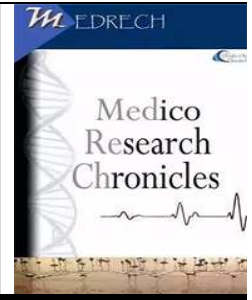




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OUTCOME MEASURES OF LAPAROSCOPIC VERSUS OPEN APPENDICECTOMY WITH UNCOMPLICATED ACUTE APPENDICITIS

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ABSTRACT

Background: Acute appendicitis is the sudden and severe inflammation of the appendix. It can cause pain in the abdomen, and this pain may occur quickly and worsen within hours.

Aim of the study: To find out the Outcome Measures of Laparoscopic Versus Open Appendicectomy with Uncomplicated Acute Appendicitis.

Methods: This is a prospective type of observational study conducted in the Department of Surgery, Bangladesh Medical College Hospital, Dhaka, Bangladesh. Study period was from 1st July 2018 to 30 June 2020. 100 cases irrespective of sex were selected through random sampling who fit the selected criteria

Result: Among 50 cases of open appendicectomy, 33 cases (66%) were male and 17 cases (34%) were female. Among 50 cases of laparoscopic appendicectomy, 34 cases (68%) were male and 16 cases (32%) were female (p value: 0.83). Open cases needed 67.50±9.20 minutes' duration of anaesthesia and laparoscopic cases 83.82±13.05 minutes (p value: <0.001). Duration of surgery in group A (open cases) was (mean±SD) 44.54±11.75 minutes and in group B was (mean±SD) 68.28±15.24 minutes (p value<0.001). Per operative hazards observed in 2% patients with laparoscopic appendicectomy (p value: 0.31). Mean time required taking narcotic analgesic after surgery in Group A was 29.06±10.46 hours and in Group B 21.36±11.93 hours (p value: 0.001)

Conclusion: After observing the outcome of both the procedure it can easily be concluded that laparoscopic appendicectomy is superior over open procedure in terms of duration of anesthesia, duration of surgery, post-operative pain and discomfort, tolerance to normal diet, hospital

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stay, return to post-operative indoor and outdoor activities, wound infection and cosmesis. So laparoscopic appendectomy is safer procedure by expert surgeons. Analyzing more recent studies, it can be suggested that laparoscopy is becoming the first-choice method for management of acute appendicitis.

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INTRODUCTION

Acute appendicitis is the commonest acute abdominal emergency from childhood to early adult life, and consequently, appendectomy is the most commonly performed urgent abdominal operation.¹⁻⁵ It is a common indication for abdominal surgery, with a lifetime incidence of between 7 to 9 percent^{6,7} with a peak incidence between 10 and 30 years.⁸ Conventional open appendectomy has been the treatment of choice for more than a century.^{9,10} Although in the majority of cases, it is rather an uncomplicated operation associated with theoretically zero mortality rate (approximately 0.1%),¹¹ there may be significant post-operative morbidity following the open operation. These include- wound infection, prolonged ileus, intestinal obstruction due to adhesions, infertility in females, and less commonly, incisional hernia.^{12,13} As a result, the open approach leads to a relatively long hospital stay and delays return to normal activities. Furthermore, a detailed examination of the abdomen and pelvis is not possible in open surgery.¹⁴ In the quest for an alternative approach that would reduce the postoperative complications, duration of hospital stay, and convalescence period as well as provide improved per operative exposure and cosmetic outcome, laparoscopic appendectomy, in recent years, has emerged to be a popular and standard procedure for treating appendicitis successfully.¹⁵ The term 'Laparoscopy' (from the Greek *Laparo*, the flank, and *skopein*, to examine) refers to the visual examination of the abdominal cavity using an endoscope or telescope (the laparoscope).¹⁶ Kurt Semm, a

