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ORIGINAL

Laparoscopic versus open splenectomy in children: A comparative study with an extended description of the surgical techniques

Esplenectomía laparoscópica frente a esplenectomía abierta en niños: Un estudio comparativo con una descripción ampliada de las técnicas quirúrgicas

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Abstract

Objective: The aim of this study is to compare and present our patients who underwent open splenectomy (OS) and laparoscopic splenectomy (LS).
Materials and methods: This research study incorporated patients who underwent splenectomy who were admitted to the Başakşehir Çam and Sakura Training and Research Hospital, Department of Pediatric Surgery, between January 2022, and April 2023. The study included a total of 48 patients who underwent splenectomy. The patients were divided into two groups: Group 1 LS (n=21) and Group 2 OS (n=27). Mentioned data were compared between groups.
Results: The study included a total of 48 patients. Out of the participants, 66.7% were male. Hematological diseases were observed in 35 patients (72.9%). hematological diseases. The surgical technique employed for splenectomy was laparoscopic in 21 cases (43.8%) and open in 27 cases (56.3%). Age, gender, and Spleen size were found to be similar between the groups (p>0.05). Regarding cholelithiasis, the laparoscopic group had a higher prevalence of 86% (n=12) compared to 31% (n=5) in the open group (p=0.003). Similarly, the rate of cholecystectomy was higher in the laparoscopic group (60%, n=12) compared to the open group (22%, n=6) (p=0.008). The distribution of diseases showed a significant difference between the two groups (p<0.001).
Conclusions: Compared to open surgery, laparoscopic splenectomy is a feasible method in terms of performing both surgeries together if the patient has gallbladder stones simultaneously.

Key words: Laparoscopic splenectomy, children, hereditary spherocytosis, splenic cyst, trauma.

Resumen

Objetivo: El objetivo de este estudio es comparar y presentar a nuestros pacientes sometidos a esplenectomía abierta (ES) y esplenectomía laparoscópica (EL).
Material y métodos: Este estudio de investigación incorporó a pacientes sometidos a esplenectomía que ingresaron en el Hospital de Formación e Investigación Başakşehir Çam y Sakura, Departamento de Cirugía Pediátrica, entre enero de 2022, y abril de 2023. El estudio incluyó un total de 48 pacientes sometidos a esplenectomía. Los pacientes se dividieron en dos grupos: Grupo 1 LS (n=21) y Grupo 2 OS (n=27). Se compararon los datos mencionados entre los grupos.
Resultados: El estudio incluyó un total de 48 pacientes. De los participantes, el 66,7% eran varones. Se observaron enfermedades hematológicas en 35 pacientes (72,9%). enfermedades hematológicas. La técnica quirúrgica empleada para la esplenectomía fue laparoscópica en 21 casos (43,8%) y abierta en 27 (56,3%). Se observó que la edad, el sexo y el tamaño del bazo eran similares entre los grupos (p>0,05). En cuanto a la colelitiasis, el grupo laparoscópico presentó una prevalencia más elevada, del 86% (n=12) frente al 31% (n=5) en el grupo abierto (p=0,003). Del mismo modo, la tasa de colecistectomía fue superior en el grupo laparoscópico (60%, n=12) en comparación con el grupo abierto (22%, n=6) (p=0,008). La distribución de las enfermedades mostró una diferencia significativa entre los dos grupos (p<0,001).
Conclusiones: En comparación con la cirugía abierta, la esplenectomía laparoscópica es un método factible en cuanto a la realización conjunta de ambas cirugías si el paciente tiene cálculos biliares simultáneamente.

Palabras clave: Esplenectomía laparoscópica, niños, esferocitosis hereditaria, quiste esplénico, traumatismo.

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Introduction

Splenectomy is occasionally performed in children with various hematologic conditions such as sickle cell disease, hereditary spherocytosis, and idiopathic thrombocytopenic purpura[1]. Traditionally, open splenectomy (OS) has been the standard surgical procedure, involving an abdominal incision. However, OS carries a significant risk of wound infection. Consequently, surgeons have increasingly turned their attention toward laparoscopic techniques as an alternative to open surgery. However, open splenectomy still holds significant importance in the management of trauma patients[2,3].

