

Laparoscopic Repair of Hiatal Hernias: Experience after 200 Consecutive Cases

Miloš Bjelović^{1,2}, Tamara Babić², Dragan Gunjić², Milan Veselinović², Bratislav Špica²

¹School of Medicine, University of Belgrade, Belgrade, Serbia;

²Department for Minimally Invasive Upper Digestive Surgery, Clinic for Digestive Surgery – First Surgical Clinic, Clinical Center of Serbia, Belgrade, Serbia

SUMMARY

Introduction Repair of hiatal hernias has been performed traditionally via open laparotomy or thoracotomy. Since first laparoscopic hiatal hernia repair in 1992, this method had a growing popularity and today it is the standard approach in experienced centers specialized for minimally invasive surgery.

Objective In the current study we present our experience after 200 consecutive laparoscopic hiatal hernia repairs.

Methods A retrospective cohort study included 200 patients who underwent elective laparoscopic hiatal hernia repair at the Department for Minimally Invasive Upper Digestive Surgery, Clinic for Digestive Surgery, Clinical Center of Serbia in Belgrade from April 2004 to December 2013.

Results Hiatal hernia types included 108 (54%) patients with type I, 30 (15%) with type III, 62 (31%) with giant paraesophageal hernia, while 27 (13.5%) patients presented with a chronic gastric volvulus. There were a total of 154 (77%) Nissen funduplications. In 26 (13%) cases Nissen procedure was combined with esophageal lengthening procedure (Collis-Nissen), and in 17 (8.5%) Toupet funduplications was performed. Primary retroesophageal crural repair was performed in 164 (82%) cases, Cleveland Clinic Foundation suture modification in 27 (13.5%), 4 (2%) patients underwent synthetic mesh hiatoplasty, 1 (0.5%) primary repair reinforced with pledgets, and 4 (2%) autologous fascia lata graft reinforcement. Poor result with anatomic and symptomatic recurrence (indication for revisional surgery) was detected in 5 patients (2.7%).

Conclusion Based on the result analysis, we found that laparoscopic hiatal hernia repair was a technically challenging but feasible technique, associated with good to excellent postoperative outcomes comparable to the best open surgery series.

Keywords: hiatus hernia; laparoscopic repair; Collis-Nissen gastroplasty; fascia lata

INTRODUCTION

Although the posttraumatic and congenital diaphragmatic hernias had been described in early 16th century, acquired hiatal hernia was not recognized as a potentially severe clinical entity until the mid-20th century [1]. Hiatal hernia refers to the herniation of abdominal cavity elements, most commonly the stomach, through the esophageal hiatus of the diaphragm into the mediastinum [2]. Up to 95% of all hiatal hernias represent type I (sliding or axial) hiatal hernias [2]. Less common types of hiatal hernias, type II, III and IV, represent a variety of paraesophageal hernias with the remaining 5% of all hiatal hernias [2]. A special entity of the type III represents a giant paraesophageal hernia (PEH) with at least one third of the stomach positioned intrathoracically [3]. Since the 1950s the repair of hiatal hernias has been performed traditionally via open laparotomy or thoracotomy [4]. The first laparoscopic hiatal hernia repair was done by Cuschieri [5] in 1992. Although Collis published esophageal lengthening procedure back in 1957, laparoscopic utilization was addressed to Hunter, who published specific technique in 2000 [6].

Laparoscopic repair of hiatal hernias had been routinely performed by the team of the

Department for Minimally Invasive Upper Digestive Surgery, Clinic for Digestive surgery, Clinical Center of Serbia since 2004. At our Department, innovative biologic hiatal reinforcement with autologous fascia lata graft, in the case of large hiatal defect, has been the standard procedure since April 2013.

OBJECTIVE

In the current study, we present the experience after 200 consecutive laparoscopic hiatal hernias repairs.

