UDK :61

ISSN 1857-5587

PHYSIOACTA

Journal of Macedonian Association of Physiologists and Anthropologists

Vol 12 No 3
2018

Physioacta

Journal of Macedonian Association of Physiologists and Anthropologists

Publisher

Medical faculty, Ss Cyril and Methodius University Skopje, R. Macedonia

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A SAFE LAPAROSCOPIC APPENDECTOMY IN RELATION TO PREOPERATIVE PARAMETERS: OUR EXPERIENCE

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ABSTRACT

The safety of laparoscopic appendectomy (LA) is in a close relation to the emergence of complications, intraoperative difficulties and the need for conversion. With preoperative determination of conditions related to the intraoperative difficulties, complications and the need for conversion, a strategy can be performed to improve the safety of the LA. The goal of this paper is to present the correlation between certain preoperative parameters and the possible endangerment of the safety of performing LA. This is a prospective clinical study including 63 participants who were subjected to LA, because of acute appendicitis. The cases were registered in the Clinical Hospital of Shtip and in the Clinic for Digestive Surgery in Skopje, in the period from 22.02.2016 until 16.01.2018. Strict and precisely determined inclusive and exclusive criteria were used. Preoperatively, certain clinical, laboratory, ultrasonography and computed-tomography parameters were determined. In all cases, LA was performed and the intraoperative difficulties, complications, early postoperative complications as well as the reasons for conversion were determined. The participants were divided in a group without complications and a group with difficulties, complications or conversion, and then, a descriptive and analytic comparison between the two groups was done. For a safe LA, one should pay a close attention to the presence of comorbidities, long-standing symptomatology, the high values of CRP, the total bilirubin in the blood, as well as to the possibility of complicated appendicitis.

Keywords: laparoscopic appendectomy, preoperative parameters, safety

АПСТРАКТ

Безбедноста на лапароскопската апендектомија (ЛА) е тесно поврзана со појавата на компликации, интраоперативни потешкотии и потребата од конверзија. Со предоперативно утврдување на состојбите кои носат ризик од појава на потешкотии,

компликации и потреба од конверзија може да се направи стратегија за подобрување на безбедноста на ЛА. Целта на овој труд е да се претстави поврзаноста на одредени предоперативните параметри и нарушување на безбедноста на ЛА.Ова е проспективна, клиничка студија со 63 учесници кај кои е изведена ЛА поради акутен апендицитис, оперирани во ЈЗУ Клиничка Болница-Штип и во ЈЗУ УК за Дигестивна Хирургија-Скопје, во периодот од 22.02.2016г. до 16.01.2018г. Користени се точно утврдени инклузивни и екслузивни критериуми. Предоперативно се констатирани соодветни параметри од клиничкиот, лабораторискиот, ехотомографскиот и КТ наодот. Кај сите е направена ЛА, при што се констатирани интраоперативните потешкотии и компликации, раните постоперативни компликации како и причините за конверзија. Учесниците се поделени во група без компликации и група со потешкотии, компликации или конверзија, а направена е и дескриптивна и аналитичка споредба помеѓу групите. За изведување на безбедна ЛА меѓудругото треба да се сврти особено внимание на присуството на коморбидитети, долготрајна симптоматологија и високи вредност на С – реактивниот протеин и тоталниот билирубин во крвта, како и на можноста на постоење на комплициран апендицитис.

Клучни зборови: лапароскопска апендектомија, предоперативни параметри, безбедност

INTRODUCTION

Some of the basic principles for a safe laparoscopic procedure are a well-trained surgical and anesthesiology team and an impeccable laparoscopic equipment. If those conditions are fulfilled, the safety of laparoscopic appendectomy (LA) is in a close relation to the emergence of complications, intraoperative difficulties and the need for conversion to an open approach. The term “safe” is related to the LA that is performed with affordable rate of intraoperative difficulties, complications and conversion to open appendectomy (OA). The question is whether it is possible by reviewing of some laboratory, ultrasonography and radiology parameters preoperatively to predict the emergence of intraoperative difficulties, complications and the need for conversion during LA. With the decision not to approach laparoscopically or by taking certain precautions in those cases one can improve the safety of the LA [1,2]. Complications occurring during the surgery can be divided into perioperative and postoperative. Postoperative complications may occur early - in the first 30 postoperative days and late – after the first 30 postoperative days. In abdominal surgery the complications can be divided in abdominal and extra-abdominal. The complications occurring during laparoscopic surgery are divided usually in the following groups: complications from the pneumoperitoneum, complications from the access, complications from the surgical procedure, and postoperative complications. Complications from the pneumoperitoneum include: disorders from decreased venous return to the hearth, disturbed pulmonary function, hypercapnia with pulmonary acidosis, various kinds of emboli, pneumothorax, pneumomediastinum, etc. Complications from accessing with the Veress needle and the trocars are: injury of the small bowel, injury of the iliac vessels, hemorrhage from the