Gynecologist from Kiel, Germany first introduced laparoscopic appendectomy in 1983. He used laparoscopy to remove the appendix of a patient with chronic appendicitis. Since then the procedure has gained popularity among surgeons as well as patients worldwide. Appendectomy is one of the most commonly performed operations. In 1889 McBurney performed the first open appendectomy, since then it has been the gold standard for the treatment of acute appendicitis for more than one hundred years. Laparoscopic appendectomy has emerged as a safe procedure, and its potential advantages of shorter hospital stay, early mobilization, acceptable complication rate along with the recent enthusiasm of minimally invasive surgery, has led some authors to advocate this approach as the procedure of choice for uncomplicated acute appendicitis.^{19, 20} Moreover, the laparoscopic approach may offer a particular advantage in case of women of childbearing age and obese individuals^{21, 22} this study aims to compare the outcomes of these two surgical procedures on different aspects and to find out any significant statistical difference between them. Age and sex factors were kept almost identical. The comparison was done based on –operative time, postoperative pain control, postoperative complications (wound, infective, urinary, pulmonary, gastrointestinal), post op. stay in the hospital, cost of surgery, time to return to indoor and outdoor activity, satisfaction with cosmesis and other complications if any. To find out the Outcome Measures of Laparoscopic Versus Open Appendectomy with Uncomplicated Acute Appendicitis.

MATERIALS AND METHODS

This is a prospective type of observational study conducted in the Department of Surgery, Bangladesh Medical College Hospital, Dhaka. The study period was from 1st July 2018 to 30 June 2020. 100 cases irrespective of sex were selected through random sampling that fit the selected criteria. Following that sampling units are allocated in two groups by lottery; each group consisting of 50 cases. Inclusion Criteria includes Between 10 and 40 years of age, Patients willingly give informed consent to take part in the study, Patients presenting within 3 days of abdominal pain. Exclusion criteria include Patient/attendant unwilling to give informed consent to take part in the study, pregnant women, Patients presenting with the appendicular lump. All cases underwent either laparoscopic or open appendicectomy for acute appendicitis. Per-operative events and post-operative follow up were documented in a preset data collection sheet. After collecting information, data was checked, verified for consistency, and edited for finalization of the result. Statistical analyses were done by unpaired t-test and chi-square test. After editing and coding, the coded data were analyzed by computer with the help of SPSS/PC software. Results are presented in tables as percentages.

RESULTS

100 patients were selected for either laparoscopic (50 cases) or open (50 cases) appendicectomy for acute appendicitis. Age distribution of patients revealed mean±SD age of open appendicectomy was 20.30±6.79 years

and laparoscopic appendicectomy was 19.82±6.33 years (p-value: 0.72) with the highest frequency observed in 10-20 year age group (56% in open, 62% in laparoscopy). Among 50 cases of open appendicectomy, 33 cases (66%) were male and 17 cases (34%) were female. Among 50 cases of laparoscopic appendicectomy, 34 cases (68%) were male and 16 cases (32%) were female (p-value: 0.83). Open cases needed 67.50±9.20 minutes' duration of anesthesia and laparoscopic cases 83.82±13.05 minutes (p-value: <0.001). Duration of surgery in group A (open cases) was (mean±SD) 44.54±11.75 minutes and in the group, B was (mean±SD) 68.28±15.24 minutes (p value<0.001). Per operative, hazards were observed in 2% of patients with laparoscopic appendicectomy (p-value: 0.31). The mean time required for taking narcotic analgesic after surgery in Group A was 29.06±10.46 hours and in Group B 21.36±11.93 hours (p-value: 0.001). Mean time required taking NSAIDs analgesia after surgery in case of open procedure was 9.00±2.46 days and in case of laparoscopic appendicectomy was 6.72±2.47 days (P value<0.001). Meantime required to tolerate regular diet was 47.36±9.34 hours after open appendicectomy and 30.94±8.15 hours after laparoscopic appendicectomy (p-value <0.001). Regarding hospital stay, in Group A stay period was 3.28±0.64 days, and in group B- 2.44±0.70 days (p-value <0.001). Indoor activity returned after a mean of 9.66±2.42 days in Group A and 6.28±2.04 days in Group B.

Table 1: Preoperative clinical features and operative findings

Preoperative findings	Group A (n=50)	Group B (n=50)	P Values
Symptoms			
Migratory RIF pain	36(72.0%)	40(90.0%)	0.68 ^{NS}
Anorexia	22(44.0%)	38(76.0%)	0.41 ^{NS}
Nausea vomiting	20(40.0%)	22(44.0%)	0.68 ^{NS}
Signs			
Tenderness (RIF)	50(100.0%)	50(100.0%)	0.40 ^{NS}
Rebound Tenderness	42(84.0%)	45(90.0%)	0.29 ^{NS}

