

Prospective Study

Laparoscopic vs mini-incision open appendectomy

Fatih Çiftçi

Fatih Çiftçi, Vocational School of Health Services, Istanbul Gelisim University, Istanbul 34306, Turkey

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Correspondence to: Fatih Çiftçi, MD, Assistant Professor, Vocational School of Health Services, Istanbul Gelisim University, Basaksehir Mah., Erciyes Sok. No 15, Daire 24, Basaksehir, Istanbul 34306, Turkey. oprdrfatihciftci@gmail.com
Telephone: +90-505-6164248
Fax: +90-212-4627056

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Abstract

AIM: To compare laparoscopic vs mini-incision open appendectomy in light of recent data at our centre.

METHODS: The data of patients who underwent appendectomy between January 2011 and June 2013 were collected. The data included patients' demographic data, procedure time, length of hospital stay, the need for pain medicine, postoperative visual analog scale of pain, and morbidities. Pregnant women and patients with previous lower abdominal surgery were excluded. Patients with surgery converted from laparoscopic appendectomy (LA) to mini-incision open appendectomy (MOA) were excluded. Patients were divided into two groups: LA and MOA done by the same surgeon. The patients were randomized into MOA and LA groups a computer-generated number. The diagnosis of acute appendicitis was made by the surgeon with physical examination, laboratory values, and radiological tests (abdominal ultrasound or computed tomography). All operations were performed with general anaesthesia. The postoperative vision analog scale score was recorded at postoperative hours 1, 6, 12, and 24. Patients were discharged when they tolerated normal food and passed gas and were followed up every week for three weeks as outpatients.

RESULTS: Of the 243 patients, 121 (49.9%) underwent MOA, while 122 (50.1%) had laparoscopic appendectomy. There were no significant differences in operation time between the two groups ($P = 0.844$), whereas the visual analog scale of pain was significantly higher in the open appendectomy group at the 1st hour ($P = 0.001$), 6th hour ($P = 0.001$), and 12th hour ($P = 0.027$). The need for analgesic medication was significantly higher in the MOA group ($P = 0.001$). There were no differences between the two groups in terms of morbidity rate ($P = 0.599$). The rate of total complications was similar between the two groups (6.5% in LA vs 7.4% in OA, $P = 0.599$). All wound infections were treated non-surgically. Six out of seven patients with pelvic abscess were successfully treated with percutaneous drainage; one patient required

surgical drainage after a failed percutaneous drainage. There were no differences in the period of hospital stay, operation time, and postoperative complication rate between the two groups. Laparoscopic appendectomy decreases the need for analgesic medications and the visual analog scale of pain.

CONCLUSION: The laparoscopic appendectomy should be considered as a standard treatment for acute appendicitis. Mini-incision appendectomy is an alternative for a select group of patients.

Key words: Appendicitis; Surgical wound infections; Laparoscopic surgical procedure; Abdominal abscess; Mini-incision open appendectomy

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Core tip: Acute appendicitis is mostly encountered disease in a daily routine. Researchs regarding decreasing morbidity and mortality are still needed, although it is very well known. Hospital stay, operation time, postoperative complication rates are important for the management of acute appendicitis. Therefore, we suggest that laparoscopic appendectomy should be accepted as a standard treatment for acute appendicitis. Mini-incision appendectomy is an alternative for a select group of patients.

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INTRODUCTION

The most common reason for admission to the emergency room is acute appendicitis (AA), and appendectomy is a daily surgical procedure performed around the world^[1,2]. Open appendectomy (OA) is accepted as a standard treatment for (AA); its morbidity and mortality are very low^[1,2]. However, laparoscopic appendectomy (LA) has recently become more accepted^[1,2]. Many advantages of LA have been shown such as lower hospital stay, shorter recovery period, shorter period for returning to daily activities, lower postoperative pain, and lower postoperative infections^[1-6]. In spite of these advantages, there is controversy over the best model of appendectomy techniques in the literature. Any extra potential advantages resulting from the laparoscopic approach are hard to prove because OA has the advantages of minimally invasive surgery such as a small incision, faster return to daily activities, and short hospital stays^[3,7]. Moreover, there are some discouragements for LA such as longer operation time, higher intra-abdominal abscess, and higher failure rate in complicated

appendicitis cases^[2,4,5,8]. Therefore, there is no consensus in the literature about whether LA should be chosen as a routine procedure for all acute appendicitis cases or only for selected cases such as young women, obese patients, and professional workers^[3,7,9].