METHODS

A retrospective cohort study included 200 patients who underwent elective laparoscopic hiatal hernia repair at the Department for Minimally Invasive Upper Digestive Surgery, Clinic for Digestive Surgery, Clinical Center of Serbia in Belgrade from April 2004 to December 2013. The standard preoperative work-up included symptoms evaluation, barium swallow radiography, upper flexible endoscopy and in some cases of giant PEHs computed tomography (CT) of thorax and abdomen [2]. Esophageal

Correspondence to:

Miloš BJELOVIĆ
Department for Minimally
Invasive Upper Digestive Surgery
Clinic for Digestive Surgery
– First Surgical Clinic
Clinical Center of Serbia
Dr Koste Todorovića St. No. 6
11000 Belgrade
Serbia
milos.bjelovic@gmail.com

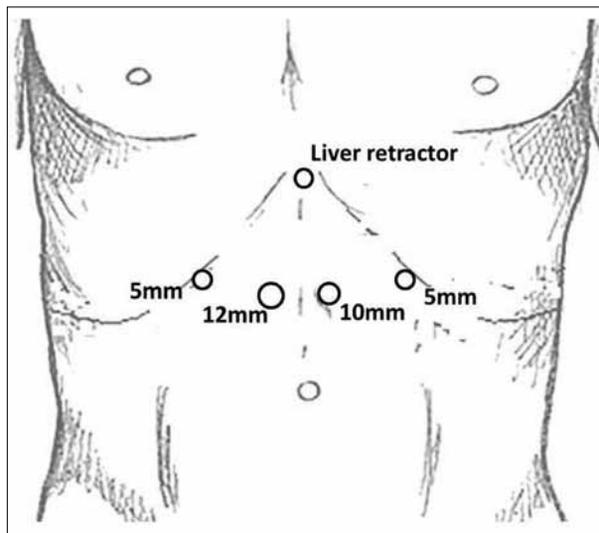


Figure 1. Trocar position (adopted from Luketich et al. [9])

manometry and 24-hour esophageal pH-study were used only in cases of small type I hernia with non-erosive reflux disease [7]. Indications for surgical treatment were based on the guidelines issued by the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) [8]. All patients underwent antibiotic prophylaxis and prophylaxis for deep vein thrombosis. The standard surgical technique for hiatal hernia repair was based on the technique adopted from the University of Pittsburgh Medical Center (UPMC), and described in details in further text [9, 10]. The standard postoperative care included prevention of early postoperative nausea and vomiting syndrome (PONVs) [11]. Control barium radiography was routinely performed on the second postoperative day followed by clear liquid diet, with exception of patients who underwent esophageal lengthening procedure when barium radiography was performed on the fifth postoperative day. After hospital discharge, the first check-up was performed a month after surgery, six months after surgery, and then once a year. The standard postoperative annual check-up included symptoms evaluation, control barium radiography and upper flexible endoscopy.

Surgery was performed under general endotracheal anesthesia. The first 33 hiatal hernia repairs were performed

with the patient in a French position and the remaining 167 with the patient in a supine position (dorsal decubitus modified by Luketich [9]) (Figure 1). After trocar placement and exposure, herniated stomach was reduced by pulling the perigastric fat and hernia sac with atraumatic graspers in a hand-over-hand fashion. The hernia sac and the retroperitoneal fat were carefully dissected out from the mediastinum using a combination of sharp dissection with the harmonic shears and blunt dissection. The dissection was continued to expose the junction between the right and left pillars in the retroesophageal space. Next, the gastrosplenic ligament was divided along with the posterior attachments to the fundus using the electro thermal bipolar tissue sealing system (EnSeal or LigaSure). Mobilization of the esophagus should be performed up to the level of inferior pulmonary veins. In many patients this was sufficient to restore the adequate length of the intraabdominal esophagus. However, the exact length of the intraabdominal esophagus could be measured only if the gastroesophageal fat pad was removed, the angle of His was fully exposed, and the stomach and esophagus were tension-free. If the esophagogastric junction did not remain below the diaphragmatic hiatus, with an adequate tension-free length of the intraabdominal esophagus of at least 2-3 cm, the esophageal lengthening procedure was added before the fundoplication. The esophageal lengthening procedure was typically performed utilizing the technique of Collis wedge gastroplasty [6]. A 59 FG Moloney esophageal bougie was placed into the stomach along the lesser curve. The neoesophagus was created using endoscopic linear staplers/cutters. The staplers/cutters were fired in the cranial direction, snugly against the bougie to create a tension-free intraabdominal neoesophagus (Figure 2). The stapler lines were carefully inspected for potential leaks.