access point, injury to the urinary bladder, and so on. Complications from the surgical procedure during LA include injuries to any hollow or solid organ and vascular injuries. The abdominal postoperative complications usually occurring are: postoperative ileus, intestinal perforation, postoperative hemoperitoneum, intraabdominal abscess, perforation of the urinary bladder, ureteral injury, surgical site infection (SSI), operative wound dehiscence, enterocutaneous fistula, etc. The extra-abdominal complications during LA include pulmonary atelectasis, pleural effusion, arrhythmia, postoperative heart insufficiency, myocardial infarction, phlebothrombosis and thrombophlebitis, pulmonary thromboembolism, postoperative cerebrovascular insult, postoperative delirium and so on. A safe LA is distinguished by absence of any of the numbered complications [3,4].

A conversion is not a surgical complication by itself, but rather a mature decision by the surgeon. In the presence of profound perioperative difficulties a decision is made by the surgeon to continue with an open approach in order to avoid various intraoperative complications. Most of the studies report a conversion rate of about 10% that is in a close relation to the training of the surgeon and his ability of objective reasoning. The reasons for conversion are usually divided into reasons related to the local finding and reasons of technical nature. The former include extensive inflammation on and around the appendix, necrosis of the base of the appendix, extensive adhesions, periappendiculare abscess or diffuse peritonitis, appendiceal tumor, etc. The latter group includes an inability to identify the appendix, inability to fully remove the appendix, excessive hemorrhage, a bowel injury, an inability to sustain the pneumoperitoneum, hypotension from the Trendelenburg position, etc. The conversion increases the operative cost, extends the operative time and raises the probability for complications. If we can identify the cases of LA that will end up with conversion, preoperatively and take certain measures, we can improve the safety of the LA procedure [5, 6].

The worldwide scholarly literature does not fully define which conditions should be acknowledged as intraoperative difficulties during the LA procedure. Those difficulties can be defined as conditions related to the complex perioperative findings, commonly related to the advanced stages of AA or anatomical variations. The intraoperative difficulties which extend the operative time could lead to various complications and could be a reason to convert to an open approach. They can emerge in any phase of the operative procedure. Specifically, the difficulties occur during accessing the trocars, during visualization and mobilization of the appendix, during controlling the appendicular artery, during closing of the appendiceal base and during extracting the removed appendix from the abdominal cavity. The correlation with the complications or conversion includes intraoperative difficulties in conditions that could jeopardize the safety of the LA. Intraoperative difficulties could be more significant in the facilities where laparoscopic surgery is not routinely implemented. By overcoming the “learning curve” and appropriate training, these conditions may lose their significance. The preoperative recognition of the cases predisposed for intraoperative difficulties could improve the safety of LA [7, 8 , 9, 10]

THE AIM OF THE STUDY

The aim of this study is to measure descriptively and analytically the correlation between certain preoperative parameters (mostly clinical or laboratory) and the level of endangered safety of LA recognized by emergence of intraoperative difficulties, complications or conversion.

MATHERIALS AND METHODS

This is a prospective clinical study including 63 participants who were subjected to LA because of suffering from acute appendicitis. The cases were registered in the Clinical Hospital of Shtip and in the Clinic for Digestive Surgery in Skopje, in the period from 22.02.2016 until 16.01.2018. The data were collected by using existing standardized questionnaires adjusted to the local conditions and context. Our questionnaire consists of the following parts: a) preoperative evaluation upon admission, b) LA, c) evaluation of the patient condition on the 7-th postoperative day, and d) evaluation of the patient condition on the 30-th postoperative day. The inclusive selection criteria include age - between 15-60 years, suspicion for AA that demands observation in hospital or emergency operation, regardless of gender, religion, education level, place of residence, socio-economic status and other demographic characteristics. The participants were willing to take part in the survey and an informed consent was signed by the participant/guardian. The exclusive criteria were: a) age outside of the 15-60-year range, b) contraindications for laparoscopic procedure, c) diffuse peritonitis, d) signs for periappendiculare abscess or infiltration, e) previous laparotomies, f) pregnancy and g) unwillingness for participation. Even though the pregnancy is included in the exclusive criteria, it is worth mentioning that according to the latest recommendations the pregnancy is not a contraindication for LA in any trimester.

