

ANALYSIS OF RISK FACTORS THAT INDICATE CONVERSION OF LAPAROSCOPIC CHOLECYSTECTOMY TO OPEN SURGERY

Slobodan Arandjelović^{1,2}, Ljiljana Jeremić³, Milan Radojković^{3,4},
Darko Bogdanović³, Marko Gmijović³, Ilija Golubović³, Vladan Đorđević⁵

Laparoscopic cholecystectomy (LC) has become the "gold standard" in the surgical treatment of gallbladder disease. However, in some cases LC needs conversion to open cholecystectomy (OC). Preoperative assessment that should determine in which patient conversion should be performed as well as identification of the risk factors for conversion are relatively difficult and imprecise.

The aim of this study was to identify the risk factors for conversion of LC to OC.

We performed the retrospective analysis of 65 patients, of both genders, with gallbladder disease, operated in the period from 01/01/2007 to 06/ 2013, in whom conversion of LC to OC was performed. A total of 1292 laparoscopic cholecystectomies (LCs) was done in this period. The authors analyzed: total conversion rate; the conversion rate according to patient characteristics (age, gender, body mass index (BMI)); local pathological condition (acute cholecystitis, chronic complicated cholecystitis, simple calculosis or gallbladder polyposis); surgeon-related parameters (number of performed LCs and total surgical experience).

Total conversion rate (conversion of LC to OC) was 5,03%. Higher conversion rate was registered in the female patients (53.84%), but there were no statistically significant differences. The highest conversion rate was registered in the groups of patients in the 6th and 7th decade ($p < 0.05$). Conversion rate was higher in patients with BMI > 30 (6.56%), compared with those with lower BMI, but there was no statistical significance. Patients operated for acute cholecystitis had statistically significantly higher conversion rate (26.95 %), compared with those with the diagnosis of chronic simple cholecystitis (1.16 %), complicated chronic cholecystitis (8.46%), benign gallbladder polyposis (3.5%), ($p < 0.05$). Surgeons with a lower number of performed LCs (25-50) had higher conversion rate (12.67%), compared with experienced surgeons that performed over 200 LCs (1.4%) ($p < 0.05$).

Conversions are statistically significantly more present in older patients during surgery, in patients with the diagnosis of acute or complex chronic cholecystitis, and in those operated by inexperienced surgeons. Gender, high BMI, anatomical anomalies and variations, previous laparotomy or technical problems were not statistically significant conversion factors. *Acta Medica Medianae* 2016;55(3):13-20.

Key words: laparoscopy, cholecystectomy, conversion

Surgical Clinic CBC Priština, Gračanica, Serbia¹
Faculty of Medicine in Priština, Kosovska Mitrovica, Serbia²
Clinic for General Surgery, Clinical Center Niš³
University of Niš, Faculty of Medicine, Niš, Serbia⁴
General Hospital Pirot, Pirot, Serbia⁵

Contact: Slobodan Arandjelović
Faculty of Medicine in Priština
Kosovska Mitrovica, Serbia
E mail: slobodan.arandjelovic@med.pr.ac.rs

Introduction

Cholecystectomy is the most common operation in digestive surgery, implicated by the

fact that about 3 million cholecystectomies are done that in the world annually. In the US, about 700,000 cholecystectomies per year are performed, of which 90% with the laparoscopic technique (1-3). In Serbia, according to incomplete statistics, the number of cholecystectomies performed annually is around 13,000 (4).

Laparoscopic cholecystectomy (LC), as a minimally invasive surgical technique, has been accepted both by the patient and the surgeon. LC was officially declared a "gold standard" in the treatment of biliary calculi at a conference of the American Association for Endoscopic Surgery (SAGES) in Bethesda, in 1995 (4, 5). Although laparoscopic cholecystectomy has replaced open cholecystectomy (OC) for the treatment of diseases of gallbladder, some cases still require conversion to the open procedure. That percentage ran-

ges from 2% to 6% in the elective operation, while the percentage of conversion due to acute inflammation of the gallbladder is far greater, ranging up to 20% (6).

Preoperative assessment that should determine in which patient conversion should be performed as well as identification of the risk factors for conversion are relatively difficult and imprecise.

The most common factors responsible for the conversion of laparoscopic to open cholecystectomy are the age of patients, morbid obesity, complex pathomorphological substrate, insufficient experience of the surgeon and institution where the surgery performed (1, 2). Anatomic variations, previous operations in the abdomen and technical problems with equipment are less common conversion factors for the conversion of LC to OC (4-6).