Antireflux procedure of choice was a total floppy Nissen fundoplication, performed using interrupted 2.0 non-absorbable sutures. It is essential to sweep the anterior vagal nerve to the right of the esophagus along with the fat pad and a part of the dissected hernia sac. The fundus of the stomach should be wrapped solely around the esophagus, avoiding incorporation of the anterior vagal nerve into

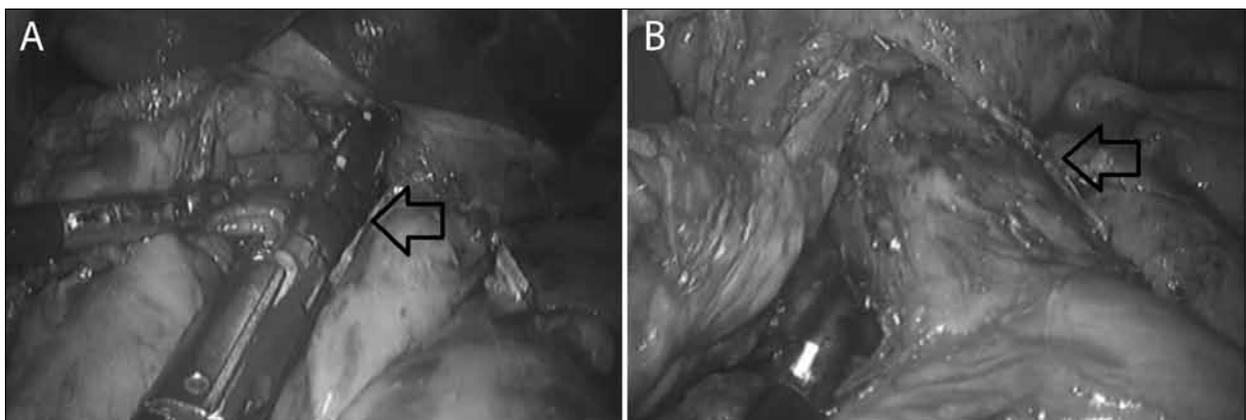


Figure 2. Esophageal lengthening procedure (Collis wedge gastroplasty): A) use of linear cutters to create neo-esophagus; B) neo-esophagus created at the end of the procedure

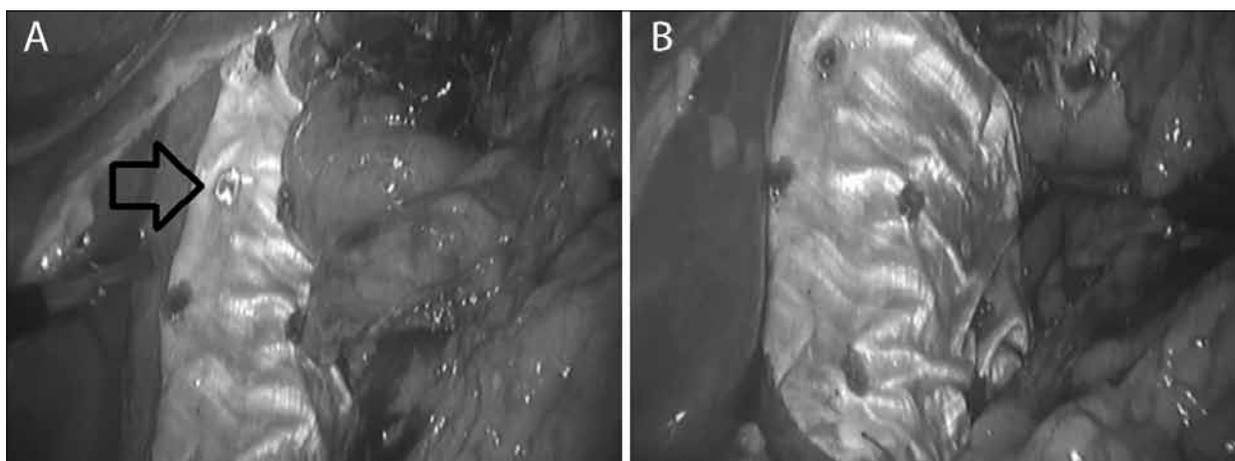


Figure 3. Autologous fascia lata graft reinforcement of the large hiatal defect: A) fixation of the fascia lata to the right pillar; B) fascia lata in place

the fundoplication. In cases when the total fundoplication was not feasible due to the patient's age, co-morbidity and local intraoperative findings, a partial posterior Toupet fundoplication or gastropexy was performed. In most cases the hiatal defect was closed by performing primarily retroesophageal cruroraphy, using interrupted 0 non-absorbable sutures. In cases of unusually large and/or round shaped hiatal defect, the Cleveland Clinic Foundation suture technique was performed [12]. Other techniques for resolving a large hiatal defect or the friable crura included placing Teflon pledgets, using onlay synthetic mesh, or in recent cases an autologous fascia lata graft (Figure 3). The use of abdominal drains and NG tube was optional, based on the assessment of the operating surgeon. After the operation the chest radiography was mandatory in all cases to exclude iatrogenic pneumothorax.