The diagnosis was confirmed by using the following laparoscopic grading system of AA: 0) normal looking appendix, 1) redness and edema, 2) fibrin, 3A) segmental necrosis, 3B) base necrosis, 4A) abscess, 4B) regional peritonitis and 5) diffuse peritonitis. Using this classification the grades 1 and 2 are considered as *uncomplicated appendicitis* cases and the rest are considered as *complicated appendicitis* cases (CA) [11].

For all the patients the following general information was collected: admission date, operation date, gender, year of birth, place of permanent residence, nationality, height, weight, BMI, heart rate, body temperature and blood pressure. From the clinical symptoms we recorded a presence or absence of the following symptoms: nausea, vomiting, loss of appetite, right lower quadrant (RLQ) pain, pain migration and duration of symptomatology. In some patients certain comorbidities were noted. In all of the patients presence or absence of the following clinical signs was noted: RLQ tenderness, rebound tenderness in the RLQ divided into light, medium and strong, guarding in the RLQ and Rovsing – sign. From the laboratory parameters information was gathered about the blood level of: glucose, albumins, total proteins, creatinine, urea, aspartate transaminase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), lactate dehydrogenase (LDH), gamma-glutamyl transferase (GGT), total bilirubin, potassium, sodium

and C-reactive protein (CRP). From the total blood count, in all the patients, information was gathered about the leucocytes, erythrocytes and thrombocytes count, levels of hemoglobin, hematocrit, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC), as well as the percentage of neutrophils, lymphocytes and monocytes. In all of the participants the values of Alvarado, Appendicitis inflammatory response (AIR) and Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) scoring systems were calculated.

Ultrasonographic examination of the abdomen and of the ileocecal region of 50 patients was conducted and the findings were classified into the following grades: 1) normal appendix, 2) the appendix that was not seen, but no inflammatory changes or free fluids were evident, 3) the appendix that was not seen, but secondary signs of appendicitis were present, such as a fecolith, pericecal fluid, or increased pericecal echogenicity consistent with infiltration of the mesenteric fat, 4) identification of an appendix of borderline enlarged size (5–6 mm), and 5) acute appendicitis, defined as an enlarged noncompressible appendix with an outer diameter, which was greater than 6 mm. In this classification, grades 1 and 2 are negative and grades 3, 4 and 5 are positive findings for AA [12].

In 21 participants, noncontrast CT scan was conducted preoperatively. Dilated appendix of more than 6 mm in diameter on CT was considered as a primary CT sign for AA and secondary signs were: periappendicular infiltration, thickening of the caecal wall, presence of an appendicolith, periappendicular phlegmon or abscess and periappendicular or ileocecal lymphadenopathy. According to this classification, if the primary sign is absent, simultaneous presence of at least two secondary signs is a positive finding for AA [13].

Examination by Gynecologist was conducted preoperatively in all the female participants.

In all the cases, laparoscopic examination of the abdominal cavity was performed, as well as LA in the cases with AA. If the appendix was not diseased, it was not removed and the patient was excluded from the study.

After the LA, the presence or absence of intraoperative difficulties and complications was noted, as well as the reason for conversion to an open approach if present. Moreover, the duration of the operation measured in minutes from the first incision of the skin until the last skin suture was recorded.

For all participants, the duration of the hospital stay and the presence or absence of early postoperative complication on the 7^{th} and on the 30^{th} postoperative day were documented.

The participants were divided into two groups: a group without complications and a group with intraoperative difficulties, complications or conversion to an open approach. All statistical analysis was performed by using SPSS 20.0. The numerical (quantitative) series were analyzed by using the measures for central tendention (average and median), as well as the measures for

dispersion (standard deviation). Chi square test for two samples was used to compare certain marks between the two groups of participants as well as for determining the association between the certain marks. For testing the significance of the difference between the two groups depending from the distribution of the data, parametric Student's t-test or nonparametric Mann Whitney U test was used. A p value of ≤ 0.05 was considered statistically significant.

The participation in the study is anonymous with guarantied secrecy of the acquired information. A signed document for informed consent was provided from all the participants or their guardians respectively.