Elevated Temperature	17(34.0%)	23(46.0%)	0.22 ^{NS}
Lab			
Leukocytosis	45(90.0%)	42(84.0%)	0.29 ^{NS}
Shift to left	7(14.0%)	9(18.0%)	0.58 ^{NS}
Operative findings			
Non- inflamed	0	0	-
Inflamed	44(88.0%)	47(94.0%)	0.42 ^{NS}
Phelgmonous	0	0	-
Gangrenous	6(12.0%)	3(6.0%)	0.31 ^{NS}

Table 2: Postoperative complications

Complications	Group A (n=50) No. (%)	Group A (n=50) No. (%)	p value
Wound infection	7(14.0%)	2(4.0%)	0.04 ^S
Intra-abdominal abscess	0	0	
Ileus	4(8.0%)	1(2.0%)	
Respiratory	0	3(6.0%)	
Urinary	2(4.0%)	0	
No complications	37(74.0%)	44(88.0%)	

Table 3: Overall satisfaction

Cosmetic outcome	Group A (n=50) No. (%)	Group A (n=50) No. (%)	p value
Excellent	0	17(54.0%)	<0.001
Good	14(28.0%)	29(58.0%)	
Satisfactory	27(54.0%)	2(4.0%)	
Poor	9(18.0%)	2(4.0%)	
Total	50(100.0%)	50(100.0%)	

DISCUSSION

A total number of 100 cases of acute appendicitis were analyzed in this prospective observational study of laparoscopic versus open appendicectomy; half of the total patients were allocated to open procedure and the remaining half to laparoscopic appendicectomy. There was no mortality in my study. The overall reported mortality of appendicectomy is very low and was estimated in a review of a large administrative database at 0.05% for laparoscopic appendicectomy and

0.3% for open appendicectomy,¹ reinforcing the fact that appendicectomy in the absence of peritonitis is a safe procedure, regardless of the technique performed.³¹ Among the 100 respondents, the majority presented with right iliac fossa pain (100%). Martin *et al*³² reported similar nature of pain for laparoscopic appendicectomy. Laparoscopic appendicectomy was done with general anesthesia and the mean duration of anesthesia was 83.82±13.05 minutes (p=0.001) whereas open appendicectomy was done by spinal

anesthesia and the mean duration of anesthesia was 67.50 ± 9.20 minutes ($P=0.001$). Both the results were significant and laparoscopic appendectomy needed more time over open appendectomy. The mean duration of surgery (in minutes) in the case of laparoscopic appendectomy was 68.28 ± 15.24 minutes ($P=0.001$) and in the other hand in the case of open appendectomy mean duration of surgery (in minutes) was 44.54 ± 11.75 minutes ($P=0.001$). The operative duration was 24 minutes longer in the laparoscopic appendectomy group as compared to that in the open appendectomy group. In considering operating time, the exact identification of the timing of the start of the procedure and its conclusion varies. In general, the time should be calculated from the insertion of the first trocar to the end of the skin suturing. Cox *et al.*³³ defined operating time as the time from incision to wound closure. Tate *et al.*³⁴ calculated the time as the use of anesthesia to the administration of a reversal agent. Both anesthesia and the actual skin-to-skin time were measured and were found longer in the laparoscopic appendectomy group. No study was found demonstrating a shorter time for laparoscopic appendectomy,^{35, 36, 37} despite the subjective perception that it can be an easier operation. No operative complication occurred in the open appendectomy group. Excessive bleeding occurred from mesoappendix and retroperitoneum in 1 patient in laparoscopic appendectomy and was controlled by electrocautery. Injury to inferior epigastric vessels was avoided by placing trocars under direct vision. No visceral injury has occurred. Pier *et al.*³⁸ also observed similar results. Open appendectomy was done by spinal anesthesia and one dose of narcotic analgesic (Inj Pethidin 100 mg) was given in all patients just after surgery in the operation theater. After the operation, the mean time required to take narcotic analgesic was 29.06 ± 10.46 ($P=0.001$) hours were 26 (52%) patients required narcotic

