Original article:

Comparative clinical study of complications associated with laparoscopic and open appendicectomy

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ABSTRACT

Introduction: A prospective study of complications associated with laparoscopic and open appendicectomy was performed in 130 patients who were selected by nonprobability sampling method. The study was conducted to compare the incidence of complications in laparoscopic and open appendicectomy.

Materials and Methods: The study was conducted in the postgraduate department of surgery. Patients less than 14 years of age were excluded from the study. All the patients with clinical and laboratory diagnosis of acute appendicitis, irrespective of gender were included in the study. Patients were operated under general anaesthesia. Both Intraoperative and postoperative complications were recorded, and compared in both the groups. Patients were followed up after discharge.

Observations: Majority of the patients were in 3rd decade of life, with more male patients (59%). Pain abdomen and tenderness at Mc Burney point was the commonest presentation and clinical sign respectively. Besides baseline investigation ultrasonography was done in all. Open appendicectomy was done in 68 patients (52.30%) and laparoscopic appendicectomy was done in 62 patients (47.70%). The mean duration of procedure was 35.96 minutes for laparoscopic appendicectomy and 58 minutes for open appendicectomy.

Conclusion: The incidence of complications associated with laparoscopic appendicectomy is much less as compared to open appendicectomy.

Keywords: Appendicectomy, Complications, Laparoscopic

INTRODUCTION:

Acute appendicitis is one of the most common conditions requiring surgical intervention. Since Charles Mc Burney first developed the surgical incision in 1984 and the technique of appendicectomy, the procedure has evolved through various stages into laparoscopic appendicectomy. Laparoscopic appendicectomy has struggled to prove its superiority over the conventional method. There are surgeons who criticise this laparoscopic method as being costly, associated with increased operating time and increased incidence of intraabdominal abscesses. Proponents of laparoscopic appendicectomy, however claim that advantages of laparoscopic appendicectomy include improved wound healing, better cosmesis, reduced postoperative pain and ultimately early discharge from hospital.

AIMS AND OBJECTIVES:

To compare the complications associated with laparoscopic and open appendicectomy.

MATERIAL AND METHODS:

130 patients undergoing laparoscopic or open appendectomy were included in the study, who were selected by nonprobability (purposive) sampling method. The procedure was based on the personal preference of the

patient, general condition and associated cost of the procedure. General anaesthesia was used both for laparoscopic and open cases. A single dose of preoperative broad-spectrum antibiotic was given. Analgesics were given for 2-3 days postoperatively and later as and when required.

All patients underwent open appendicectomy either through Grid Iron or muscle splitting Rutherford Morrison's incision because of difficulty in dissection of appendix. Grid Iron incision was centred over McBurney's point. After skin and subcutaneous tissue were incised, the external oblique aponeurosis was exposed and divided in the "hands in pocket" direction of its fibres to revel the underlying internal oblique muscle. At the point of lateral border of rectus sheath, a small incision was made in the internal oblique muscle which was then opened in the direction of its fibres. Once the underlying transversus muscle was exposed, it was split in a similar fashion to reveal the transversalis fascia and peritoneum. The peritoneum was entered by picking up a fold of its tissue and nicking it with a blade. It was stretched with inserted index fingers and the appendix and caecum were exposed. Appendix was identified and trans-fixation of the base of appendix with polyglactin 910 was done, peritoneum was closed with continuous absorbable suture, transverse oblique and internal oblique muscles were approximated using catgut, external oblique aponeurosis was closed with polyglactin 910 continuous sutures and the skin was primary closed with either silk or stapler.

For laparoscopic appendectomy operation theatre layout was such that the operating surgeon, the telescope port, the operative site and the monitor were located in the same line. The patients were placed supine on the operating table with arms by the side of the patient. The operating surgeon and the cameraman used to be on the left side of the patient. Three ports were used. Pneumoperitoneum was created through umbilical port. 30° angled telescope was used. Exploration of peritoneal cavity was done to find out any associated pathology. Adhesiolysis and division of mesoappendix was done using Ultracision hormonic scalpel or monopolar electrocautery. Ligation was done with two pretied polyglactin 910 endoloops (self-made) which were tightened in place with the help of a knot-pusher. Appendix was extracted by putting it in 10 mm port and then pulling the port along with appendix or sometimes in an endo retrieval bag (self-made) so that contact with peritoneal wall could be avoided. Thorough drainage of pelvis and para colic gutters was done whenever there was perforation or pus around appendix. Decision of placing drain was taken at time of surgery. Abdominal fascia was closed with polyglactin 910 (2-0). Skin was closed with silk.