RESULTS

The group without complications consisted of 42 participants from which 21 (50%) are female and 21(50%) are males, with an average age of 29.8 years ± 11.82. The group with difficulties, complications or conversion consisted of 21 participants with 7 (33.3%) females and 14 (66.7%) males with an average age of 34.4 years ± 15.5. All the other results are shown in table 1.

Table 1 Total results

In regard to the analyzed parameters for $p \leq 0.05$, there is significant difference between the two groups in correlation with the average values of the total bilirubin (Mann-Whitney U Test: Z=2.035; p=0.042), sodium (Mann-Whitney U Test: Z=2.316; p=0.021) and CRP (Mann-Whitney U Test: Z=3.142; p=0.002) as significantly higher values in the study group. For $p \leq 0.05$, there is significant correlation between the presence of cases with complicated appendicitis and the group of participants (Pearson Chi-square: 14.032, df=1, p=0.0001). The cases with complicated appendicitis are significantly more frequently represented in the study group.

In 10 cases (47.6%) intraoperative difficulties occurred during the mobilization of the appendix, in 3 cases (14.3%) difficulties occurred during the extractions of the removed appendix, in 1 case (4.8%) there was a difficult management the appendicular artery with significant intraoperative bleeding, in 1 case (4.8%) there was significant bleeding from the supraumbilical incision, in 1 case (4.8%) there was appendicular tear with spilling of pus and coprolite, intra-abdominally, in 1 case (4.8%) there was a damage to the nearby structures and in 4 cases (19%) no intraoperative complications or difficulties occurred. In 6 cases (28.6%), conversion to an open approach was performed, in four of which, the reason being an inability to mobilize the appendix, because of its bad position. In two cases the mobilization of the appendix was impossible because of significant adhesions and in one case a conversion was performed because of intraoperative finding of diffuse peritonitis. In 5 cases (23.8%) complications were registered on the 7-th postoperative day, three of those five cases were with seroma of the operative wound, 1 case was with significant postoperative intra-abdominal bleeding from the port side and 1 with oliguria with hematuria and significant excretion on the intra-abdominal

drain. On the 30th postoperative day, only in 1 patient (4.8%) a complication was noted in form of infections at the level of the supra-umbilical incision.

DISCUSION

Recent recommendations of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) and the European Association of Endoscopic Surgery (EAES) emphasize that there should not be any limitations to the utilization of LA and the indications for LA and OA should be identical [14,15]. On the other hand, data show limited application of LA even in countries with developed healthcare systems besides all the advantages of LA over the OA, such as a better cosmetic effect, lower postoperative pain, shorter duration of the hospital stay, quicker return to the normal professional and everyday activities and lower overall cost [16,17]. The difficulties are especially present at the start of the LA implementation in the institutions where Mac Burney's laparotomy is firmly embedded as the standard procedure. Exactly in those conditions, choosing LA for well-selected cases, which will result in low rate of complications and conversions to an open approach, will have a big role in the affirmation of the advantages that LA has over OA. The question is: Which are the cases that will allow a safe utilization of LA? We know from our surgical practice, mainly from using laparoscopic cholecystectomy that if we want a safe surgery, we should chose a relatively young and healthy patient, not obese, preferably female. Most of the data from the recent scholarly literature has shown that gender and age are not related to the safety of the LA procedure. Regarding the age of the patients, recent studies have shown a lower rate of postoperative complications with older individuals operated laparoscopically instead of using OA. Popa et al. in a review study, among other findings, concluded that older individuals above 65 might have a special benefit from utilizing the laparoscopic approach with a lower complication rate, a lower mortality rate, lower cost and shorter duration of hospitalization [18]. Regarding the BMI of the patients, recent recommendations suggest that LA has a great advantage in the patients with high body weight over OA, and it is the procedure of choice. Dasari et al., in a review study from 2014, compared the outcome of LA vs. OA in overweight patients regarding the mortality, morbidity, duration of the operation and the duration of hospitalization. They concluded that the LA is a safe alternative opposite OA in patients with BMI>30kg/m² [19]. Carraci et al., in their methaanalisis, concluded that LA is related to lower SSI and other postoperative complications, shorter operative time and shorter duration of hospitalization in patients with BMI>30kg/m² [20]. The presence of comorbidities could jeopardize the safety of the LA procedure. Antonacci et al. discussed the five factors that are statistically significant as predictors for conversion during the LA and they are: the presence of comorbidities, perforation of the appendix, periappendiculare abscess and diffuse peritonitis [21]. In our study, none of the previously mentioned parameters have shown statistically significant difference between the two groups. We can conclude that gender, age and BMI should not be related to the safety of the laparoscopic appendectomy. One can say the same for the presence of comorbidities, but it is wise to be cautious with such patients.