analgesic after 21-30 hours. In the case of laparoscopic appendectomy mean time required for taking narcotic analgesic was 21.36 ± 11.93 hours where 21(42.0%) patients required narcotic analgesic after 11-20 hours. The result shows laparoscopic appendectomy needs more frequent narcotic analgesic. The meantime required taking NSAIDs analgesia after surgery in laparoscopic appendectomy group was 9.00 ± 2.46 days and as compared to that in the open appendectomy group meantime was 6.72 ± 2.47 days ($P=0.001$). Laparoscopic appendectomy required fewer NSAIDs. The post-operative pain was qualitatively stratified into mild, moderate, and severe, according to the visual analog scale (VAS). In the case of laparoscopic appendectomy visual field is more and we can inspect the whole of the abdominal cavity which is another advantage of laparoscopic surgery. We can diagnose others' pathology. In my study, I found ovarian cyst (2%), salpingitis (2%), and mesenteric adenitis in 4% of patients. But all the patients had inflamed appendices. The postoperative course was uneventful in 37(74.0%) patients in open appendectomy and 44(88.0%) patients in laparoscopic appendectomy. Wound infection was recognized by erythema and purulent discharge. In laparoscopic appendectomy port site infection was found in 2(4.0%) patients and wound infection found in 7(14.0%) patients in open appendectomy. The appendix was delivered into the trocar before removing. This maneuver minimizes the chances of wound infection to the skin. Incidence of wound infection was higher in the open procedure as there is more chance of contamination. The incidence of wound infection was found less after laparoscopy³⁹. There is no intra-abdominal abscess in my study. Paralytic ileus was observed in 4(8.0%) patients in open appendectomy and laparoscopic appendectomy in 1(2.0%) patients. Urinary tract infection was observed in 2(4%) patients in open appendectomy.

Post-operative oral feeding could be started as soon as bowel sound appeared after both of the procedures. But meantime by which normal regular diet was tolerated was 47.36 ± 9.34 hours in open appendectomy and laparoscopic appendectomy, it was 30.94 ± 8.15 hours which is less than an open procedure. The result was significant ($P=0.001$). The length of mean postoperative hospital stay after open appendectomy was 3.28 ± 0.64 days ($P=0.001$) and in laparoscopic appendectomy, it was 2.44 ± 0.70 days ($P=0.001$). The length was short in laparoscopic appendectomy. This finding is similar to other studies. In open appendectomy 46(92.0%) patients were discharged within 3-4 days and in laparoscopic appendectomy 33(66.0%) patients were discharged within 1-2 days. The return to outdoor activity following appendectomy is the subject of intense debates. A minimally invasive surgery by definition should allow for a quicker recovery, shorter convalescence at home and quicker return to work. In my study time to return to indoor activity is less in the laparoscopic group. The mean duration of return to indoor activity in open procedure was 9.66 ± 2.42 days and in the laparoscopic group was 6.28 ± 2.04 days which is statistically significant. In open procedure 23(46.0%) patients returned to indoor activity within 9-11 days whereas in the laparoscopic group 26(52.0%) patients returned to indoor activity within 6-8 days. Time to return to outdoor activities in the laparoscopic group was 18.96 ± 5.33 days and the mean duration of return to outdoor activity in open procedure was 25.70 ± 4.97 days.⁴¹ Regarding cosmetic outcome, in the open procedure group, 14(28.0%) patients were graded as good, 27(54.0%) patients were satisfied and 9(18.0%) patients were graded as poor. In another hand in the laparoscopic group, 17(54.0%) patients were graded as excellent, 29(58.0%) patients were graded as good, 2(4.0%) patients were satisfied. So cosmetic

outcomes after laparoscopy are outstanding and superior to open procedure and this is statistically significant ($P=0.001$). Although optimum care has been taken, still some limitations existed.

Limitations of the study:

The study was conducted in a selected institute, so the study population might not represent the whole community. Larger sample size would have given a better result. Complicated appendicitis was not evaluated.

CONCLUSION

After observing the outcome of both the procedure it can easily be concluded that laparoscopic appendectomy is superior over the open procedure in terms of duration of anesthesia, duration of surgery, post-operative pain and discomfort, tolerance to a normal diet, hospital stay, return to post-operative indoor and outdoor activities, wound infection and cosmesis. So laparoscopic appendectomy is the safer procedure by expert surgeons. Analyzing more recent studies, it can be suggested that laparoscopy is becoming the first-choice method for the management of acute appendicitis.