MATERIALS AND METHODS

Our hypothesis is that for treatment of AA, whether complicated or not, in all adult patients, LA is superior to mini-incision open appendectomy (MOA) in terms of safety and effectivity. The longer operation time and higher intra-abdominal abscess rate in LA will improve in advanced laparoscopic surgical centres with increased laparoscopic experience. Therefore, we compared the shorter and longer outcomes of LA and MOA in patients with AA.

Patients

From January 2011 to June 2013, the data of patients who underwent MOA and LA were recorded at the general surgery department of Safa Hospital. Patients with completed follow-up were included in the study. Pregnant women and patients with previous lower abdominal surgery were excluded. The patients were randomized into MOA and LA groups a computer-generated number. Patients with surgery converted from LA to MOA were excluded. Patients were divided into two groups: LA and MOA done by the same surgeon. All patients gave their informed consent. Patients' demographic data, procedure time, histopathologic reports, the need for analgesics, postoperative visual analog scale (VAS) score at 1, 6, 12 and 24 h, the hospital stay period, the period of time to return to daily activity, morbidity, and mortality were recorded. The diagnosis of AA was made by the surgeon with physical examination, laboratory values, and radiological tests (abdominal ultrasound or computed tomography). All operations were performed with general anaesthesia.

Methods

LA was performed based on the three trocars technique: a 10 mm port was placed at the umbilical area for the scope; a 5 mm port was placed in the left lower quadrant; a 5 mm port was inserted in the suprapubic area. The mesoappendix was transected with ultrasonic energy, and the appendix was tied at the radix. Appendectomy was completed by endo scissors and was removed from the abdomen through a 10 mm port in the umbilical area in an endo-loop (EndoLoop, Vicryl Coated Ligature, Ethicon UK Ltd., Edinburgh, United Kingdom). The appendix stump was not embedded. A drain tube was placed in the rectovesical area when considered necessary.

MOA was performed as a standard treatment. A 3 cm Mc Burney incision was made to enter the peritoneum. Appendectomy was completed followed

Table 1 Patients' characteristics and operative data *n* (%)

	LA (<i>n</i> = 122)	MOA (<i>n</i> = 121)	<i>P</i> value
Age (yr) ¹ (median, range)	25.9 ± 9.6 (26.91-99)	28.8 ± 11.1 (29.81-97)	0.249
Gender (F/M)	56/66	50/70	0.389 ²
ASA score	108/16/3	106/11/4	0.449
BMI ³ (kg/m ²)	24.1 ± 2.9	24.6 ± 3.1	0.998
Operative time (min)	51.0 ± 13.9	50.9 ± 19.9	0.844
Surgeon	122	121	
Appendix			
Normal	8 (6.5)	18 (14.8)	0.009
Gangrenous	14 (11.4)	11 (9.0)	0.149
Phlegmonous	93 (76.2)	86 (71.0)	0.079
Perforated	7 (5.7)	6 (4.9)	0.073

¹Students' *t* test; ² χ^2 test; ³mean ± SD. BMI: Body mass index; ASA: American Society of Anaesthesiology; MOA: Mini-incision open appendectomy; LA: Laparoscopic appendectomy.

