colon surgery, techniques and technologies have evolved to render this procedure more amenable to routine use by general surgeons. Many new techniques and technologies have emerged in an attempt to flatten the learning curve, in part by relying upon skills of surgeons acquired in open surgery. These are : -

- Total laparoscopic colorectal surgery
- Laparoscopic assisted colorectal surgery
- Handport assisted colorectal surgery

Total laparoscopic colorectal surgery – The total surgery is performed under laparoscopic vision. As it involves use of staplers , the cost may become prohibitive.

Lap assisted colorectal surgery – The most practical approach in the present technology, this involves mobilization and preliminary mesenteric division laparoscopically, followed by exteriorization of the mobilized segment through a small incision in the abdominal wall, and subsequent resection and anastomosis. Using this technique, the procedure is not unnecessarily prolonged, costly or difficult and the shortcomings can be overcome.

Handport assisted colorectal surgery – Simply, stated, hand assisted laparoscopic surgery (HALS) involves the insertion of a hand inside the abdomen during a laparoscopic procedure, while maintaining pneumoperitouem to facilitate the dissection. This has become possible since the development of hand port devices. It allows for providing the much valued tactile sensation and dissection to the surgeon. The potential benefits are of great significance.

Special instruments required for performance of minimally invasive colorectal surgery apart from the other conventional Laparoscopic equipment are : -

1. 30 degree 10 mm telescope.
2. Bowel graspers
3. Newer energy delivery devices – Ultracision, ligature etc.
4. Endo GI staplers including circular staplers
5. Hand port

Procedures for Benign Disease - Minimally invasive colorectal surgery has been used for tackling many benign conditions, some of which include

1. **Segmental colonic resections, total abdominal Colectomy** – Due to theoretical long term advantages like fewer adhesions formation, decreased rate of bowel obstruction, decreased likelihood of chronic pain, and decreased incidence of infertility or wound hernias, Laparoscopic procedures have been employed for either segmental colonic resections or total abdominal colectomies. The mobilization of the colon had been done as in open surgery –lateral to medial . Recent operators have developed medial to lateral approach which allows for less handling of the bowel itself and better mobilization of mesentry.
2. **Hartmann's procedure and Reversal, Management of rectal prolapse** – Good risk patients who have rectal prolapse and constipation should be considered for Laparoscopic sigmoid resection and rectopexy. The advantages are preservation of the native compliant rectum, removal of redundant sigmoid colon, alleviation of constipation, and low recurrence rate (<3%). Imperfect anal continence is not a contraindication to a rectopexy.
3. **Ileostomy / Colostomy, Adhesiolysis** - Either in loop or end colostomy, it is recommended that such resections be performed by experienced laparoscopists. Good data exists from a number of non randomized studies highlighting the advantages of Laparoscopic procedures for adhesiolysis.

4. **Malignant Diseases** –Clonic carcinoma
5. **Endoluminal rectal surgery** - Endoluminal rectal surgery involves the use of specialized equipment including operating proctoscope, insufflation and magnified, stereoscopic vision to improve the accessibility visualization, and precision of resection of lesions throughout the rectum. It provides access to the entire rectum, therefore any lesions or abnormalities within the rectum are potentially amenable to endoluminal rectal surgery. Indications can be neatly divided into benign and malignant categories.

a) Benign diseases – In the case of benign disease, any lesion that can be safely excised or corrected with minimal functional consequences is appropriate. They include – rectal polyps, carcinoid tumors, retrorectal masses, anastomotic strictures, extrasphincteric fistulae and pelvic abscess.

b) Malignancies – For malignancy, the technical ability to excise the lesion must be combined with the ability to cure the disease. They include malignant polyps, T1-T2 rectal cancer, palliative excision of T3 cancer.

c) Stricture and prolapse repair – Endoluminal rectal surgery has been effectively used to treat anastomotic strictures, rectal prolapse, high extrasphincteric fistulae and for transrectal drainage of pelvic collections.

Absolute Contraindications – Septic shock with diffuse peritonitis

Relative contraindications – These include morbid obesity, liver cirrhosis, severe acute inflammatory bowel disease, large abscess or phlegmon, severe cardiovascular or pulmonary disease, large abdominal aneurysm, pregnancy, multiple laparotomy coagulopathy, blood dyscrasisas.

LAPAROSCOPIC RECTOPEXY

A plethora of operations is used to treat rectal prolapse. The choice of operation depends on many factors, including the age and sex of the patient, associated constipation,, degree of incontinence, history of repairs, comorbid conditions and the expertise of the surgeon.