CONFLICT OF INTEREST: None

REFERENCES

1. Reiertsen O, Larsen S, Trondsen E, Edwin B, Faerden AE, Rosseland AR, 1997. Randomized control trial with sequential design of laparoscopic versus conventional appendectomy, *Br J surg*, 84,842-847.
2. Cox MR, McGall JL, Toouli J et al, 1996. Prospective randomized comparison of open versus laparoscopic appendectomy in men, *World J Surg*, 20, 263-266.
3. Frazee RC, Roberts JW, Symmonds RE et al, 1994. Prospective randomized trial comparing open versus laparoscopic appendectomy, *Ann Surg*, 219,725-728.
4. Kum CK, Ngoi SS, Goh PMY, tekant Y, Issac JR, 1993. Randomized control trial comparing laparoscopic versus open

- appendectomy, *Br J Surg*, 80, 1599-1600.
5. Tate JJT, Dawson JW, Chung SCS, Lau YK, Li AKC, 1993. Laparoscopic versus open appendectomy: prospective randomized trial, *Lancet*, 342, 633-637
 6. Addis DG, Shaffer N, Fowler BS, Tauxe RV, 1990. The epidemiology of appendicitis and appendectomy in the United States, *Am J Epidemiol*, 132; 910-25.
 7. Kumar B, Samad A, Khanzad TA, Laghari MH, Sheikh AR, 2008. Superiority of laparoscopic appendectomy over open appendectomy: the Hyderabad experience, *Rawal Med J*, 165-68
 8. Kumar B, Samad A, Khanzada TW, Laghari MH, Shaikh AR, 2008. Superiority of Laproscopic appendectomy over open appendectomy: The Hyderabad experience. *Rawal Med J* 2008, 33: 165-8
 9. Kum CK, Ngoi SS, Goh PMY, tekant Y, Issac JR, 1993. Randomized control trial comparing laparoscopic versus open appendectomy, *Br J Surg*, 80, 1599-1600.
 10. Tate JJT, Dawson JW, Chung SCS, Lau YK, Li AKC, 1993. Laparoscopic versus open appendectomy: prospective randomized trial, *Lancet*, 342, 633-637.
 11. Blomqvist PG et al. 2001. Mortality after appendectomy in Sweden, 1987-1996, *Ann Surg*, 233-455.
 12. Lujan Mompean JA, Robles Campos R, Paricio PP, Aledo Vs, Ayllon JG, 1994. Laparoscopic versus open appendectomy: a prospective assessment. *Br J Surg*, 81, 133-135.
 13. Seco JL, Ojeda e, Reguilon C, et al, 1990. Combined topical and systemic antibiotic prophylaxis in acute appendicitis. *Am J Surg*, 159, 226-229.
 14. McAnena OJ, Ausin O, O'Connell Pr, Hedermam WP, Goery TF, Fitzpatrick, 1992. Laparoscopic versus open appendectomy: a prospective evaluation. *Br J Surg*, 79, 818-820
 15. Nathaniel J, Soper, Brunt LM, Kerbl, 1994. Laparoscopic general surgery. *N Engl J Med*, 330(6), 409-419
 16. Nathaniel J, Soper, Brunt LM, Kerbl, laparoscopic general surgery. *N Engl J Med* 1994; 330(6): 409-419
 17. Jan WA, Rehman ZU, Khan SM, Ali G, Qayyum A, Mumtaz N, Outcome of open versus laparoscopic appendectomy in department of surgery, Lady reading hospital, Peshawar. *JPMI* 2011; 3: 245-251
 18. Jamy L. Young, WaiLun Law, Chung YauLo, Chi Ming Lam, 2006. A Comparative Study of Routine Laparoscopic Versus Open Appendectomy, *JLSLS*, Apr-Jun; 10(2), 188-192.
 19. Gross E, et al. 1998. Laparoscopic versus conventional appendectomy - a comparison with reference to early postoperative complication. *Zentralbl Chir*, 123, 858-862.
 20. Tranoff M, Atabek U, Goodman M, Alexander JB, Chrzanowski F, Mortman K, et al, 1998. A comparison of laparoscopic and open appendectomy. *J Soc Laparoendosc Surg*, 2, 153-158
 21. Lujan Mompean JA, Robles Campos R, Paricio PP, Aledo VS, Ayllon JG, Laparoscopic versus open appendectomy: a prospective assessment. *Br j Surg* 1994; 81: 133-135
 22. Seco JL, Ojeda E, Reguilon C, et al. Combine topical and systemic antibiotics prophylaxis in acute appendicitis *Am J Surg* 1990; 159: 226-229
 23. Nicholson T, Tiruchelvam V., 2001. Comparison of laparoscopic-assisted appendectomy with intracorporal laparoscopic appendectomy and open appendectomy, *J Soc Laparoendosc Surg*, 5, 47-51.
 24. Ortega AE, Hunter JG, Peters JH, Swanstorm LL, Schirmer B., 1995. A prospective, randomized comparison of laparoscopic appendectomy with open appendectomy. *Laparoscopic*