Aim

The aim of this study was to identify the risk factors for the conversion of laparoscopic to open cholecystectomy procedure.

Materials and methods

We performed a retrospective analysis of 65 patients, of both genders, with symptomatic cholelithiasis, operated during the period from 01/ 01/ 2007 to 01/ 06/ 2013 at the Surgical Clinic in Niš, with conversion of LC to OC.

From January 2007 to June 2013, 1.292 laparoscopic cholecystectomies were performed. The process of conversion of laparoscopic cholecystectomy to the open one was performed in 65 (5.03%) patients.

Patients with a history of jaundice, dilatation of the common bile duct over 8 mm on ultrasound examination, verified choledocholithiasis and suspected malignant tumor of the gallbladder were excluded from the study.

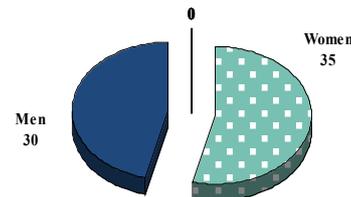
The following parameters were retrospectively analyzed:

- The frequency of conversion during open and laparoscopic cholecystectomy;
- Characteristics of patients with conversion:
 - Patient demographics (gender, age, body mass index (BMI));
 - Characteristics of pathological substratum:
 - acute cholecystitis, chronic cholecystitis with adhesion, simplex calculus or polyps in the gallbladder;
- The parameters related to the surgeon:
 - Experience of surgeons (age, year of specialists training, duration of laparoscopic cholecystectomy), training of surgeons, continuity in the work - the number of operations per week, experience of assistant, availability and performance of additional diagnostic and therapeutic procedures).

Results

The process of conversion of LC to OC was performed in 65 patients (5.03%).

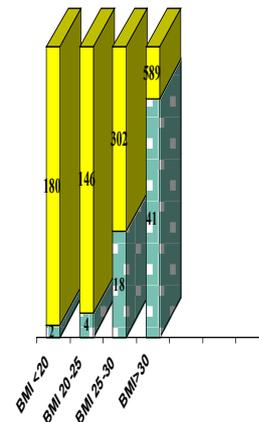
The analysis of demographic characteristics of examined patients showed a higher frequency of conversions in females (53.84%). Considering that in the total number of treated patients the number of female patients was significantly higher (61.91% compared to 37.9% men), this percentage has no statistical significance ($p > 0.05$) (Graph 1).



Graph 1. The percentage of conversion according to gender

The average age of patients with conversion was 32.6 years. The highest percentage of patients with the conversion was presented in the sixth and seventh decade of life (25.8%).

The percentage of conversion was higher in the group of patients with a BMI > 30 (6.56%), where conversion is done in 41/630 patients, compared with group of patients with a BMI 25-30 (5.62%), BMI 20-25% (2.6%) and BMI below 20 (1.09%), but without statistical significance ($p > 0.05$) (Graph 2).



Graph 2. The number of conversions in relation to BMI

The distribution of patients in relation to pathomorphological substrate showed that the most common indication for operation was the existence of chronic calculus cholecystitis (1120 patients or 86.6%). Of these, 860 patients were operated due

to the so-called simplex cholecystitis, while 260 patients were operated due to complex cholecystitis with expressed inflammatory process or pericholecystitic adhesions. The number of patients operated due to acute cholecystitis (115 patients), compared with the total number of patients was 8.90%. Fifty-seven patients were operated because of the presence of benign polyps in the gallbladder (4.41%) (Table 1).

The percentage of conversion of the patients treated due to acute cholecystitis is 26.95% (31 patients). This percentage is higher than the percentage of patients with conversion that operated because of chronic simplex cholecystitis (1.16%), where the conversion carried out in 10 of 860 pa-

tients, or in groups of patients with complex chronic cholecystitis 8.46% (22/260 patients) or due to benign tumors of the gallbladder (3.5% or 2/57 patients) ($p < 0.05$) (Table 1).