The duration of symptomatology is one of the parameters which is often mentioned in the literature in regard to the emergence of complications and conversion during LA. Chung et al. concluded that late presentations of the patients with symptomatology of more than 3 days as well as perforation of the appendix are two parameters that are closely related to conversion and complications emergence in pediatric patients treated with LA [22]. Gupta et al. presented preoperative duration of symptomatology of above 48h among other factors as significantly related to emergence of conversion [23]. In our study, the p value for this parameter is 0.062, which is very close to statistical significance. We can say that the duration of symptomatology is a parameter that should be taken into consideration when we chose a suitable patient for a safe LA.

The laboratory parameters point to registered statistical significance for the blood level of total bilirubin, sodium and CRP in a form of significantly higher values in the study group. Abe et al. concluded that beside CT inflammation grade 4 and 5, complicated appendicitis and diffuse peritonitis, the CRP level is a significant factor for conversion to OA during LA [24]. Shalton et al. concluded that CRP>150g/l is a statistically significant variable for emergence of complications during LA and raised the question whether open appendectomy should be preferred as the better choice of treatment in those cases [25]. There are a number of studies that point to the correlation between the high level of total bilirubin and the high grades of appendicitis, especially perforated appendicitis which on the other hand is closely related to emergence of complications and conversion during LA. Estrada et al. were among the first who noted that hyperbilirubinemia is frequently associated with appendicitis and that elevated bilirubin levels have a predictive potential for the diagnosis of appendicular perforation [26]. Sand et al. concluded that patients with hyperbilirubinemia and clinical symptoms of appendicitis should be identified as having a higher probability of appendiceal perforation than those with normal bilirubin levels [27]. In a systemic review from 2013, Burchart et al. concluded that apart from the essential clinical finding, CRP and WBC levels, as well as the CT finding elevated serum bilirubin can be used as a supplemental diagnostic tool in perforated appendicitis [28]. As far as high levels of sodium are considered, we could not find any studies that connect this parameter to the conditions related to the safety of LA, which certainly opens an area for further investigation.

One condition that is most often in relation to emergence of complications and conversion to OA in the literature is certainly the presence of CA. The p-value for this parameter in our study is 0.0001 at the expense of grater representations of CA in the study group. Beside the fact that modern literature is abundant with studies that favor the usage of LA in cases with CA, this condition must be understood as a basic risk factor for jeopardizing the safety of LA. Recognition of the CA preoperatively might be useful in bringing the correct decision for the right approach for appendectomy. Siewert et al. concluded that CT signs for CA are connected with an increased risk for conversion to OA [29]. Xu et al. concluded that the loss of the sub-mucosal layer of the appendix on the ultrasonography finding is the unique sign connected to CA with a very high

specificity and sensitivity [30]. Atema et al. developed a contemporary scoring system by using clinical and imaging parameters which recruit the cases of uncomplicated appendicitis with 95% accuracy [31].

CONCLUSION

Apart from a suitable training of the team of surgeons and anesthesiologists and a technically flawless laparoscopic equipment, the safe application of the LA procedure requires a detailed and contemporary approach to the patient with a clinical sign for AA, which incorporates the usage of certain laboratory parameters, scoring systems and imaging examinations.

In avoiding the intraoperative difficulties, complications and the possibility of conversion to an open approach we are suggesting that surgeons should be extremely careful, take certain precautionary measures and possibly make a decision to approach openly in patients with comorbidities, long-standing symptomatology, and high values of CRP and total bilirubin.

If there is a clinical sign of advanced grade of appendicitis preoperatively, it is wise to use the advantages of ultrasonography and CT, not only for establishing the diagnosis, but also for deciding of the appendicitis grade. Ultrasonography or CT examinations must be an integral part of the algorithm of preoperative examinations when a decision is reached for laparoscopic treatment of AA in order to provide a safe LA.

REFERENCES

[1] Noah JS, Richdeep SG, Shahzeer K. The Evolution of the Appendectomy: From Open to Laparoscopic to Single Incision. Scientifica, vol. 2012, Article ID 895469, 5 pages, 2012.

[2] Mán E, Németh T, Géczi T, Simonka Z, Lázárcorresponding G. Learning curve after rapid introduction of laparoscopic appendectomy: are there any risks in surgical resident participation?. World J Emerg Surg. 2016; 11: 17.