Good risk patients who have rectal prolapse should be considered for laparoscopic rectopexy. The left colon is mobilized from middescending colon to sacral promontory. The presacral space is entered, and the rectum and mesorectum are mobilized posteriorly to the coccyx. The rectum is straightened and suspended from, the presacral fascia. A prolene mesh is placed posteriorly to rectum and fixed to sacrum. The mesh is then fixed to lateral rectal wall by nonabsorbable sutures. A recent meta-analysis combined data from studies in the literature that compared laparoscopic with open rectopexy. Not surprisingly, laparoscopic rectopexy required 60 minutes longer to perform than did open rectopexy. Laparoscopic rectopexy required 3.5 days fewer in the hospital on average. Overall operative morbidity was similar between the groups. Recurrence rates were similar; however, follow-up generally was short, and ranged from 12 to 31 months.

TRANSANAL ENDOSCOPIC MICROSURGERY (TEM)

Transanal endoscopic microsurgery (TEM) is unique when compared with other minimally invasive techniques, particularly abdominal laparoscopic surgery. TEM involves the use of specialized equipment including an operating proctoscope, insufflation and magnified, stereoscopic vision to improve the accessibility, visualization and precision based on the anal sphincter and bony confines of the pelvis are overcome have become accessible with the use of TEM, this does not change the indications for local excision of rectal masses, particularly rectal cancer.

Laparoscopic surgery, though innovative and beneficial, does not allow surgeons to perform any procedures previously not possible. TEM allows surgeons to transanally excise lesions that previously were inaccessible. TEM is a safe procedure associated with a shorter hospital stay and lower perioperative morbidity and mortality when compared with transabdominal rectal resections. No studies have been compared with transabdominal rectal resections. No studies have compared functional results between TEM and abdominal / rectal resections, but TEMP appears to be associated with minimal functional consequences. Finally, oncologic results vary, but TEM seems to be associated with lower local recurrence rates when compared with standard transanal excisions, and for early stage rectal cancer may provide identical oncologic outcomes to radical resection.

CONCERNS

Though laparoscopic colon surgery can be utilized for both benign and malignant cases, but initial concerns over port site metastasis, adequacy of oncologic resection and harvesting adequate number of lymph nodes have considerably dampened early enthusiasm for its role in malignant cases. With the better understanding of cause of port site metastases and following oncological principles the incidence of port site metastasis has decreased. As such, the evidence till date indicates that patients undergoing laparoscopic resection of colon malignancies are at no increased risk of port site metastasis compared with those undergoing open surgery. It appears that early reports of high rates of port site recurrences were in fact related to surgeon inexperience and inappropriate handling of the tumor laparoscopically.

The goals of laparoscopic colectomy performed in the setting of colon cancer are the same as for open surgery. Those involve appropriate vessel ligation, adequate resection with 5 cm proximal and distal resection margins and radical mesenteric lymphadenectomy. Many of these elements have been evaluated in the content of clinical trials. A recent metaanalysis reviewed five randomized controlled trials reporting specifically on number of recovered lymph nodes within surgical specimens and adequacy of resection margins. There was no difference between laparoscopic and open resection groups.

With the increase in technical skills and expertise, also with better instrumentation ever increasing number of cases are being done laparoscopically. In spite of all these, few contraindications do remain such as diffuse peritonitis with septic shock. Few conditions like morbid obesity, cirrhosis, severe acute inflammatory bowel disease, pregnancy, coagulopathy and blood dyscrasia not only post problem when dealt laparoscopically, but even in open procedures

also.

SHORTCOMINGS

Although the shortcomings of laparoscopic colonic surgeries are probably higher than the risk in open surgery, the risks are probably greater because of surgeon's inexperience with the laparoscopic procedure. Having experienced proctors minimizes the risk of complications attributed to inexperience. With the present technology and in view of the various shortcomings, the most practical approach is to perform the mobilization and preliminary mesentric division laparoscopically, followed by exteriorization of the mobilized segment through a small incision in the abdominal wall and subsequent resection and anastomosis. Using this technique, the procedure is not unnecessarily prolonged, costly or difficult and the shortcomings can be overcome. Should the conditions not exist for a safe and relatively short laparoscopic procedure, the operation should be converted to the traditional open one. This is not to be seen as a sign of inadequacy or failure, but rather one of a surgical maturity and good judgement.

MINIMALLY INVASIVE SURGERY FOR ANAL DISEASES

Fistula in ano – the commonly performed procedures for fistula like fistulotomy and fistulectomy left very large wounds necessitating painful defecation and painful dressings for long durations. The development of the core out technique with a step ladder excision of long fistulous tracts has a resulted in reducing the morbidity of fistula surgery.