The patients were discharged once fit and called on regular follow-up in the OPD.

OBSERVATION AND RESULTS:

The study was conducted on 130 patients, including 77 (59.23%) males and 53 (40.77%) females .The youngest patient was 14 years old, Table-2. 89 patients (68.46%) presented immediately after the onset of symptom and 41 patients (31.53%) presented after 24 hours of duration of symptoms. Features of inflamed appendix were observed in 70% of patients on ultrasonography, 12% needed CECT abdomen before surgery to confirm the diagnosis. 62 patients (47.69%) underwent laparoscopic appendicectomy, and 68 patients (52.31%) underwent open appendicectomy . Inflamed appendix was found in 99 patients (76.15% cases). Appendicular perforation was present in 26 patients (20.00% cases), Retro-caecal position was the most common in 88 patients (67.69%), and was followed by pelvic position in 34 cases (26.15%), Table-4. Bleeding was the commonest intraoperative complication in 1 case (01.61%) of laparoscopic appendicectomy and in 2 cases (02.94%) of open appendicectomy. Iatrogenic injury to gut and fragmentation of appendix each occurred in 1 case (1.47%) of open appendectomy, Paralytic ileus was the commonest postoperative complication in both procedures, 4 cases

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(6.45%) of laparoscopic appendectomy and 7 cases (10.29%) of open appendectomy, Wound infection occurred in 7 cases (10.29%) of open appendectomy only in early postoperative period, whereas 1 case of wound infection was found in each group in late postoperative period, Adhesive intestinal obstruction occurred in 5 cases (7.35%) of open appendectomy only, Hypertrophic scar and right groin hernia occurred as late complications each in 1 case (1.47%) of open appendectomy, Pain perception was more in open appendectomy on both 0^{th} POD and one week following surgery, Postoperative ambulation was earlier for patients who underwent laparoscopic appendectomy, The mean duration of surgery was 35.96 minutes for Laparoscopic appendicectomy (20 to 90 minutes) and 58 minutes for open appendectomy (28 to 86 minutes). The duration of hospital stay was 37-48 hours in most of the patients undergoing laparoscopic appendicectomy (64.52%), average 24-72 hours and 96-120 hours in most of the patients undergoing open appendicectomy (71%), average 72-144 hours.

TABLE 1: DISTRIBUTION OF CASES ACCORDING TO PAIN PERCEPTION AT THE END OF 1 WEEK FOLLOWING SURGERY.

	Laparoscopic Appendectomy			Open Appendectomy		
Visual analogue score	At Rest	On Mobility	On Straining	At Rest	On Mobility	On Straining
	No. of Patients	No. of Patients	No. of Patients	No. of Patients	No. of Patients	No. of Patients
Mild (1-3)	62(100%)	58(93.55%)	56(90.32%)	68(100%)	61(89.71%)	54(79.41%)
Moderate (4-6)	Nil	03(04.84%)	05(08.06%)	Nil	06(08.82%)	10(14.71%)
Severe (7-10)	Nil	01(01.61%)	01(01.61%)	Nil	01(01.47%)	04(05.88%)

TABLE 2: DISTRIBUTION OF CASES ACCORDING TO PERIOD OF AMBULATION.

	Laparoscopic Appendectomy		Open Appendectomy	
Period of Ambulation	No. of Patients	Percentage	No. of Patients	Percentage
On Day of Surgery	0	0	0	0
1^{st} POD of Surgery	42	67.74%	37	54.41%
2^{nd} POD of Surgery	15	24.19%	17	25.00%
More than 2^{nd} POD of Surgery	04	06.45%	14	20.59%

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DISCUSSION:

Open appendicectomy has been the 'gold' standard for treatment of acute appendicitis for more than a century. Although it is a safe procedure but postoperative complications occurs in 10-20% (A. Hellberg et al)[1] and is also associated with postoperative pain affecting the normal activity. Several reports in literature have suggested decrease in postoperative disability, hospital stay and earlier return to normal activity (Attwood et al, Vallina [2] and others) with laparoscopic appendicectomy. A prospective study of 130 patients was performed to compare the complications associated with laparoscopic and open appendectomy out of which 59.23% (77) were males and 40.77% (53) were females. Similarly, in study conducted by Adiss DG, Shaffer N, Tauxe RV [3], males had higher incidence of appendectomy than females (overall rate ratio; 1.4:1). In a study conducted by Swank HA, Eshuis EJ, Henegouwen Mi et al[4] (2011), 63% patients were males and 37% were females with a median age of 34 years (range 18-96). Mean age of patients was 30.6 years. Similar mean age was found in study conducted by K F Richards et al [5], where 253 patients with mean age of 29.8 years (with 199 males and 134 females). Median age of 25 years was observed by John Brendan Hansen et al [6], range 14-89 years, Michael R. Cox et al [7], (18-75 years) and William Richards et al [8], (18-75 years).