RESULTS

The outcomes of 200 consecutive laparoscopic hiatal hernia repairs from April 2004 to December 2013 were included. Female patients were slightly more prevalent (60% female and 40% male patients), the mean age was 54.4 years and the average duration of symptoms 4.9 years. The hiatal hernia types included 108 (54%) type I, 30 (15%) type III, and 62 (31%) giant PEH with 27 (13.5%) of patients presented with a chronic stomach volvulus.

There were a total of 154 (77%) Nissen fundoplications. In 26 (13%) cases the Nissen procedure was combined with esophageal lengthening procedure (Collis-Nissen), and 17 (8.5%) Toupet fundoplications was performed.

Primary retroesophageal crural repair was performed in 164 (82%) cases, Cleveland Clinic Foundation suture modification in 27 (13.5%), 4 (2%) patients underwent synthetic mesh hiatoplasty, 1 (0.5%) primary repair reinforced with pledgets and 4 (2%) autologous fascia lata graft reinforcement. There were no emergency conversions to open procedure. However, there were 8 (4.0%) planned conversions to open procedure. The average surgical time was 2.7 hours. The average duration of hospitalization was 6.3 days and the 30-day death rate was zero. All

these features were separately analyzed depending on the hiatal hernia type (Table 1). The most frequent symptoms in case of sliding hiatal hernias were typical reflux symptoms, heartburn in 124 (89.60%) and regurgitation in 109 (78.9%) patients. In the majority of cases (119; 86.23%) the Nissen fundoplications with primary retroesophageal crural repair (130; 94.2%) was performed. The conversion to open procedure occurred in 5 (3.62%) cases due to severe adhesions in 4 and inability to perform safe laparoscopic stomach reposition in 1 patient with BMI of more than 35 kg/m². The average surgical time was 150 min/2.5 hours with intraoperative complications mainly relating to iatrogenic pneumothorax subsequently solved with a chest tube. The postoperative complications occurred in 8 (5.8%) patients with type I and III of hiatal hernias and mainly involved pulmonary complications in 2 (1.45%) patients, coronary in 2 (1.45%), early stomach reherniation in 1 (0.72%), gastric wall hemorrhage in 1 (0.72%) and late spleen hemorrhage in 1 (0.72%) patient. Reoperation was performed in 3 (2.17%) patients. The average length of hospitalization was 6 days (Table 1). Slightly different results were obtained by analyzing features of giant PEHs. The most common were mechanical symptoms including chest pain (40; 64.51%), heart palpitations (40; 64.51%), breathing difficulties (36; 58.1%) and epigastric pain (35; 56.45%). The Nissen fundoplication was performed in 35 (56.45%) cases. In 16 (25.8%) cases the Nissen procedure was combined with esophageal lengthening procedure (Collis-Nissen), in 8 (12.9%) Toupet fundoplications was performed and gastropexy in 3 (4.76%) cases. There were a significantly higher number of Cleveland Clinic Foundation suture modifications in hiatal closure, compared to type I and III hernias. The conversion rate was 4.84% with no emergency conversions to open procedure. The postoperative complications occurred in 10 (16.13%) patients with giant PEHs and included port site infection in 2 (3.22%) patients, pulmonary complications in 5 (8.06%), coronary complications in 2 (3.22%), and early stomach re-herniation in 1 (1.61%) patient. Reoperation was performed in 1 patient. The average length of operation was 181 min/3 hours and the average length of hospital stay was 7 days. The 30-day death rate was zero (Table 1).