The first reported laparoscopic splenectomy (LS) dates back to 1993, gaining rapid acceptance among surgeons[4]. LS theoretically offers advantages such as shorter hospital stays, improved cosmetic outcomes, and faster recovery. However, the actual realization of these benefits is not guaranteed. Some concerns remain unresolved regarding LS. For instance, the efficacy of LS in cases of massive splenomegaly is questioned by some authors, while the potential risk of missing an accessory spleen during LS is a concern for others. Moreover, some authors question LS's ability to accurately diagnose massive splenomegaly. As a result, it remains unclear whether LS truly offers any substantial advantages over OS in pediatric patients[5,6].

The aim of this study is to compare and present our patients who underwent open splenectomy (OS) and laparoscopic splenectomy (LS).

Materials and methods

Study population and groups

This research study incorporated patients who underwent splenectomy (both LS and OS) who were admitted to the Başakşehir Çam and Sakura Training and Research Hospital, Department of Pediatric Surgery, between January 2022, and April 2023. The study included a total of 48 patients who underwent splenectomy. Patient records and medical charts were reviewed to collect relevant data. Information regarding demographic characteristics, specific conditions, and surgical techniques employed were evaluated. The patients were divided into two groups: Group 1 LS (n=21) and Group 2 OS (n=27). Mentioned data were compared between groups.

Type of the study

This study is a type III descriptive study.

Ethical approval

Ethical approval was obtained from the non-interventional local ethics committee of Başakşehir Çam and Sakura Training and Research Hospital on Kaek with the number 2023.05.192

Inclusion criteria

Patients aged <18 years and diagnosed and treated in our hospital with regular and accessible data were included in this retrospective study.

Exclusion criteria

Patients aged >18 years, with irregular, incomplete, inaccurate or inaccessible data were excluded from the study (n=3). Patients who had a splenectomy due to a mass or who had a partial splenectomy were also excluded from the study.

Operative technique

In children, splenectomy can be performed open or laparoscopically. Especially in recent years, robotic splenectomy has also come to the fore. However, this study only compares laparoscopic and open techniques[8].

Laparoscopic splenectomy

Patient positioning and port placement are the first steps in the procedure. Typically, surgeons take a lateral approach while a little bit elevating the left flank. On the patient's right, the surgeon and his assistant are standing. The upper midline instruments can be inserted without cannulas in young patients and those with small spleens, and a variety of incision locations can be used. The splenocolic ligament is first split during the procedure, which allows the splenic flexure to move away from the spleen. After dividing the short gastric vessels and opening the lesser sac, the surgeon moves towards the head and divides the inferior portion of the gastrosplenic ligament. Checking for accessory spleens in the lesser sac is necessary[8,9].

The splenophrenic ligament is then split to fully mobilize the upper pole after that. The next choice is whether to use energy devices to divide each vessel individually or staple across all of them. Numerous reports have verified this technique's safety. For the dissection and ligation of hilar vessels, the EnSeal and LigaSure, which have limited lateral thermal spread, can be used successfully[9,10].

After being morcellated, the spleen is then put in a bag and extracted from the body via the umbilical incision. Splenic cysts and a wandering spleen can be treated laparoscopically using the same methods used for laparoscopic splenectomy. However, due to the requirement for rapid bleeding control in patients with unstable conditions, the laparoscopic approach is typically not suitable for traumatic splenic injuries[11] (**Figure 1**).

During laparoscopy splenectomy, simultaneous cholecystectomy was also performed in patients with cholelithiasis, if indicated (**Figure 2**).

Open splenectomy

The open technique through a left upper quadrant incision is usually reserved for massive splenomegaly. The initial division of the splenorenal, splenocolic, and splenophrenic ligaments allows the spleen to be mobilized from the left upper quadrant and out of the abdominal cavity. The short gastric vessels are divided initially, followed by the hilar vessels. A careful search must be undertaken for accessory spleens. All other steps are similar to those performed in the laparoscopic method (***Figure 3***).