[3] Perugini RA, Callery MP. Complications of laparoscopic surgery. In Holzheimer RG, Mannick JA (editors) Surgical Treatment: Evidence-Based and Problem-Oriented. Munich: Zuckschwerdt; 2001.

[4] Drăghici L, Drăghici I, Ungureanu A, Copăescu C, Popescu M, Dragomirescu C. Laparoscopic surgery complications: postoperative peritonitis. J Med Life. 2012 Sep 15;5(3):288-96.

[5] Liu SI, Siewert B, Raptopoulos V, Hodin RA. Factors associated with conversion to laparotomy in patients undergoing laparoscopic appendectomy. J Am Coll Surg. 2002;194(3):298-305.

[6] Tomoyuki A, Takashi N, Mitsuhiro M, Miho O, Tatsuro F, Kiyoshi K. Risk factors of converting to laparotomy in laparoscopic appendectomy for acute appendicitis. Clin Exp Gastroenterol. 2013; 6: 109–114.

[7] Sahu SK, Agrawal A, Sachan PK. Intraoperative difficulties in laparoscopic cholecystectomy. Jurnalul de Chirurgie (Iaşi), 2013:9(2):149-155.

[8] Nachani J, Supe A. Pre operative prediction of difficult laparoscopic cholecystectomy using clinical and ultrasonographic parameters. Indian J Gastroenterol. 2005: 24:16-18.

[9] Palanivelu C. Difficult Laparoscopic Cholecystectomy. In: Parthasarathi R editor. Art of Laparoscopic Surgery. Textbook and Atlas. 1st ed. India: Jaya Publications; 2005. p. 607-6

[10] Goel A, Bansal A, Baliyan A. Preoperative predictive factors for difficult laparoscopic appendectomy. Int Surg J. 2017 Oct;4(10):3488-3491.

[11] Gomes CA, Nunes TA, Fonseca Chebli JM, Junior CS, Gomes CC. Laparoscopy grading system of acute appendicitis: new insight for future trials. Surg Laparosc Endosc Percutan Tech. 2012;22(5):463-6.

[12] Preeyacha P, Jun Y, Leann EL, Alan SB, Diane SB. Sonography in the Evaluation of Acute Appendicitis. Are Negative Sonographic Findings Good Enough?. J Ultrasound Med. 2010;29:1749–1755.

[13] in't Hof KH, van Lankeren W, Krestin GP, et al. Surgical validation of unenhanced helical computed tomography in acute appendicitis. Br J Surg. 2004;91(12):1641-5.

[14] SAGES. Guidelines for Laparoscopic Appendectomy. Printed Oct 1992, revised Apr 2009.

[15] Vettoretto N, Gobbi S, Corradi A, et al. Consensus conference on laparoscopic appendectomy: Development of guidelines. Colorectal Disease, 2011; 13(7): 748–754.

[16] Wei B, Qi CL, Chen TF, et al. Laparoscopic versus open appendectomy for acute appendicitis: a metaanalysis. Surg Endosc. 2011;25(4):1199–1208.

[17] Li X, Zhang J, Sang L, et al. Laparoscopic versus conventional appendectomy-a meta-analysis of randomized controlled trials. BMC Gastroenterol. 2010 Nov 3;10: 129.

[18] Popa D, Soltes M, Uranues S, Fingerhut A. Are There Specific Indications for Laparoscopic Appendectomy? A Review and Critical Appraisal of the Literature. J Laparoendosc Adv Surg Tech A. 2015 Nov;25(11):897-902.

[19] Dasari BV, Baker J, Markar S, Gardiner K. Laparoscopic appendicectomy in obese is associated with improvements in clinical outcome: systematic review. Int J Surg. 2015 Jan;13:250-6.

[20] Ciarrocchi A, Amicucci G. Laparoscopic versus open appendectomy in obese patients: A meta-analysis of prospective and retrospective studies. J Minim Access Surg. 2014 Jan;10(1):4-9.

[21] Antonacci N, Ricci C, Taffurelli G, et al. Laparoscopic appendectomy: Which factors are predictors of conversion? A high-volume prospective cohort study. Int J Surg. 2015 Sep;21:103-7.

[22] Ho-Yu Chung P, Chan KL, Kwong-Hang Tam P .Risk factors for morbidities in laparoscopic appendectomy for acute appendicitis of paediatric patients. Surgical Practice. 2009 Aug;13:69-72.