Table 1. Symptoms evaluation and surgical technique regarding types of hiatal hernias (number of patients and percentage)

Features		Type I and III	Giant PEH
Overall number		138 (69%)	62 (31%)
Average duration of symptoms		52.74 months (4.4 years)	71.01 month (5.92 years)
Symptoms	Heartburn	124 (89.60%)	33 (53.22%)
	Epigastric pain	97 (71.9%)	35 (56.45%)
	Regurgitation	109 (78.9%)	16 (25.80%)
	Breathing difficulties	28 (20.3%)	36 (58.10%)
	Chest pain	36 (26.08%)	40 (64.51%)
	Heart palpitations	44 (31.90%)	40 (64.51%)
Type of operation	Nissen fundoplication	119 (86.23%)	35 (56.45%)
	Collis- Nissen procedure	10 (7.24%)	16 (25.80%)
	Toupet fundoplication	9 (6.53%)	8 (12.90%)
	Gastropexy	0 (0%)	3 (4.76%)
Crural closure	Posterior cruroraphy	130 (94.20%)	34 (54.84%)
	Cleveland modification	4 (2.90%)	23 (37.10%)
	Mesh hiatoplasty	3 (2.20%)	1 (1.61%)
	Pledget hiatoplasty	1 (0.7%)	0 (0%)
	Fascia lata graft hiatoplasty	0 (0%)	4 (6.45%)
Average duration of operation		150 min/2.5 hours	181 min/3.01 hours
Conversion	Total	5 (3.62%)	3 (4.84%)
	Severe adhesions	4 (2.90%)	2 (3.22%)
	Inability to perform safe stomach reposition	1 (0.72%)	1 (1.61%)
Intraoperative complications	iatrogenic pneumothorax	4 (2.90%)	5 (8.06%)
Postoperative complications	Total	8 (5.80%)	10 (16.13%)
	Wound infection	1 (0.72%)	2 (3.22%)
	Pulmonary complications	2 (1.45%)	5 (8.06%)
	Coronary complications	2 (1.45%)	2 (3.22%)
	Early stomach reherniation	1 (0.72%)	1 (1.61%)
	Hemorrhage from gastric wall	1 (0.72%)	0
	Late spleen hemorrhage	1 (0.72%)	0
Reoperation		3 (2.17%)	1 (1.61%)
Average length of hospital stay		6 days	7 days
30-day death rate		0 (0%)	0 (0%)

PEH – paraesophageal hernia

In our series, a median follow-up was more than three years. Laparoscopic repair of hiatal hernia provided excellent patients' satisfaction and symptom resolution. It was associated with good to excellent postoperative outcomes in nearly 90% of patients. Poor result with anatomic and symptomatic recurrence (an indication for revisional surgery) was obtained in 5 patients (2.7%).

DISCUSSION

Numerous studies have addressed the laparoscopic approach stating that it is as effective as the open procedure but with reduced postoperative complications, recovery time and similar recurrence rates [13]. Treatment of hiatal hernia, especially the giant PEH, is technically feasible and safe in high-volume medical centers and performed by surgeons experienced in specific surgical technique [14]. The laparoscopic repair of hiatal hernias has been routinely performed by the team of the Department for Minimally Invasive Upper Digestive Surgery, Clinic for Digestive surgery, Clinical Center of Serbia since 2004. In our study the most commonly represented type was

type I hiatal hernia (108 cases; 54%). The major clinical significance was its association with intractable reflux, and the indication for repair in the majority of cases was gastroesophageal reflux disease [8]. Regarding type III hiatal hernia, which was diagnosed in 30 (15%) cases, symptomatology included reflux and mechanical symptoms, while in cases of giant PEH the mechanical symptoms (as most prevalent), including chest pain, heart palpitations and breathing difficulties, were deemed most troublesome. A special feature in cases of the giant PEH included the rotation of the herniated stomach around its longitudinal axis resulting in the organoaxial volvulus. Gastric volvulus may lead to acute gastric obstruction, incarceration and perforation [10]. All symptomatic paraesophageal hernias should be repaired electively in suitable surgical candidates because of the troublesome risk of complications including gastric obstruction and perforation [15]. The standard surgical technique included stomach reposition, crural repair and antireflux procedure. Hernia sac dissection and complete detachment from the mediastinal pleura is mandatory. After doing so, it is possible to return the stomach and gastroesophageal junction to its usual infradiaphragmatic position in a tension-free man-