The existence of an anatomical anomaly and variations of d. cysticus was registered only in 4 cases (0.3% of the total number of operated patients), and in 6.15% of the operated patients anatomical anomalies caused conversion. In two cases, joining of sectoral branches the main bile duct at a lower level was verified (0.15%) (Figure 1a), and one case of joining d. cysticus the main bile duct on the left side (0.075%) (Figure 1b) as well as low joining of d.cysticus, with a parallel course with the main bile duct (0.075%)(Figure 1c)

Table 1. Distribution by type of cholecystitis with the number of conversions

| Pathological substrate | Number | % | Number of Conversions | % Conversion |
|-----------------------------------|--------|-------|-----------------------|--------------|
| Simple chronic cholecystitis | 860 | 66.56 | 10 | 1.16 |
| Complex chronic cholecystitis | 260 | 20,12 | 22 | 8.46 |
| Acute cholecystitis | 115 | 8.90 | 31 | 26.95 |
| Benign tumors of the gall bladder | 57 | 4.41 | 2 | 3.5 |
| Total | 1292 | 100 | 65 | 5.03 |

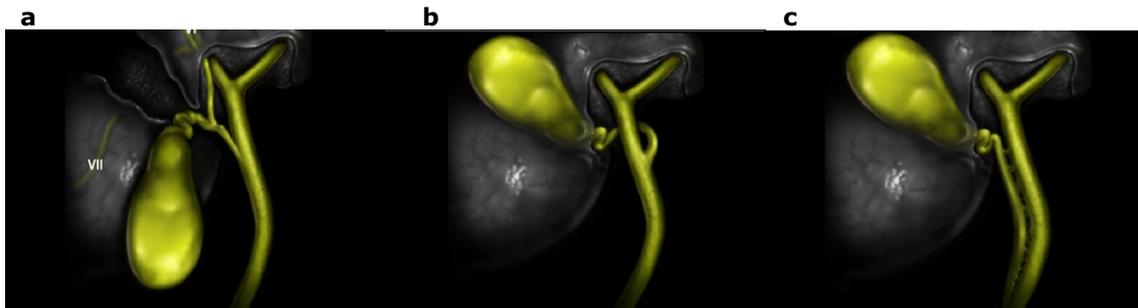


Figure 1. Variations of d. cysticus that caused conversion

Table 2. The percentage of conversion compared to the experience of the surgeon

| Experience of surgeons | Number of LCs* | Number of Conversions | % Conversion |
|------------------------|----------------|-----------------------|--------------|
| 25-50 LCs | 142 | 18 | 12.67 |
| 50-100 LCs | 180 | 15 | 8.33 |
| 100-200 LCs | 200 | 21 | 10.50 |
| > 200LCs | 770 | 11 | 1.4 |
| Total | 1292 | 65 | 5.03 |

*Abbreviation: Laparoscopic cholecystectomy – LC.T

respectively.

In relation to the experience of surgeons in LC, the highest percentage of conversion (12.67%) was registered in the group of surgeons with the lowest number of LC (25-50), compared with the group of surgeons with the experience of 50-100 LCs (8.33%) or 100-200 LCs (10.50%). The lowest percentage of conversions, as expected, was registered in the group of surgeons with the experience of over 200 LCs (1.4%) (Table 2).

Discussion

Disease of the biliary tract is as old as mankind. The first findings date back to 2000 BC when the Babylonians accurately described the gallbladder, biliary ducts and cystic duct (4, 5). At the end of the eighteenth century, in 1733, surgery for the removal of stones from the gallbladder was performed for first time (5, 6). In 1882, Karl Langenbuch performed the first chole-

cystectomy and laid down the principle that applies today: gallbladder should not be removed because it contains a calculus but because they are formed, and the only proper method of treating gall bladder calculus is cholecystectomy (5, 6). Mucha from Bobligena was the first to perform laparoscopic cholecystectomy in 1985, but Phillip Mouret from Lyon became known in the history of surgery as he described this procedure in his publication in 1987 (5).

Cholecystectomy is today the most common operation in digestive surgery. About 3 million cholecystectomies are done worldwide per year, in the US approximately 700,000 cholecystectomies annually, of which 90% using the laparoscopic technique (1-3). In Serbia, according to incomplete statistics, the number of performed cholecystectomies is around 13,000 (4).

The percentage of minor and severe complications during and after cholecystectomy ranges from 0.5 to 6% (6-9). Intraoperative complications may arise in all phases of operations: during the performance of laparotomy or creating pneumoperitoneum and insertion of a trocar into the abdominal cavity; complications that occur when approaching the gallbladder and during the detachment of the gallbladder; complications during the gall bladder removal from the abdominal cavity. The most common postoperative complications are: pain, bleeding, lesions of the biliary tract with the appearance of postoperative bile (biliary fistula or peritonitis) or benign biliary stricture; infectious complications, pancreatitis, residual choledocholithiasis, retained foreign bodies in the abdomen cavity (5-12).