by tying off of the mesoappendix and radix of the appendix. The appendix stump was embedded. A drain tube was placed in the rectovesical area when considered necessary. All appendectomy specimens were sent for histopathological examination. All patients received intravenous 3rd generation cephalosporin as a prophylactic antibiotic (Seftriakson - Novosef, 1000 mg iv, Zentiva, İstanbul, Türkiye). Patients with complicated AA received both 3rd generation cephalosporin and metronidazole (Biteral, 500 mg iv, Deva, İstanbul, Turkey) as prophylactic antibiotics. All patients received a dose of analgesic medication (diclofenac sodium, 75 mg im, Deva, İstanbul, Turkey) prior to intubation in the operating room. In the postoperative period, patients received analgesic medication based on the need for pain medication. The postoperative VAS score was recorded at postoperative hours 1, 6, 12, and 24. Patients were discharged when they tolerated normal food and passed gas and were followed up every week for three weeks as outpatients. Sutures were removed one week after surgery. Follow-ups for complications occurred in postoperative weeks two and three. Patients with complications were admitted to the hospital.

Statistical analysis

Results for categorical variables are given as frequencies and proportions (%), and results for continuous variables are given as mean ± SDs. Results for categorical variables were compared by χ^2 tests; results for continuous, normally distributed variables were compared by student *t*-tests; and results for non-normally distributed continuous variables were compared using a Mann Whitney *U* test. Variables were considered statistically significant if the *P*-value ≤ 0.05 was in the 95%CI. Statistical analyses used SPSS for SPSS 16.0 software (SPSS Inc., Chicago, Illinois, United States).

RESULTS

The study's 243 patients were randomly divided into

two groups, either MOA (*n* = 121) or LA (*n* = 122). Five patients who had undergone conversion from LA to OA were excluded from the study. As shown in Table 1, there were no statistical differences in demographics between the two groups. The data of the operations are shown in Table 1. The mean operating time was similar in both groups. Between the two groups, diagnoses of gangrenous, inflamed, and perforated appendicitis histopathologically were normally distributed. However, the rate of false appendicitis was statistically lower in the LA group (*P* = 0.009). The early postoperative VAS was statistically lower in LA, whereas the differences were similar at the postoperative 24 h mark (*P* = 0.056, Table 2). The need for analgesics in the LA group was lower in the postoperative period (*P* = 0.001). The length of hospital stay was lower in LA, but the difference was not statistically significant (*P* = 0.071, Table 2). The rate of total complications was similar between the two groups (6.5% in LA vs 7.4% in OA, *P* = 0.599). All wound infections were treated non-surgically. Six out of seven patients with pelvic abscess were successfully treated with percutaneous drainage; one patient required surgical drainage after a failed percutaneous drainage (Table 2). There were no other complications such as bowel obstruction or incisional hernia. The follow-up period was similar in both groups (14.7 mo for OA and 15.6 mo for LA, *P* = 0.449). No mortality was reported in the follow-up period.

DISCUSSION

As a minimally invasive technique, controversy regarding the superiority of LA over OA has existed for several years^[1,9,10]. Because there are no differences in surgical outcomes between the two groups, OA is considered the better option due to lower cost^[3]. However, lower postoperative pain, diagnostic accuracy, especially in women and the elderly, shorter periods of healing, and better cosmetic results have been considered advantages of LA over OA^[2,4,9]. There were different protocols in previous studies, which resulted in various outcomes reported in the literature^[3]. The longer operating time required for LA is a factor in comparing the two groups, and it extends farther in laparoscopic procedures done by inexperienced surgeons^[1,4,9]. A previous study reported that operating time is shorter if the procedure is performed by an experienced surgeon due to better exposure^[11]. Because our surgical team has laparoscopic procedure experience, we have concluded that the operating times for LA and MOA are similar. In our institution, ultrasonic energy is used for transecting the mesoappendix. But it is not actually mandatory, electro-cautery and other devices can be preferred^[12-14]. Moreover, the similar operating time should be considered a positive factor for LA. The hospital stay period is directly dependent on a patient's general condition^[4], and a shorter hospital stay in LA has been shown in previous studies; this outcome was proven by meta-analysis studies^[3,6,7,9].