[23] Gupta N, Machado-Aranda D, Bennett K, Mittal VK. Identification of Preoperative Risk Factors Associated With the Conversion of Laparoscopic to Open Appendectomies. Int Surg. 2013 Oct-Dec; 98(4): 334–339.

[24] Abe T, Nagaie T, Miyazaki M, et al. Risk factors of converting tolaparotomy in laparoscopic appendectomy for acute appendicitis. Clin Exp Gastroenterol. 2013; 6: 109–114.

[25] Shelton JA, Brown JJ, Young JA. Preoperative C-reactive protein predicts the severity and likelihood of complications following appendicectomy" Ann R Coll Surg Engl. 2014 Jul;96(5):369-72.

[26] Estrada JJ, Petrosyan M, Barnhart J, et al. Hyperbilirubinemia in appendicitis: a new predictor of perforation. J Gastrointest Surg. 2007 Jun;11(6):714-8.

[27] Sand M, Bechara FG, Holland-Letz T, Sand D, Mehnert G, Mann B. Diagnostic value of hyperbilirubinemia as a predictive factor for appendiceal perforation in acute appendicitis. Am J Surg. 2009 Aug;198(2):193-8.

[28] Burcharth J, Pommergaard HC, Rosenberg J, Gögenur I. Hyperbilirubinemia as a predictor for appendiceal perforation: a systematic review. Scand J Surg. 2013;102(2):55-60..

[29] Siewert B, Raptopoulos V, Liu SI, Hodin RA, Davis RB, Rosen MP. CT predictors of failed laparoscopic appendectomy. Radiology. 2003 Nov;229(2):415-20.

[30] Xu Y, Jeffrey RB, Chang ST, DiMaio MA, Olcott EW. Sonographic Differentiation of Complicated From Uncomplicated Appendicitis: Implications for Antibiotics-First Therapy. J Ultrasound Med. 2017 Feb;36(2):269-277.

[31] Atema JJ, van Rossem CC, Leeuwenburgh MM, Stoker J, Boermeester MA. Scoring system to distinguish uncomplicated from complicated acute appendicitis. Br J Surg. 2015 Jul;102(8):979-90.