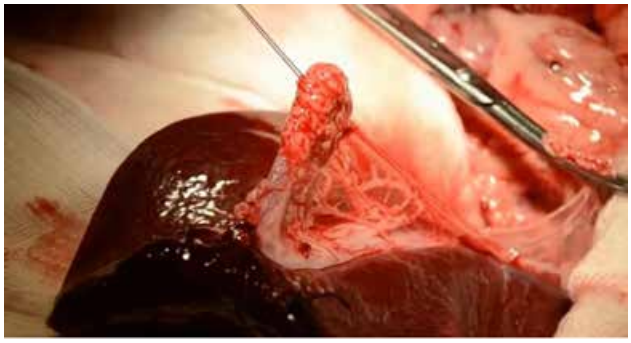
Limitations of the study

This study, though informative, bears certain limitations that must be considered when interpreting its findings.

Figure 1: Intraoperative view during laparoscopic splenectomy.

Figure 2: Laparoscopic cholecystectomy simultaneously with LS.

Figure 3: Intraoperative view during open splenectomy.



Its retrospective nature could introduce recall bias and uncontrolled confounding factors. The data's reliability is contingent upon the accuracy and completeness of previously collected records, and any inaccuracies could distort the outcomes. The relatively small sample size of 48 patients may not be entirely representative of the larger population, potentially limiting the study's statistical power and capacity to detect notable differences between the groups. Moreover, the absence of randomization in patient assignments to the laparoscopic or open surgery groups could lead to selection bias, thereby undermining the comparability of the groups. This study also falls short of providing long-term patient follow-up, limiting the scope to establish the long-term effects and complications of the two surgical methods. Furthermore, it lacks detailed insight into the operation time, amount of bleeding during surgery, duration of hospital stay, and operative and postoperative complications, which represent essential elements in comprehensively assessing surgical procedures. These omissions form the most significant constraints of the study.

Statistical analysis

The patient data were subjected to a thorough statistical analysis, which included evaluating frequencies, other characteristics, and descriptive statistics (mean ± standard deviation) for each category. The Shapiro-Wilk and Kolmogorov-Smirnov tests were used to determine the normality of the distribution of continuous variables. The Student's T-test was applied to compare continuous variables when the data were normally distributed. Comparing categorical variables was done using the Chi-square test. SPSS Statistics for Windows, Version 24.0 (IBM Corp., Armonk, NY, USA) was used for all statistical analysis. *P*-values were two-sided, and a statistically significant result was one with a p-value of less than 0.05.

Results

The study included a total of 48 patients, with a mean age of 104.7±55.6 months. Out of the participants, 66.7% were male. The average spleen size was measured as 151.5±29.6 mm. We identified the presence of accessory spleen in 6.7% of the patients, with a total of 8 cases. Regarding specific conditions, cholelithiasis was present in 17 patients (35.4%), while cholecystectomy had been performed in 18 patients (37.5%). Hematological diseases were observed in 35 patients (72.9%). Among these, hereditary spherocytosis was the most common condition, affecting 29 patients (60.4%). Pyruvate kinase deficiency/anemia was identified in 2 patients (4.2%), thalassemia in 3 patients (6.3%), and Wiskott-Aldrich Syndrome in 1 patient (2.1%). Non-hematological diseases were found in 13 patients (27.1%). The most prevalent non-hematological conditions were trauma, observed in 5 patients (10.4%), and splenic cyst, also identified in 5 patients (10.4%). Additionally, a wandering

spleen was present in 1 patient (2.1%), and 2 patients (4.2%) had other non-hematological diseases. The surgical technique employed for splenectomy was laparoscopic in 21 cases (43.8%) and open in 27 cases (56.3%). One of our patients underwent surgery due to major multiple trauma; however, unfortunately, the patient's general condition deteriorated and this patient was lost due to severe bleeding (2.1%) (**Table I**).

Table I: Patient demographic.