ner [10]. In some cases, sac excision can be quite challenging, particularly in large hernias. It is necessary to remove the hernia sac from the mediastinum but not from the body, because a complete sac excision might predispose to vagal nerve injury [16]. At the completion of hiatal dissection, the intra-abdominal esophagus should measure at least 2-3 cm in length to decrease the chance of recurrence. In most cases we achieved this length by mediastinal dissection at the level of inferior pulmonary veins, while in 26 patients (13%), we performed the esophageal lengthening procedure (Collis wedge gastropasty) using the standard technique described above. Some authors report very high utilization rates of Collis gastropasty in the primary hiatal repair, especially in types III and IV cases, some using this procedure routinely in the majority of patients [17]. Recently, there have been debates whether a neo-esophagus, formed by the Collis gastropasty, does not exhibit peristaltic activity like the native esophagus, with subsequent dysphagia as a potential problem [18]. In our series, out of 26 patients who underwent the Collis gastropasty, none had intractable postoperative dysphagia. In addition, postoperative leak could be a serious problem after the Collis gastropasty. However, a proper surgical technique could significantly minimize the prevalence of leak.

Primary posterior or retroesophageal cruroraphy has been the mainstay of practice for many years in the hiatal hernia repair. In our series we performed a total of 164 (82%) posterior cruroraphies. To avoid tension on the suture line in cases of a large or round-shaped hiatal defect, in mixed (type III) and in giant PEHs (27; 13.5%) cases we performed the Cleveland Clinic Foundation suture technique. The aim of this widely accepted technique is to loosen tension on the pillars as much as possible [18]. There are two main technical causes of recurrent hiatal hernia: unrecognized secondary short esophagus and insufficient hiatal closure. In the cases of large hiatal defect and friable crura, the crura repair should be reinforced. In one case (with peritoneal tear on the pillars), we used pledgets to buttress primary sutured hiatal repair. Some authors suggest routine use of pledgets to lessen the pressure on the suture line [19]. However, most reinforced repairs use some form of mesh. The ideal mesh and technique are unknown at this point. Some authors recommend the use of a synthetic mesh in patients with the hiatal defect larger than 8 cm in crural separation [20]. Using the intraoperative measurement of esophageal hiatus by calculation of the hiatal surface area (HSA), in 3 cases with the hiatal defect larger than 8 cm we reinforced the primary crural repair with an onlay application of "U" shaped synthetic mesh fixed by tacks [21]. Postoperative complications were reported with all types of mesh, although in a smaller percent in biologic mesh usage, regardless of mesh geometry and fixation. Even though mesh erosion is most feared complication, other complications may also occur, such as esophageal stenosis, pericardial tamponade and effusion which leads to the suggestion that synthetic mesh should therefore be avoided [22]. In our series, probably due to a small

number of cases and limited follow-up, none of the above described complications of synthetic mesh reinforcement occurred. Recently, to avoid the above described complications of synthetic mesh reinforcement in patients with an extremely large hiatal defect we used an autologous fascia lata graft for crural reinforcement in 4 cases. In 1968, Brain published the use of autologous fascia lata graft to create a new phrenoesophageal ligament in the transthoracic repair of hiatal hernia [23]. Recently, a Hungarian group has published a study on the fascia lata crural reinforcement in experimental animals, postulating that it could be a good biological alternative for synthetic mesh [24]. At our Department, the first use of autologous fascia lata graft was performed in April 2013.

Recent studies have indicated that the fundoplication is the necessary step in all hiatal hernia repairs due to the incompetent lower esophageal sphincter and extensive hiatal dissection, which may also potentiate reflux [25]. In our series, we performed a total of 154 (77%) 360° Nissen floppy funduplications. There was no persistent severe postoperative dysphagia. In 17 (8.5%) patients we performed partial posterior fundoplication according to Toupet. According to guidelines for laparoscopic hiatal hernia repair, stomach reposition with gastropexy represents a safe alternative in high-risk patients, but it may be associated with high recurrence rates of as much as 22% in the first 3 months of follow-up period [26, 27]. In our series, 3 morbidly obese patients, all above 65 years of age with cardiovascular and pulmonary co-morbidities, underwent gastropexy, with one having early proximal stomach reherniation that required reintervention. To our experience, the gastropexy alone should not be the aim of surgery but rather a fallback option. The average duration of operation was 159 min/2.7 hours, which could be attributed to the learning curve (in the first period), conjoined procedures (adhesionolysis, cholecystectomy, and incisional hernia repair), etc. The conversion rate to open procedure was 4% without emergency conversions, mainly because severe adhesions due to previous operations in the first 50 laparoscopic hiatal hernia repairs. With experience gaining and becoming a high-volume center, the conversion rate in the last 80 laparoscopic hiatal hernia repairs was zero. The average length of hospitalization was 6.3 days. The 30-day death rate was zero. Similar results were obtained in other series [9, 10]. Routine postoperative management in all cases included deep vein thrombosis prophylaxis and prevention of early postoperative nausea and vomiting syndrome (PONVs). Sudden early postoperative increases in intra-abdominal pressure were thought to predispose the patient to early anatomic failure of the fundoplication and hiatal hernia repair [28]. According to the literature, early postoperative dysphagia rates were up to 50%, so in all patients slow diet advancement from liquids to solids was applied. The standard follow-up included symptoms evaluation, barium radiography and upper flexible endoscopy. Routine radiographic follow-up showed a higher incidence of recurrence than symptomatic follow-up alone [29]. The post-operative barium radiography was available in 184 (92%) of patients. Radiographic recurrent hiatal hernia