Table 2 Result of mini-incision open appendectomy vs laparoscopic appendectomy *n* (%)

	LA (<i>n</i> = 122)	OA (<i>n</i> = 121)	<i>P</i> value
Hospital stay (h) ³	25.61 ± 23.72	28.92 ± 21.93	0.071 ⁴
Return to daily activities (d)	4 (2-12)	5 (3-15)	
Overall morbidity	8 (6.5)	9 (7.4)	0.599 ²
Mortality	0	0	-
VAS score ³			
1 st hour	7.1 ± 0.5	7.6 ± 0.7	0.001 ¹
6 th hour	3.9 ± 1.1	4.5 ± 1.2	0.001 ¹
12 th hour	2.6 ± 1.3	3.1 ± 1.4	0.027 ¹
24 th hour	2.4 ± 0.7	2.9 ± 0.9	0.056 ¹
Number of analgesics			
1	33 (27.0)	18 (14.8)	
2	46 (37.7)	42 (34.7)	
3	25 (20.4)	27 (22.3)	0.00 ⁴
4	17 (13.9)	33 (27.2)	
Postoperative complications			
Pelvic abscess	4	3	
Wound infection	1	5	
Atelectasis	1	-	

¹Student's *t* test; ² χ^2 test; ³mean ± SD; ⁴Mann-Whitney test. LA: Laparoscopic appendectomy; OA: Open appendectomy.

The 48 h discharge policy recommended for both OA and LA by previous studies has caused confusion due to different policies of individual hospitals^[3,9]. Many studies list hospital stay periods by the number of days vs hours because they may be affected by social standards, insurance systems, and hospital discharge policies^[3,4,9,15]. In this study, we used hours to define hospital stay periods to reflect differences between the two groups. The hospital stay period was shorter by three hours in LA; it is unclear if this is clinically significant. A meta-analysis done by Cochrane Colorectal Cancer Group revealed that returning to daily activities in a shorter amount of time is considered as an advantage for LA^[3,9,16]. Minimal trauma to the abdominal wall is considered the main reason for faster healing and lower pain for LA^[3,11,17-28]. Early mobilisation after LA is another advantage, and this is achieved by minimal manipulation of the cecum and ileum during the procedure^[3]. While the recovery period was shorter in LA, it was not considered significant.

Postoperative pain on day one was evaluated by the need for analgesics and VAS^[3]. Evaluating pain was difficult due to the use of different analgesics, administration of those analgesics in different forms, and different cultures' perceptions of pain. Therefore, to obtain a better result in regard to pain evaluation, we used two methods. Many previous studies have shown lower needs for analgesics and VAS^[3,9]. In this study, postoperative pain was measured by VAS, and the need for analgesics was statistically lower in the LA group. All of these results supported LA as the preferred option for AA. The presence and degree of postoperative complications are generally considered as safety indicators for a procedure. The most common complications of AAs are wound infections, intra-abdominal abscess, and ileus^[9]. It has been shown that postoperative complications are lower in LA vs OA^[3,4,7,9]. Lower complications in LA, as shown in this study, are

due to the lower incidence of wound infections. There is considerable controversy regarding the occurrence of intra-abdominal abscess after appendectomy, which is a serious and life threatening complication^[9]. Some studies in the literature have shown that the rate of intra-abdominal abscess is higher in OA^[1-3,5,15,16]. Moreover, some studies have favoured LA in terms of these complications. The laparoscopic technique has some advantages such as the removal of intra-abdominal infected fluid with suction. However, it can spread infected fluid into the peritoneum, especially in perforated appendicitis and when using more irrigation. Additionally, carbon dioxide insufflation can spread bacterial contamination into the peritoneum^[3,9,13]. It is believed that using advanced surgical techniques and gaining more laparoscopic experience may decrease the intra-abdominal abscess rate in LA^[3]. Overall, the lower rate of wound infection is an advantage for LA because the infected appendix can be removed from a small incision in an endobag^[3,4,9]. The economical analysis of these two techniques is another issue that must be addressed. Although there are many studies about the cost analysis between LA and OA^[29,30], we did not make an actual consideration, which needs to be addressed in further studies. In this study, pregnancy group was excluded, because we believe in that MOA vs LA in the pregnant should be evaluated in a separate study^[31].