- Appendectomy Study Group, *Am J Surg*, 169, 208-212.
25. Golub R, Siddiqui F, Pohl D., 1998. Laparoscopic versus open appendectomy: a metaanalysis, *J Am Coll Surg*, 186, 545-53.
 26. Katkhouda N, Mason RJ, Towfigh S., 2006. Laparoscopic versus open appendectomy: a prospective, randomized, double-blind study, *AdvSurg*, 40, 1-19.
 27. Katkhouda N, Mason RJ, Towfigh S, Gevorgyan A, Essani R, 2005. Laparoscopic versus open appendectomy; a prospective randomized double blind study, *Ann Surg*, 242, 439-448.
 28. Angela M. Ingraham, Mark E. Cohen, Karl Y. Bilimoria, Timothy A. Pritts, Clifford Y. Ko, Thomas J. Esposito, 2010. Comparison of outcomes after laparoscopic versus open appendectomy for acute appendicitis at 222 ACS NSQIP hospitals. *American College of Surgeons*, 148, 625-637.
 29. Xiaohang Li, Jialin Zhang, Lixuan Sang, Wenliang Zhang, Zhiqiang Chu, XinLi, Yongfeng Liu, 2010, Laparoscopic versus conventional appendectomy - a meta-analysis of randomized controlled trials, *BMC Gastroenterology*, 10-129.
 30. A. Hellberg, Dr C. Rudberg, E. Kullman, L. Enochsson, G. Fenyö, H. Graffner, B. Hallerbäck, B. Johansson, B. Anderberg, J. Wenner, I. Ringqvist, S. Sörensen, 2003, Prospective randomized multicentre study of laparoscopic versus open appendectomy, *Br J surg* ,10, 1365-2168.
 31. Guller U, Harvey S, Purves H, 2004. Laparoscopic versus open appendectomy: outcome comparison based in large administrative database, *Ann Surg*, 239:43-52.
 32. Martin LC, Puente I, Sosa JL, Basin A, Breslaw R, McKenney MG, 1995. Open versus laparoscopic appendectomy: A prospective randomized comparasion , *Ann Surg*, 222:256-262.
 33. Laparoscopic appendectomy in Men, 1996 *World j. Surg* 20:263-266
 34. Tate JJT Laparoscopic appendectomy, 1996. *Br J Surg*, 83,1169-1170
 35. Katkouda N, Manson RJ, Towfigh S, Gevorgyan A, Essani R. 2005, Laparoscopic versus open appendectomy, a prospectivr randomized double blind syudy, *Ann Surg*, 242(3), 439-450.
 36. Young JI, Law WL, Lo CY, Lam CN, 2006, A comparative study of routine laparoscopic versus open appendectomy, *Journal of society of laparoscopic surgeons*, 10,188-192.
 37. Hellberg A, Rudberg C, Kullman E, Prospective randomized multicentral study of laparoscopic versus open appendectomy. *Br J Surg*. 1999; 86:48-53.
 38. Pier A, Gotz F, Bacher C. Laparoscopic appendectomy in 625 cases: from innovation to routine. *Surg Laparoscopic Endosc*.1991; 1:8-13.
 39. Hansen JB, Sinithers BM, Schache D, Wall DR, Miller BJ, Menzies BL. Laparoscopic versus open appendectomy. *World J Surg*. 1996; 20:17-21.
 40. Vanilla V, McCullach C. Laparoscopic versus conventional appendectomy. *Ann Surg*. 1993; 218:685-689.
 41. Pedersen AG, Petersen OB, Warna P, Ronning H, Qvist N, Laurberg S.. Randomized clinical trial of laparoscopic versus open appendectomy. *br J Surg*.2001; 88:200-205.