Different authors have described the placement of ports for laparoscopic appendectomy differently. Tate et al, Ortega et al, Richard C Frazee et al used umbilical port for camera where as in our study camera was kept in the umbilical port initially for the placement of suprapubic port which was used as camera port during procedure. This allowed us to work with both hands simultaneously and maintaining the triangulation of trocars. Any anatomical location of appendix could be visualised by this method and had additional benefit of adhesiolysis especially in laparoscopically detected appendicular lump and abscess.

Use of three trocars was a routine in our study with 10mm supraumbilical and suprapubic ports and 5mm port in right lower quadrant. Both suprapubic and right lower quadrant ports used to be below the crease line. Apelgren et al also used 3 port technique with 10mm port at umbilicus, a 12mm port at left lower quadrant and a 5mm in right upper quadrant. Van L.Vallina et al used three ports, suprapubic, periumbilical and at McBurney's point, fourth port was added in few cases at right upper quadrant.

Management of mesoappendix and appendicular artery was achieved by two different methods in our study. We used ultracision to secure the meso-appendix and appendicular artery 41 cases (66%). K.K. Yau [11] also used ultrasonic dissector to divide the mesoappendix. In remaining 21 cases (34%) of our patients, combination of endoclips and monopolar electrocautery was used. Frazee et al, C. K. Kum et al [12] and Mehoff et al also used similar technique for securing the mesoappendix and appendicular artery. Bipolar cautery was not used in any of our cases.

Closure of skin was performed with silk in all cases of laparoscopic appendectomy 62 cases (100%) and in 54 cases (79.41%) of open appendectomy. In 12 cases (17.65%) of open appendectomy, metallic staplers were used and delayed primary closure was performed in 2 cases (02.94%). We did not find any wound infection in the cases which were subjected to delayed primary closure. Similar findings were observed in a study conducted by Chiang RA, Chen SL, Tsai YC [13] (2012), the primary closure group had higher incidence of wound infection (3.8% versus 2.9%, $p<0.001$). similar observations were concluded in a study conducted by Cohn SM, Giannotti G, Ong AW et al [14] (2001). Their strategy was delayed primary closure for dirty abdominal wounds after 4 days after surgery, which produced a decreased wound infection rate compared with primary closure group.

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Except for bleeding at trocar site in one (1.6%) which could be managed by suturing we had no other intraoperative complication. Peiser and Greenberg have described perforation of small bowel from trocar in one of their patients and trocar site haemorrhage in another while doing laparoscopic appendicectomy in 97 patients.

The mean operative time is an indirect measure to determine the severity of the disease and possible complications following the procedure. Duration of surgery has been unfavourable for laparoscopy in most of the studies conducted in the past. In studies conducted by Vallina et al and Attwood et al the mean operating room time (from induction of anaesthesia to reversal) was 61 minutes whereas mean operating time in study conducted by Frazee and others was 87 minutes. Long et al found mean duration of operation as 110.5 minutes in 93 patients undergoing laparoscopic appendectomy. Duration of surgery, in present study from incision to port closure ranged from 20 minutes to 90 minutes with mean duration of 35.96 minutes. In case of complicated appendicitis (perforated and gangrenous appendix) the duration of surgery increased to a mean of 56 minutes because of inflammatory tissue reaction and adhesions of appendix with omentum, caecum and small gut that made the identification and handling of the inflamed anatomical structures difficult. The mean operative time in open appendectomy in our study was 58 minutes which ranged from 28 minutes to 86 minutes. Similar mean operative time 60.14 minutes was observed in a study by Suh YJ, Jeong SY, Park KJ et al (2012) and 43.94 minutes by Yagnik VD, Rathod JB, Phatak AG [29] (2010). The more time taken in our study can be explained that we had taken complicated appendicitis in our study whereas complicated appendicitis patients were excluded in other studies.

In our study we had 11 (08.46%) cases of paralytic ileus where bowel sounds took more than 24 hours to return. Tate et al and Richards et al noticed prolonged paralytic ileus in 3% and 2% patients respectively. Similarly, in a study conducted by Lim SG, Ahn EJ, Kim SY [17] (2011) paralytic ileus was found to be 13.6% following open appendicectomy in complicated appendicitis. Patients were allowed to take oral liquids once they passed flatus or when the bowel sounds were audible mostly on 1st POD and a regular diet was started once they tolerated liquids well, usually on second POD. It was similar to studies of Kum et al and Frazee et al where patients started taking regular diet at 1.8 and 1.7 days respectively.