In conclusion, LA has a similar hospital stay, operating time, and rate of postoperative complications as MOA, yet decreases the need for analgesics and VAS. Therefore, LA should be the suggested treatment for AA. MOA is still a viable alternative for selected patients.

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COMMENTS

Background

Laparoscopic appendectomy is still not accepted as a standard management for acute appendicitis due to longer operation time and higher cost. In the literature, there are few studies on surgical treatment comparing laparoscopic and mini-incision open appendectomy.

Research frontiers

Hospital stay, operation time, postoperative complication rates are important for the management of acute appendicitis. It is important for the patient's comfort to understand the best technique with regard to mini-incision open and laparoscopic techniques.

Innovations and breakthroughs

Acute appendicitis is mostly-encountered disease in a daily routine. Researches regarding decreasing morbidity and mortality are still needed, although it is very well known. There were no differences in the period of hospital stay, operation time, and postoperative complication rate between the two groups. Laparoscopic appendectomy decreases the need for analgesic medications and the visual analog scale of pain. Therefore, the author suggests that laparoscopic appendectomy should be accepted as a standard treatment for acute appendicitis. Mini-incision appendectomy is an alternative for a select group of patients.

Applications

The author suggests that laparoscopic appendectomy should be accepted as a standard treatment for acute appendicitis. Mini-incision appendectomy is an alternative for a select group of patients.

Peer-review

The author describes the differences between two techniques about the acute appendicitis. This is an interesting issue.