The most serious complication of cholecystectomy is a lesion of the bile ducts. The importance of iatrogenic biliary tract lesions lies in the following: they are not rare; they can be avoided (in most cases); they often occur in young people working to full capacity; they significantly increase the morbidity and mortality of the biliary surgery; treatment of these lesions, especially if they are not recognized during surgery and resolved "in the first act", is complicated and with questionable results (4-6).

The exact incidence of these lesions is not absolutely determined, because of the steady growth in biliary surgery and the introduction of new techniques (laparoscopy). The number of lesions of the biliary tract in open cholecystectomy ranges from 1:300 to 1:1000. Roslin noted the incidence of lesions of bile ducts in the US of 0.2% (2), while Uragami and Matsumoto in Japan recorded the incidence of 0.35% (3).

Due to specific vision of the operating field during the performance of LC, a different tactile sensation during surgery, limited manipulation of instruments which over their working surfaces exert great physical force, lesions of the bile ducts are 2-3 times more common, and range from 1:100 to 1:200 000 (5). Surgical misconceptions during LC are the most common causes of lesions of bile ducts and emerge as a consequence of the

lack of tactile sense, active touch, haptic perception, lack of the third dimension and the impossibility of perceiving operating fields from multiple angles (1-6, 13).

Conversion of laparoscopic to open cholecystectomy

The percentage of the conversion of LC to OC is variable and ranges from 1.6% to over 20% (1-6, 14, 15). Most conversions are performed due to technical difficulties or occurrence of intraoperative complications. Inability of anatomical orientation causes the conversion in up to 50% of cases, bleeding is the cause in 15%, lesions of bile ducts in 10%, shedding a large number of stones in about 5%, perforation of the colon in 5%, and concomitant pathologic finding in up to 15% of cases. Surgeon experience and the development of technical tools have made that most of intraoperative complications can be solved using the direct laparoscopic technique without the need for conversion (14).

The decision for conversion of LC to OC should ensue after a detailed inspection and minimal dissection, before the onset of complications. Of paramount importance for the surgeon and the patient is that a decision for the conversion should not be disposed of, which confirms surgical catchword that "timely conversion is not an expression of weakness, but wisdom of surgeon" (4, 6).

Preoperative identification of factors that are responsible for the conversion may have great practical significance in selection of patients for laparoscopic or open cholecystectomy.

Scoring Systems

Kama and al. (2001) showed, based on multivariate analysis, that male gender, painful sensitivity of the abdomen, previous abdominal surgery, thickened wall of the gallbladder, age over 60 and previous attacks of acute cholecystitis are the strong predictor factors for conversion, on which they have developed scores for the assessment of the probability of conversion of LC to OC. If there are less than 3 of these factors, the risk of conversion is 1.6%, while in the group of patients with more than 3 present factors, the risk is much higher and amounts to 11.4% (14).

Previous operations

Previous operations in the abdomen may be a risk factor for conversion (16). However, this group of risk factors was not registered in our material because of patients with previous laparotomy in supraumbilical part of the abdomen that were primarily operated by open technique, while patients with incision in the lower part of abdomen (16 patients) were operated by laparoscopy with the use of Hasson's technique, through the abdominal cavity using the semi-open method, without the need for conversion.

Age

LC in the elderly is associated with an increased percentage of conversions (17,18), probably due to the presence of other risk factors (previous attacks of acute cholecystitis, complex forms of chronic cholecystitis, greater possibility of previous operations in the abdomen), but not due to the chronological age (19).

In our material, the percentage of conversion in the group of patients older than 65 years was 9.6%, while in the group of patients younger than 65 that percentage was 4.7%, with large statistical significance ($p = 0.037$).

Pathological obesity

Morbid obesity was marked as a risk factor for the conversion of LC to OC in numerous studies. Angrisani and colleagues in 1995 found that morbid obesity prolongs the length of operation, but is not affected by higher degree of morbidity and mortality (20, 21).

Rosen and colleagues demonstrated that isolated morbid obesity by itself was not a risk for conversion, but demonstrated that obesity in combination with acute cholecystitis was a very strong predictor of conversion (22). The combination of acutely inflamed gallbladder and previous abdominal operations along with obesity multiply increases the risk of conversion to open cholecystectomy (23).

Likewise, patients with multiple coexisting diseases, which are planned for non-elective laparoscopic cholecystectomy, often require conversion. Finally, morbidly obese patients with chronic cholecystitis and fibrous wall of the gallbladder will also probably require conversion. These factors can help in advising patients undergoing laparoscopic cholecystectomy about the possibility of conversion to open procedure (14, 21-23).