Excision with primary closure and other forms of **flap transfers** have been described but are not particularly popular.

Biological glues and **collagen plugs** to make the fistula surgery even less traumatic are under investigation and preliminary use. They hold significant promise for a change in the approach to anal fistula surgery.

STAPLED ANOPEXY

Excisional hemorrhoidectomy has been the most definitive and reliable treatment of both internal and external hemorrhoidal disease till recent past. In 1997, Antonio Longo introduced a new technique. This operation utilized a modified circular stapler, inserted through the anus, and used to excise a circular ring of mucosal tissue from the anal canal, well above the dentate line. The absence of making any incision in the anoderma results in maintenance of normal anal anatomy and restoration of normal physiological function. It improves cosmesis and allows rapid healing. The indications of stapled anopexy are almost the same as for Milligon-Morgan hemorrhoidectomy. The patients with fourth-degree hemorrhoids that is, irreducible internal hemorrhoids – may not be good candidates for stapled anopexy. Abscess or gangrenous hemorrhoids are absolute contraindications, because these conditions will not be treated by stapled anopexy. Concomitant fistulotomies, sphincterotomies, biopsies and excisions can safely be performed, along with stapled anopexy. There is a rapidly growing body of evidence regarding the efficacy of stapled hemorrhoidectomy. The operative time for stapled anopexy has been demonstrated to be shorter than excisional hemorrhoidectomy. The main benefit of this operation is reduced pain, which also translates into quicker return to work or normal daily activities. Most of the trials report similar incidence of delayed bleeding between stapled and excisional groups.

Overall stapled anopexy is a safe and effective procedure for hemorrhoids that offers a less painful alternative to excisional hemorrhoidectomy. If the results continue, as they are presently, then stapled anopexy may become the new standard of care for the operative treatment of internal hemorrhoids.

The principles of minimally invasive surgery as applied to colorectal diseases have led to the development of newer techniques for providing a safe and satisfactory outcome with a heightened patient acceptability. Till now the disadvantage of high cost has been a problem which on the analysis of savings by way of reduced pain, hospital stay, early return of bowel activity leading to an early return to work makes the overall expenditure much more acceptable than was hitherto thought. It is now a responsibility of those who utilize these techniques to propagate them and with adequate training make sure that the facility of minimally invasive colorectal surgery becomes available to a large number of patients with no additional harm.

In the past few years that I have delved in the development of colorectal surgical techniques I have had the good fortune of being helped assisted by a series of colleagues in the Department whose contributions have been of immense value and I extend my grateful thanks to all of them. I am thankful to Ms Pooja for the excellent secretarial work.

RECOMMENDED READING

1. *Shackelford Surgery of Alimentary tract, 5th Edition, 2003. Laparoscopic colorectal Surgery, Page 204, Chapter 15. Tonia M Young Fadok*
2. *Corman Colorectal Surgery, 5th Edition 2005. Laparoscopic colorectal Surgery, Page 1225, Chapter 27. Marvin L Corman*
3. *The EAES Clinical Practice Guidelines on Laparoscopic resection of colonic cancer, Page 161. Chapter 8 of EAES Guidelines for Endoscopic Surgery. Neugebauer EAM, Sauerland S, Fingerhut A et al.*

ETHICAL GUIDELINES FOR BIOMEDICAL RESEARCH

The need for uniform ethical guidelines for research on human subjects is universally recognised. It has acquired a new sense of urgency as the critical issues in the area of biogenetic research involving human subjects have become acute. Apart from the mandatory *clinical trails on new drugs, a number of diagnostic procedures, therapeutic interventions and prevention measures* including the use of vaccines, are being introduced which involve human subjects. Further the advent of *new medical devices* and *radio-active materials* and therapeutic benefits of *recombinant DNA products* have added a new dimension to the ethical issues that need to be considered before evaluating these for their efficacy, utility and safety.

Any research using the human beings as subjects shall bear in mind the following **principles** of : i) **essentiallity**, (ii) **voluntariness, informed consent**, (iii) **non exploitation**, (iv) **privacy** and **confidentially**, (v) **precaution** and **risk minimisation**, (vi) **professional competence**, (vii) **accountability & transparency**, (viii) **maximisation of public interest** and **distributive justice** (ix) **institutional arrangements** (x) **public domain** (xi) totality of **responsibility** and (xii) **compliance**.

Recent advances in the field of **Assisted Reproductive technologies, organ transplantation, Human genome analysis** and **gene therapy** promise unquestionable benefits to mankind. At the same time, they raise many questions of law and ethics, stimulating public interest and concern.

(Source : ICMR Publication 2000)