In our study 5 patients (07.35%) developed adhesive small bowel obstruction either as early or late complication following open appendicectomy out of which 2 were subjected to exploratory laparotomy in which adhesiolysis was carried out. In a study conducted by Shams M, Sherif F, Gamal M [18] 2007 on postoperative intestinal obstruction from 1996 to 2006 which included 477 patients, 57 patients had post appendicectomy small bowel obstruction for which they were admitted. 8.6% were operated upon, out of which 14% patients required intestinal resection and 45% had simple adhesiolysis , whereas 14% of the patients improved with conservative treatment. According to Andersson R E [19] (2001), the probability of post appendicectomy adhesive small bowel obstruction is significantly increased in those who had perforated appendicitis. Similarly in our study all patients who required exploratory laparotomy for adhesive intestinal obstruction had perforated appendix. The findings are also consistent with studies conducted by Kehagias I, Karamanakos SN, Panagiotopoulos S et al (2008), 5 patients (10.6%) who developed bowel obstruction underwent open appendectomy in complicated appendicitis. This confirms to the observations by Khairy GA, Afzal MF, Murshid KR et al [20](2005) where 4 out of 6 patients of small bowel obstruction following open appendectomy had perforated appendix. Similar observations were concluded in the study conducted by Tsao KJ, Peter SDS, Valusek PA et al [21](2007) and Moon KM, Kim DY, Kim SC et al [22] (2004).

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The post appendectomy faecal fistula though rare complication but is associated with significant morbidity, it is reported to be 1.33% and 3.5% in studies conducted by Genier F, Plattner V, Letessier E et al (1995) and by Swank HA, Eshuis EJ, Henegouwen Mi et al (2011). Post appendectomy faecal fistulas occur mostly when there is severe peri-appendicitis which involves the base of appendix. We did not encounter any faecal fistula in our study, however there was one incidence of iatrogenic injury to caecum while performing adhesiolysis which was repaired primarily using absorbable sutures without any postoperative complications.

In our study 1 patient (01.47%) developed hypertrophic scar following open appendicectomy whereas in a study conducted by Sarda K, Kher K, Wagh D et al [28] 2010, hypertrophic scar was observed in two patients (06.67%).

Patients started ambulating early in case of laparoscopic appendectomy 67.74% on 1st POD as compared to 54.41% in open appendectomy. Patients recovered at a fast rate and 80% patients were back to work by the end of second week (14 days). It was similar to studies of Long et al and Klingler et al were patients were back to full activity by 14 days. Richards et al and Golub et al noticed patients attending normal activities at a median of 10.3 days and 11.9 days respectively.

The duration of hospital stay is an indirect measurement of the morbidity, cost, quality of life, increased pain and possible longterm consequences of any surgical procedure. The mean length of hospital stay in laparoscopic appendectomy in our study was about 2 days. We used to discharge patients once they were afebrile and accepting a regular oral feed. Richards et al and Frazee et al also observed a similar postoperative stay of 2.1 days and 2 days respectively whereas Kum et al and Heinzelmann noticed a mean hospital stay of 3.2 days and 5.6 days respectively. The mean length of hospital stay in open appendectomy in our study was 4.5 days. The mean length of stay in studies observed by Kehagis I, Karamanakos SN, Panagiotopoulos S et al (2008), Yagnik VD, Rathod JB, Phatak AG (2010), Suh YJ, Jeong S, Park KJ et al (2012), Khanzada TW, Samad, Memon W [30] (2008), Swank HA, Eshuis EJ, Henegouwen Mi et al (2011) was 3.1 days, 3.02 days, 3.83 days, 5.02 days and 5.8 days respectively. The increased mean length of hospital stay in our study can be explained due to the increased magnitude of infection in our study in comparison to other studies.

Follow up in our study ranged from 2 weeks to 40 weeks with a mean follow up period of 28 weeks. Follow up included enquiry about any complaint and clinical examination.

CONCLUSION:

Patients with acute appendicitis with similar demographic features and comorbidities were admitted and were subjected to open and laparoscopic appendectomy. Three main parameters were assigned to study the complications associated with both the procedures i.e; Postoperative pain, ambulation and wound infection. On the basis of these parameters laparoscopic appendectomy is associated with less complications, early ambulation and less incidence of wound infection.

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