	N	%
Age (months)*	104,7±55,6	
Gender (M)	32	66,7%
Spleen size (mm)*	151,5±29,6	
Accessory spleen	8	6,7%
Cholelithiasis	17	35,4%
Cholecystectomy	18	37,5%
Hematological disease	35	72,9%
Hereditary spherocytosis	29	60,4%
Pyruvate kinase deficiency /anemia	2	4,2%
Thalassemia	3	6,3%
Wiskott Aldrich Syndrome	1	2,1%
Non-hematological disease	13	27,1%
Trauma	5	10,4%
Splenic cyst	5	10,4%
Wandering spleen	1	2,1%
Other	2	4,2%
Surgical Technique		
Laparoscopic	21	43,8%
Open	27	56,3%
Mortality	1	2,1%

* mean±std. deviation

The study compared the outcomes between laparoscopic (n=21) and open (n=27) surgical techniques for splenectomy. Age (months) was found to be similar between the laparoscopic (114.3±48.5) and open (94.7±61.9) groups (p=0.290). The gender distribution also showed no significant difference between the laparoscopic and open groups, with 62% (n=13) male patients in the laparoscopic group and 70% (n=19) in the open group (p=0.537). The mean spleen size in patients with the hematological disease was 153.3±29.1 mm for the OS group and 149.3±27.1 mm for the LS group, showing no statistically significant difference (p=0.703). The presence of an accessory spleen was similar in both groups, with 19% (n=4) in the laparoscopic group and 15% (n=4) in the open group (p=0.715). Regarding cholelithiasis, the laparoscopic group had a higher prevalence of 86% (n=12) compared to 31% (n=5) in the open group (p=0.003). Similarly, the rate of cholecystectomy was higher in the laparoscopic group (60%, n=12) compared to the open group (22%, n=6) (p=0.008). The distribution of diseases showed a significant difference between the two groups (p<0.001). In the laparoscopic group, 100% (n=21) of patients had hematological disease, while 52% (n=14) had non-hematological disease (**Table II**).

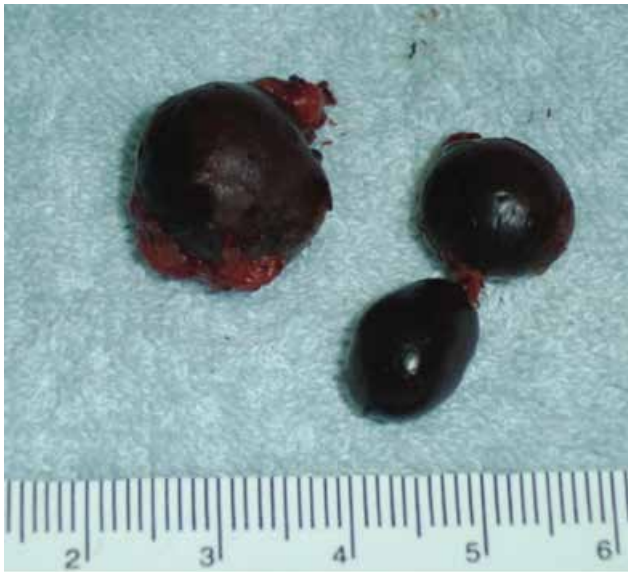
In this study, all accessory spleens were excised in both groups, since all of them were accompanied by hematological disease (**Figure 4**).

Table II: Comparison of LS and OS.

	Laparoscopic (n=21)	Open (n=27)	*p*-value
Age (months)*	114,3±48,5	94,7±61,9	0.290
Gender (M)	13 (62%)	19 (70%)	0.537
Spleen size (mm)*			
Hematological disease	149,3±27,1	153,3±29,1	0.703
Non-hematological disease		149,5±39,4	NA
Accessory spleen	4 (19%)	4 (15%)	0.715
Cholelithiasis	12 (86%)	5 (31%)	0.003
Cholecystectomy	12 (60%)	6 (22%)	0.008
Disease			<0.001
Hematological disease	21 (100%	14 (52%)	
Non-hematological disease	0 (0%)	13 (48%)	

* mean±std. deviation (T-test), others: Chi-square test, NA: Non-applicable

Figure 4: Accessory spleen.