In our material, significantly higher percentage of conversion was registered in the group of patients with BMI over 30, but without statistical significance.

Acute cholecystitis

Tissue edema, pericholecystic adhesions and inflammatory process cause difficulties in the identification of anatomical relationships, difficult dissection, and there is a probability of perforation of fragile and distended gallbladder. Therefore, in the initial stages of the laparoscopic surgery development, acute cholecystitis represented a contraindication for laparoscopic cholecystectomy. Although most studies (24-26) showed that the presence of acute cholecystitis was one of the most important conversion factors, some authors, such as Kaplan (2007) and Kum (2007), did not confirm that in their studies, explaining that as the primary selection of patients for open cholecystectomy. In the study of Kumet al.(19) the per-

centage of conversion was higher in the group of patients with acute cholecystitis (9.1%), compared with patients without acute cholecystitis (7.5%), but without statistical significance ($p > 0.05$).

In our material, statistically significantly ($p < 0.05$) higher percentage of conversion in the group of patients with acute cholecystitis (25.96%) and patients with complex chronic cholecystitis (8.46%) was noted, compared with other indications such as chronic simplex cholecystitis (1.16%) and polyyps of the gallbladder (3.5%).

Problems with laparoscopic equipment and instruments

In their study on 93 patients, Jaffary et al. (27) showed that a high percentage of conversions in poor societies might arise due to difficulties with the instruments and equipment (insufflators, cameras, light sources, clip applicators), which in any event may be prevented. In fact, in their study the percentage of conversions was 4.32 times higher when operations were performed with old instruments and equipment.

Kaplan reported 0.16% of conversions because of technical obstacles; Cuschieri and Liu noted that 1/1236 and 1/500 patients had conversion, respectively (19).

Technical problems, such as failure of instruments, inability of adequate vision, difficulty in the treatment of the wide d. cystic, shedding of a large number of calculi were overcome in our series during LC and they were not the reason for conversion to OC, in contrast to the other authors (28).

Experience of a surgeon and surgical institutions

One of the most important risk factor in surgery is certainly the experience of the surgeon and surgical institutions, both in whole surgical practice and a specific field of surgery. The NIH consensus in 1992 concluded that the outcome of LC depends directly on the education, experience, judgment and efficiency of the surgeon (29). Liu and colleagues showed that the rate of conversion of LC to OC dropped from 17% in the first 100 operations to about 4% when a surgeon already performed over 500 LC (30). The so-called "learning curve" that exists in all spheres of human activity is perhaps the most prominent in laparoscopic surgery and it explains the differences in the percentage of conversion by surgeon in relation to the number of LC.

In our study, the highest percentage of conversions (12.67%) was registered in the group of surgeons with the lowest number of LC (25-50) compared with the group with experience of 50-100 LC (8.33%) and 100-200 LC (10.50%). The lowest percentage of conversions, as expected, was registered in the group of surgeons with experience of over 200 LC (1.4%), with a strong statistical significance ($p = 0.0325$).

Many studies attempted to answer the question what is the number of independently performed operations sufficient to guarantee the safe operation in laparoscopic surgery (31, 32). It is very individual and dependent on many other factors. The optimum number of LC ranges from 20 to 100 operations, so that most associations hold the view that license for independent work should be issued after 100 assists and 30 operations under the supervision of an instructor. One of the important factors is the early start of education in laparoscopic surgery. Surgeons who familiar with this type of surgery from the first day of specialist training have a lower number of conversions and complications during LC compared with surgeons who are trained after specialization (33).

Fortunately, violent development and introduction of minimally invasive surgery in all surgical institutions in everyday practice in the last few decades has enabled continuous training of young surgeons in the field of LC, which resulted in greater confidence of the surgeons who started to deal with this delicate area of the surgery.

Conclusion

1. Conversion of LC to OC was registered at

5.03% of patient operated by laparoscopic technique.

2. Conversions are statistically more common during surgeries in elderly patients.

3. In our material a considerably higher percentage of conversions was also registered in the group of patients with BMI over 30, but without statistical significance.

4. The most important risk factor for the conversion was acute cholecystitis; conversion was often noted in the group of patients with complicated chronic cholecystitis, compared with the "uncomplicated" gallbladder.

5. The highest percentage of conversion was registered in the group of surgeons with the lowest number of LC, and the lowest percentage was registered in the group of surgeons with performed over 200 of LC.