Table 1. Total results

Parameters	study**	control***	p
participants (n)	21 (33,3%)	42 (66,7%)	
Male : Female n. (%)	14 (66,7%):7 (33,3%)	21(50%):21(50%)	Pearson Chi-square: 1,576, df=1, p=0,219
Age (years.)	34,4 ± 15,5	29,8 ± 11,82	Mann-Whitney U Test: Z=0,998; p=0,318
BMI (kg/m²)	26,2 ± 4,4	25,1 ± 4,2	T-test=1,019; df=61; p=0,312
Heart rate (beats/mun)	88,5 ± 12,2	88,2 ± 11,7	Mann-Whitney U Test: Z=0,182; p=0,855
Body temperature (°C)	37,2 ± 0,9	37,1 ± 0,6	T-test=0,543; df=61; p=0,589
Systolic b. pressure (mmHg)	124,3 ± 14,3	120,8 ± 13,3	Mann-Whitney U Test: Z=1,494; p=0,135
Diastolic b. pressure (mmHg)	76 ± 10,8	75,1 ± 8,4	Mann-Whitney U Test: Z=0,241; p=0,811
Rlevant clinical symptoms			
Nausea n. (%)	13 (61,9%)	37 (88,1%)	/
Vomiting n. (%)	10 (47,6%)	23 (54,8%)	/
Loss of appetite n. (%)	17 (80,9%)	32 (76,2%)	/
Pain in RLQ n. (%)	21 (100%)	40 (95,2%)	/
Pain migration n. (%)	20 (95,2%)	35 (83,3%)	/
Duration of symptomatology (h)	38,5 ± 16,3	31,6 ± 21,7	Mann-Whitney U Test: Z=1,866; p=0,062
Comorbidities n. (%)	7 (33,3%)	8 (19%)	Pearson Chi-square: 1,575, df=1, p=0,209
Relevant clinical signs			
RLQ tenderness n. (%)	21 (100%)	42 (100%)	/
Rebound RLQ tenderness n. (%)	20 (95,5%)	38 (90,5%)	/
Guarding n. (%)	17 (80,9%)	37 (88,1%)	/
Positive Rovsing sign n. (%)	13 (61,9%)	32 (76,2%)	/
Glycaemia (mmol/l)	6,1 ± 0,9	5,6 ± 0,9	T-test=1,427; df=60; p=0,159
Albuminemia (g/dl)	46,6 ± 2,7	44,7 ± 5,2	Mann-Whitney U Test: Z=1,279; p=0,201
Proteinemia (g/l)	72 ± 6,2	68,3 ± 13,5	Mann-Whitney U Test: Z=0,869; p=0,384
Creatinine (µmol/l)	70,6 ± 9,2	69,4 ± 11,3	T-test=0,428; df=60; p=0,670
Urea (mg/dl)	4,4 ± 1,6	4,1 ± 1,8	Mann-Whitney U Test: Z=0,937; p=0,349
AST (u/l)	17,8 ± 3,8	18,6 ± 8,5	Mann-Whitney U Test: Z=0,766; p=0,444
ALT (u/l)	18,8 ± 8,1	21,9 ± 14,4	Mann-Whitney U Test: Z=-0,082; p=0,934
ALP (u/l)	61,4 ± 29,8	62,7 ± 22,9	Mann-Whitney U Test: Z=-0,744; p=0,457
LDH (u/l)	175,4 ± 42,9	164,6 ± 39,7	Mann-Whitney U Test: Z=1,077; p=0,281
GGT (u/l)	35,1 ± 25,3	28,7 ± 18,2	Mann-Whitney U Test: Z=0,633; p=0,526
Biliribinemia (mmol/l)	22,2 ± 9,9	17,7 ± 9,8	Mann-Whitney U Test: Z=2,035; p=0,042*
Potassium (mEq/L)	4,1 ± 0,3	3,9 ± 0,4	T-test=1,171; df=55; p=0,246
Sodium (mEq/L)	138,4 ± 3,1	133 ± 20,9	Mann-Whitney U Test: Z=2,316; p=0,021*
CRP (g/l)	101,1 ± 87	46,9 ± 61,4	Mann-Whitney U Test: Z=3,142; p=0,002*
Leukocytes ($\times 10^9$/l)	15,3 ± 3,8	15,2 ± 5,1	Mann-Whitney U Test: Z=0,321; p=0,748
Erythrocytes ($\times 10^{12}$/l)	4,7 ± 0,3	4,8 ± 0,6	Mann-Whitney U Test: Z=-1,072; p=0,284
Hemoglobin (g/l)	141 ± 13,7	141,7 ± 17,3	T-test=-0,143; df=61; p=0,887
Hematocrit (%)	41,7 ± 4,4	41,3 ± 4,9	T-test=0,325; df=61; p=0,746
Thrombocytes ($\times 10^9$/l)	227,9 ± 58,5	247,1 ± 70,2	Mann-Whitney U Test: Z=-1,115; p=0,264
Neutrophils (%)	85,8 ± 5,3	83,5 ± 10,1	Mann-Whitney U Test: Z=0,561; p=0,574
Lymphocytes (%)	9,1 ± 4,5	11,6 ± 8,8	Mann-Whitney U Test: Z=-0,751; p=0,453
Monocytes (%)	4,9 ± 2,9	4,5 ± 2,7	Mann-Whitney U Test: Z=0,402; p=0,688
Scoring systems			
ALVARADO (point)	8,6 ± 1,1	8,6 ±1,5	Mann-Whitney U Test: Z=-0,311; p=0,726
AIR (point)	8,2 ± 1,5	7,6 ± 2,1	Mann-Whitney U Test: Z=0,948; p=0,343
RIPASA (point)	12,5 ± 1,7	12,6 ± 2,4	Mann-Whitney U Test: Z=-0,656; p=0,512
Ultrasonography finding n. (%)	15 (71,4%)	35 (83,3%)	/
Sensitivity of ultrasonography (%)	80	49	/
Plain CT finding n. (%)	8 (38,1%)	13 (30,9%)	/
Sensitivity of plain CT (%)	100	85	/
Appendicitis grade n (grade)	3(2°), 13 (3A°), 3(4Б°), 1(5°), 1(3Б°)	4(1°), 23(2°), 14(3A°), 1(4Б°)	/ /
Complicated appendicitis n.. (%)	18 (85,7%)	15 (35.7%)	Pearson Chi-square: 14,032, df=1, p=0,0001*
Duration of the operation (min.)	77,1 ± 25	60,8 ± 13,8	/
Duration of the hospital stay (days)	4,9 ± 1,4	3,2 ± 0,9	/

*significant for p<0,05 ** group with difficulties, complications or conversion *** group without complications