was diagnosed in 13 (10.2%) patients operated due to type I or III hiatal hernia and in 10 (16.1%) patients operated due to the giant PEH. Despite the proven radiographic reherniation, overall satisfaction with surgery and symptoms control was high and a poor result (and indication for revisional surgery) was obtained in 5 patients (2.7%). There is a general opinion that the revisional surgery should be performed by surgeons experienced in specific surgical technique in high-volume centers [19].

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CONCLUSION

In our series, we found that laparoscopic hiatal hernia repair was technically feasible; it was associated with good to excellent postoperative outcomes in nearly 90% of patients featuring low morbidity and mortality. Laparoscopic repair of hiatal hernia provided excellent patients' satisfaction and symptom resolution, with reoperation rates that are comparable to the best open series.

Лапароскопско решавање херније хијатуса једњака: искуство после 200 операција

Милош Бјеловић^{1,2}, Тамара Бабич², Драган Гуњић², Милан Веселиновић², Братислав Шпица²

¹Медицински факултет, Универзитет у Београду, Београд, Србија;

²Одељење за минимално инвазивну хирургију горњег дигестивног тракта, Клиника за дигестивну хирургију – Прва хируршка клиника, Клинички центар Србије, Београд, Србија

КРАТАК САДРЖАЈ

Увод Хернија хијатуса једњака (ХХЈ) се традиционално решавала класичном операцијом кроз лапаротомију или торакотомију. Откако је 1992. године урађена прва лапароскопска операција ХХЈ, ова метода постала је све популарнија и данас се сматра стандардном методом у центрима специјализованим за минимално инвазивну хирургију.

Циљ рада У раду су приказани резултати и искуство стечено после 200 лапароскопских операција ХХЈ.

Методе рада У ретроспективну кохортну студију укључено је 200 болесника подвргнутих елективној лапароскопској операцији ХХЈ од априла 2004. до децембра 2013. године у Клиници за дигестивну хирургију Клиничког центра Србије у Београду.

Резултати Аксијална хернија (тип I) утврђена је код 108 болесника (54%), мешовита хернија (тип III) код 30 (15%), гигантска параезофагеална хернија код 62 (31%), док је хронични волвулус желуца забележен код 27 болесника (13,5%). Код 154 болесника (77%) примењена је Нисенова (Nissen) фундопликација, код 26 (13%) Нисенова фундопли-

кација комбинована је с елонгацијом једњака због секундарно кратког једњака, тзв. Колис–Нисенова (Collis–Nissen) операција, а код 17 (8,5%) примењена је задња парцијална фундопликација (Touret). Примарно ретроезофагеално ушивање крусева урађено је код 164 болесника (82%), ушивање према модификацији Клинике Кливленд код 27 (13,5%), хијатоластика синтетском мрежицом код четири (2%), хијатоластика уз коришћење аутологног графта фасције лате код такође четири (2%), а примарно ушивање уз коришћење облоге (плеџет) код једног болесника (0,5%). Анатомски рецидив који узрокује поновну појаву симптома (што је индикација за поновну операцију) установљен је код пет болесника (2,7%).

Закључак Лапароскопска операција ХХЈ је технички захтевна хируршка процедура која је удружена са добрим, односно одличним резултатом код више од 90% болесника. Овакви налази могу се поредити с најбољим серијама у којима су анализирани резултати отворене хирургије.

Кључне речи: *hiatus hernia*; лапароскопија; Колис–Нисенова гастропластика; *fascia lata*