6. The existence of anatomical anomalies and variation was an extremely rare conversion factor of LC to OC.

7. Previous operations in the abdomen were not presented as a risk factor for conversion due to careful selection of patients and methods of entry into the abdominal cavity.

8. Technical problems with equipment and instruments must not be a factor responsible for the conversion of LC to OC.

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ANALIZA FAKTORA RIZIKA ZA KONVERZIJU LAPAROSKOPSKE HOLECISTEKTOMIJE U OTVORENU OPERACIJU

Slobodan Arandjelović^{1,2}, Ljiljana Jeremić³, Milan Radojković^{3,4},
Darko Bogdanović³, Marko Gmijović³, Ilija Golubović³, Vladan Đorđević⁵

Hirurška klinika Kliničko-bolničkog centra Priština, Gračanica, Srbija¹
Medicinski fakultet Priština, Kosovska Mitrovica, Srbija²
Klinika za opštu hirurgiju, Klinički centar Niš³
Univerzitet u Nišu, Medicinski fakultet, Niš, Srbija⁴
Opšta bolnica Pirot, Pirot, Srbija⁵

Kontakt: Slobodan Arandjelović
Faculty of Medicine in Priština
Kosovska Mitrovica, Srbija
E mail: slobodan.arandjelovic@med.pr.ac.rs

Laparoskopska holecistektomija (LC) predstavlja "zlatni standard" u lečenju hirurških oboljenja žučne kese. Međutim, pojedini slučajevi još uvek zahtevaju konverziju u otvorenu proceduru (OC). Preoperativna procena o tome kod kojeg bolesnika će verovatno doći do konverzije i identifikacija faktora rizika za konverziju je relativno teška i neprecizna.

Cilj istraživanja bio je identifikovati faktore rizika koji mogu zahtevati konverziju laparoskopske u otvorenu proceduru holecistektomije.

Izvršena je retrospektivna analiza 65 bolesnika, oba pola, sa oboljenjem žučne kese, operisanih u periodu od 01. 01. 2007. do 01. 06. 2013. godine na Hirurškoj klinici KC Niš, kod kojih je izvedena konverzija LC u OC. U navedenom periodu izvedene su 1292 laparoskopske holecistektomije. Retrospektivno su analizirani sledeći parametri: učestalost konverzije u toku otvorene i laparoskopske holecistektomije; karakteristike bolesnika kod kojih je izvršena konverzija (demografske karakteristike (pol, starost, BMI); karakteristike patološkog supstrata (akutni holecistitis, hronični komplikovani holecistitis sa adhezijama, simpleks kalkuloza ili polipoza žučne kese); parametri koji se odnose na hirurga (broj izvedenih LC procedura i vremenski period od prvog izvođenja).

Postupak konverzije laparoskopske holecistektomije u otvorenu izveden je kod 5,03% bolesnika. Veća učestalost konverzija registrovana je kod operisanih osoba ženskog pola (53,84%) bez statističke značajnosti. Najveći procenat bolesnika sa konverzijom, je u VI i VII dekadi života (25,8%) ($p < 0,05$). Procenat konverzija je veći kod bolesnika sa BMI > 30 (6,56%), u odnosu na grupe sa BMI 25-30 (5,62%), BMI 20-25% (2,6%) i BMI ispod 20 (1,09%), ali bez statističke značajnosti. Procenat konverzija kod bolesnika operisanih zbog akutnog holecistitisa iznosi 26,95%, hroničnog simpleks holecistitisa 1,16%, kompleksnog hroničnog holecistitisa 8,46%, benignih tumora žučne kese (3,5%,) ($p < 0,05$). Najveći procenat konverzija (12,67%) registrovan je u grupi hirurga sa najmanjim brojem LC (25-50), u poređenju sa hirurzima sa iskustvom od preko 200 LC (1,4%) ($p < 0,05$).

Konverzije se dešavaju statistički značajno češće u toku operacija kod starijih bolesnika, kod bolesnika sa akutnim ili kompleksnim hroničnim holecistitisom i operisanih od strane nedovoljno iskusnih hirurga. Pol, visok BMI, postojanje anatomskih anomalija i varijacija, prethodne operacije trbuha i tehnički problemi nisu od većeg statističkog značaja kao faktori odgovorni za konverziju LC u OC. *Acta Medica Medianae* 2016;55(3):13-20.

Ključne reči: laparoskopija, holecistektomija, konverzija