REFERENCES

- Tzovaras G**, Baloyiannis I, Kouritas V, Symeonidis D, Spyridakis M, Poultsidi A, Tepetes K, Zacharoulis D. Laparoscopic versus open appendectomy in men: a prospective randomized trial. *Surg Endosc* 2010; **24**: 2987-2992 [PMID: 20552369 DOI: 10.1007/s00464-010-1160-5]
- Shaikh AR**, Sangrasi AK, Shaikh GA. Clinical outcomes of laparoscopic versus open appendectomy. *JLS* 2009; **13**: 574-580 [PMID: 20202400 DOI: 10.4293/108680809X1258998404524]
- Oravsky M**, Bak V, Schnorrer M. Laparoscopic versus open appendectomy in treatment of acute appendicitis. *Bratisl Lek Listy* 2014; **115**: 660-662 [PMID: 25573735]
- Özsan İ**, Karabuğa T, Yoldaş Ö, Alpdoğan Ö, Aydın Ü. Laparoscopic Appendectomy versus Mini-Incision Appendectomy in Patients with Lower Body Mass Index and Noncomplicated Appendicitis. *Gastroenterol Res Pract* 2014; **2014**: 138648 [PMID: 25580110 DOI: 10.1155/2014/138648]
- Ward NT**, Ramamoorthy SL, Chang DC, Parsons JK. Laparoscopic appendectomy is safer than open appendectomy in an elderly population. *JLS* 2014; **18**: e2014.00322 [PMID: 25392668 DOI: 10.4293/JLS.2014.00322]
- Cipe G**, Idiz O, Hasbahceci M, Bozkurt S, Kadioglu H, Coskun H, Karatepe O, Muslumanoglu M. Laparoscopic versus open appendectomy: where are we now? *Chirurgia (Bucur)* 2014; **109**: 518-522 [PMID: 25149616]
- Sakpal SV**, Bindra SS, Chamberlain RS. Laparoscopic appendectomy conversion rates two decades later: an analysis of surgeon and patient-specific factors resulting in open conversion. *J Surg Res* 2012; **176**: 42-49 [PMID: 21962732 DOI: 10.1016/j.jss.2011.07.019]
- Fahrner R**, Schöb O. Laparoscopic appendectomy as a teaching procedure: experiences with 1,197 patients in a community hospital. *Surg Today* 2012; **42**: 1165-1169 [PMID: 22426772 DOI: 10.1007/s00595-012-0163-3]
- Gurrado A**, Faillace G, Bottero L, Frola C, Stefanini P, Piccinini G, Longoni M. Laparoscopic appendectomies: experience of a surgical unit. *Minim Invasive Ther Allied Technol* 2009; **18**: 242-247 [PMID: 20334502 DOI: 10.1080/13645700903053840]
- McGrath B**, Buckius MT, Grim R, Bell T, Ahuja V. Economics of appendicitis: cost trend analysis of laparoscopic versus open appendectomy from 1998 to 2008. *J Surg Res* 2011; **171**: e161-e168 [PMID: 21962815 DOI: 10.1016/j.jss.2011.06.067]
- Lim SG**, Ahn EJ, Kim SY, Chung IY, Park JM, Park SH, Choi KW. A Clinical Comparison of Laparoscopic versus Open Appendectomy for Complicated Appendicitis. *J Korean Soc Coloproctol* 2011; **27**: 293-297 [PMID: 22259744 DOI: 10.3393/jksc.2011.27.6.293]
- Caglià P**, Tracia A, Spataro D, Borzi L, Lucifora B, Tracia L, Amodeo C. Appendix stump closure with endoloop in laparoscopic appendectomy. *Ann Ital Chir* 2014; **85**: 606-609 [PMID: 25712546]
- Yeh CC**, Jan CI, Yang HR, Huang PH, Jeng LB, Su WP, Chen HC. Comparison and efficacy of LigaSure and rubber band ligation in closing the inflamed cecal stump in a rat model of acute appendicitis. *Biomed Res Int* 2015; **2015**: 260312 [PMID: 25699264 DOI: 10.1155/2015/260312]
- Shaikh FM**, Bajwa R, McDonnell CO. Management of appendiceal stump in laparoscopic appendectomy-clips or ligation: a systematic review and meta-analysis. *J Laparoendosc Adv Surg Tech* 2015; **25**: 21-27 [PMID: 25548964 DOI: 10.1089/lap.2014.0470]
- Pokala N**, Sadhasivam S, Kiran RP, Parithivel V. Complicated appendicitis--is the laparoscopic approach appropriate? A comparative study with the open approach: outcome in a community hospital setting. *Am Surg* 2007; **73**: 737-741; discussion 741-742 [PMID: 17879676]
- Masoomi H**, Nguyen NT, Dolich MO, Wikholm L, Naderi N, Mills S, Stamos MJ. Comparison of laparoscopic versus open appendectomy for acute nonperforated and perforated appendicitis in the obese population. *Am J Surg* 2011; **202**: 733-738; discussion 738-739 [PMID: 21992808 DOI: 10.1016/j.amjsurg.2011.06.034]
- Swank HA**, Eshuis EJ, van Berge Henegouwen MI, Bemelman WA. Short- and long-term results of open versus laparoscopic appendectomy. *World J Surg* 2011; **35**: 1221-1226; discussion 1227-1228 [PMID: 21472367 DOI: 10.1007/s00268-011-1088-5]
- Li X**, Zhang J, Sang L, Zhang W, Chu Z, Li X, Liu Y. Laparoscopic versus conventional appendectomy--a meta-analysis of randomized controlled trials. *BMC Gastroenterol* 2010; **10**: 129 [PMID: 21047410 DOI: 10.1186/1471-230X-10-129]
- Sauerland S**, Jaschinski T, Neugebauer EA. Laparoscopic versus open surgery for suspected appendicitis. *Cochrane Database Syst Rev* 2010; **(10)**: CD001546 [PMID: 20927725 DOI: 10.1002/14651858]
- Wei B**, Qi CL, Chen TF, Zheng ZH, Huang JL, Hu BG, Wei HB. Laparoscopic versus open appendectomy for acute appendicitis: a metaanalysis. *Surg Endosc* 2011; **25**: 1199-1208 [PMID: 20848140 DOI: 10.1007/s00464-010-1344-z]
- Yau KK**, Siu WT, Tang CN, Yang GP, Li MK. Laparoscopic versus open appendectomy for complicated appendicitis. *J Am Coll Surg* 2007; **205**: 60-65 [PMID: 17617333]
- Khalil J**, Muqim R, Rafique M, Khan M. Laparoscopic versus open appendectomy: a comparison of primary outcome measures. *Saudi J Gastroenterol* 2011; **17**: 236-240 [PMID: 21727728 DOI: 10.4103/1319-3767.82574]
- Thomson JE**, Kruger D, Jann-Kruger C, Kiss A, Omshoro-Jones JA, Luvhengo T, Brand M. Laparoscopic versus open surgery for complicated appendicitis: a randomized controlled trial to prove safety. *Surg Endosc* 2015; **29**: 2027-2032 [PMID: 25318368]
- Concha JA**, Cartes-Velásquez R, Delgado CM. Single-incision laparoscopic appendectomy versus conventional laparoscopy in adults. A systematic review. *Acta Cir Bras* 2014; **29**: 826-831 [PMID: 25517497 DOI: 10.1590/S0102-86502014001900010]
- Werkgartner G**, Cerwenka H, El Shabrawi A, Bacher H, Hauser H, Mischinger HJ, Wagner M, Wagner D. Laparoscopic versus open appendectomy for complicated appendicitis in high risk patients. *Int J Colorectal Dis* 2015; **30**: 397-401 [PMID: 25510816 DOI: 10.1007/s00383-015-0600-0]