Discussion

Recent advances in minimally invasive surgery have led to an increase in the use of laparoscopic techniques in pediatric patients. Laparoscopy is a common procedure in pediatric surgery because of its many benefits, including a shorter recovery time, an earlier start to feeding, and fewer cosmetic scars[11]. These advantages have contributed to the rise in the popularity of laparoscopic surgery in this field. The term "laparoscopic splenectomy," or "LS," was coined in 1993 and has since gained increasing acceptance among pediatric surgeons[4].

Very few comparison studies between OS and LS for pediatric massive splenomegaly have been published recently. Retrospective studies of 57 and 145 children, respectively, who needed splenectomy for massive splenomegaly were recently published by Deng et al[12] and Zhu et al[13] Twelve LS cases and twenty OS cases were included in the study by Hassan et al[14]. In Hassan et al.'s study, there was no sex difference between the two groups[14]. In our study, we compared the results

of laparoscopic (n = 21) and open (n = 27) surgical techniques for splenectomy. Age was discovered to be comparable between the open and laparoscopic groups (*p*=0.290). In terms of gender, there was no discernible difference between the laparoscopic and open groups, with 62% of the patients in the laparoscopic group (n=13) and 70% of the patients in the open group (n=19) (*p*=0.537).

Zhu et al.'s study reported an average spleen size of 158 mm in the LS group and 163 mm in the OS group[13]. These findings suggest only a slight variation in the average spleen size between the two techniques, which may not significantly influence the decision to perform LS or OS. In the study by Lesher et al.,[15] the average spleen sizes were smaller in both groups, recorded at 100 mm for LS and 120 mm for OS. This difference between the two studies could be attributed to several factors, including the population demographics, the underlying diseases causing splenomegaly, or even the surgeons' preference for one technique over the other depending on the spleen size. In our study, the mean spleen size in patients with hematological disease was 153 mm for the OS and 149 mm for the LS. Our findings suggest no statistically significant difference (p=0.703), which aligns with Zhu's findings, albeit with a closer margin. The fact that spleen sizes are comparable in both LS and OS groups in our study implies that the choice of surgical method might not hinge heavily on spleen size, at least within the range of sizes we observed.

In the study of Wood et al.,[16] the incidence of accessory spleen was noted as 13.7%. While this rate was noted as 14.3% in the study of Imbach et al. and 12.8% in the study of Qureshi et al.,[17] it was determined as 6.7% in our study. As in other studies[15-17], all accessory spleens were excised in our study. Although the low incidence of accessory spleens in our study is remarkable, the fact that diseases other than hematological diseases (trauma and splenic cyst, etc.) were also included in our study may be an important reason for this difference.

In line with the research by Deng et al.,[12] there were statistically fewer postoperative complications in the LS group compared to the OS group (8% vs. 10%). The LS group had statistically significantly shorter hospital stays and oral feeding recovery times after surgery. In their studies, Deng et al.,[12] and Owera et al.,[18] demonstrated the same outcomes. However, our study did not assess postoperative complications. The most significant limitations of our study are the absence of postoperative complications and the lack of follow-up information.

In such patients, any surgical procedure tends to be complicated due to the severity of anemia and the degree of hemolysis[19]. Therefore, performing simultaneous laparoscopic cholecystectomy and splenectomy is considered safe, feasible, and effective[19]. Saraf et al.,[20] reported a concurrent performance of laparoscopic splenectomy (LS) and laparoscopic cholecystectomy. In our study, simultaneous cholecystectomy was performed in 38% of the patients. In our research, laparoscopic splenectomy and cholecystectomy were safely conducted in a total of 12 patients, accounting for 60% of the laparoscopic group.

Conclusions

Compared to open surgery, laparoscopic splenectomy is a feasible method in terms of performing both surgeries together if the patient has gallbladder stones simultaneously.

Conclict of interest
No

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