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10.1007/s00384-014-2095-4]

- 26 **Sohn M**, Hoffmann M, Hochrein A, Buhr HJ, Lehmann KS. Laparoscopic Appendectomy Is Safe: Influence of Appendectomy Technique on Surgical-site Infections and Intra-abdominal Abscesses. *Surg Laparosc Endosc Percutan Tech* 2015; **25**: e90-e94 [PMID: 25462984]
- 27 **Masoomi H**, Mills S, Dolich MO, Ketana N, Carmichael JC, Nguyen NT, Stamos MJ. Comparison of outcomes of laparoscopic versus open appendectomy in children: data from the Nationwide Inpatient Sample (NIS), 2006-2008. *World J Surg* 2012; **36**: 573-578 [PMID: 22270985 DOI: 10.1007/s00268-011-1417-8]
- 28 **Ingraham AM**, Cohen ME, Bilimoria KY, Pritts TA, Ko CY, Esposito TJ. Comparison of outcomes after laparoscopic versus open appendectomy for acute appendicitis at 222 ACS NSQIP hospitals. *Surgery* 2010; **148**: 625-635; discussion 635-637 [PMID: 20797745 DOI: 10.1016/j.surg.2010.07.025]
- 29 **Casarotto A**, Zarantonello FR, Rebonato M. Appendectomy in women. Is the laparoscopic approach always better than the “open” approach in uncomplicated appendicitis? *Surg Laparosc Endosc Percutan Tech* 2014; **24**: 406-409 [PMID: 24910936 DOI: 10.1097/SLE.0000000000000063]
- 30 **Lee HJ**, Park YH, Kim JI, Choi PW, Park JH, Heo TG, Lee MS, Kim CN, Chang SH. Comparison of clinical outcomes and hospital cost between open appendectomy and laparoscopic appendectomy. *J Korean Surg Soc* 2011; **81**: 321-325 [PMID: 22148124 DOI: 10.4174/jkss.2011.81.5]
- 31 **de Moya MA**, Sideris AC, Choy G, Chang Y, Landman WB, Cropano CM, Cohn SM. Appendectomy and pregnancy: gestational age does not affect the position of the incision. *Am Surg* 2015; **81**: 282-288 [PMID: 25760205]

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