

# Modern Variants For Surgical Treatment Of Splenic Cysts In Children

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## Abstract

**Aim.** Surgical approaches for the treatment of splenic cysts (SC) in children remains controversial. There are various methods of organsaving operations on spleen with its cystic lesions in children. Aim of the study is to evaluate different options for surgical treatment of SC in children.

**Materials and methods:** a retrospective study of diagnostic work-up and treatment of 265 children ages from 1 month to 18 years with splenic cyst from January 1998 to December 2019 was performed. 175 (66.04%) children underwent surgery. The other 90 (33.96%) patients were under dynamic observation.

**Results.** 119 (68.00%) open and 56 (32.00%) laparoscopic interventions were performed in children with different localization of cysts. Among open operations, partial resection of the spleen was most often performed – in 70 patients, partial cystectomy with unroofing – in 36 children, partial cystectomy – in 12 patients, and splenectomy – in 1 child with total cystic lesion of the spleen. Recurrence of the cyst was observed in 2 (1.68%) patients, which was corrected by repeated partial cystectomy by laparotomy. Laparoscopic partial cystectomy was most commonly used in 30 children, cystectomy with unroofing – in 21 cases, and partial splenic resection in 5 children. Cyst recurrence was observed in 3 (5.36%) patients. Recurrence was also corrected laparoscopically in 1 case and open access – in 2 children. Minimal residual cyst cavity in the remote period was observed in 9 (7.56%) children after open and in 7 (12.50%) – after laparoscopic correction of the SC, which healed on its own within 1-2 years.

**Conclusion.** Partial resection of the spleen, taking into account its segmental blood supply by laparoscopic or open method, is a rational organ-preserving method of treatment of splenic cysts. Partial cystectomy should be used for small cysts that occupy only one segment of the spleen. At cysts with a diameter up to 20 mm dynamic observation is rational

**Key words:** splenic cyst – organ saving - children

## Introduction

Primary splenic cysts (SC) are rare in children and are registered with a frequency of 0.07% to 1.0% of all surgical diseases of the abdominal cavity [2, 7, 13].

Beginning in 1929, when the disease was first reported, the classification of SC changed. SC were classified based on the presence or absence of epithelial membrane, pathogenesis, etc. SC are divided into true cysts, which have an epithelial membrane (SC type 1), and false cysts (SC type 2), in which the epithelial lining is absent. A separate group consisted of pseudocysts. They are usually of post-traumatic origin and are formed in the parenchyma of the spleen or subcapsularly as a result of hematoma transformation, less often – due to an abscess or infarction of the spleen [9, 11].

Depending on the presence or absence of the pathogen, SC are divided into parasitic and non-parasitic [1, 4, 5]. Parasitic SC are usually observed in endemic areas and are caused mainly by *Echinococcus granulosus* [1, 6, 10]. Modern classification is based on the pathogenesis of cysts and divides non-parasitic SC into congenital, neoplastic, post-traumatic and degenerative [3]. Primary SC account for 10% of all non-parasitic SC and are observed in different pediatric age groups.

Most SC are asymptomatic, so they are mostly detected by accident during examinations (ultrasound, CT or MRI). In addition, they can be detected due to complications: suppuration or splenic rupture with bleeding, which requires urgent surgery [10, 12].

Although the treatment of SC is only surgical, the choice of the method remains controversial. Until recently, the only

effective radical method of treating this defect was considered to be splenectomy [3, 7, 14]. Current guidelines favor the avoidance of splenectomy to prevent primarily post-splenectomy infection, which is described in 2.7-10% after splenectomy [10, 13]. Therefore, the alternative is organ-preserving methods: partial resection of the organ, cystectomy or fenestration (unroofing), percutaneous ablation with various types of sclerosants, etc. [11, 12, 14]. These methods can be applied using traditional open access or laparoscopy [8, 14].

Given the fact that the literature provides a small series of patients, there are no clear recommendations for surgical tactics for this disease in children. There are no clear indications for surgical treatment of SC, given the cyst's location, size, etiology, and the presence of clinical symptoms. The advantages and disadvantages of each of the methods of surgical correction of SC in children in terms of their trauma and reliability are also discussed [1, 4, 9].

Our study aimed to evaluate different options for surgical treatment of SC in children.

## Materials and methods

We conducted a retrospective analysis of the examination and treatment of 265 children aged 1 month to 18 years with SC, who were in pediatric surgery clinics of the O. Bogomolets National Medical University (Kyiv) and Danylo Halytsky Lviv National Medical University (Lviv) from January 1998 to December 2019. 147 (55.47%) of the children were boys and 118 (44.53%) were girls.

Patients diagnosed with “Splenic cyst” were involved in the analysis. We carried out the analysis of medical cards of inpatients, conclusions during the preoperative assessment, results of additional investigations, protocols of operations, data of postoperative supervision. The study did not include patients with parasitic lesions of the spleen.

One hundred seventy-five (66.04%) children out of 265 were operated on. The remaining 90 (33.96%) patients were under dynamic observation.

Patients whose diameter of cystic formation in the spleen was 20 mm or less ( $n = 61$ ) were not operated on. Initially, they underwent ultrasound examination twice every 6 months, then twice a year until puberty. According to the literature, the risk of progression or regression of the cyst exists until the end of puberty [13, 15]. Therefore, we performed such examinations of patients to this date. We did not observe the progression of cyst growth in these children.

We also did not operate on those children who had cysts in the spleen ranging in size from 20 to 62 mm: they were characterized by an asymptomatic course and/or parents did not consent to surgical treatment ( $n = 29$ ). Such children were under our dynamic supervision. This group of patients was the most difficult to analyze, as most of them lacked information on the dynamics due to irregular monitoring.

The indication for surgical treatment of our patients was the presence of cystic formation in the spleen with a diameter of more than 20 mm, which in dynamics increases in size.

Current literature provides various terms to define the name of a particular operation in the correction of SC. Therefore, for the convenience of analysis and understanding of each surgical intervention, we have defined the terms and their justification in each case. We used the term “partial cystectomy” (fenestration, unroofing) to operations within the SC, which would involve partial excision of its membranes. We defined partial excision of the cyst membranes with suturing of the residual cavity (“crater”) in the parenchyma of the spleen as “partial cystectomy with capitonnage”. Furthermore, we called the operation in which we removed all elements of the cyst within the unaffected parenchyma as “partial resection of the spleen” (partial splenectomy). We add the patient, who underwent complete removal of the spleen, to the group “splenectomy”. More than that, we assigned unoperated patients to the “observation” group.

All operated patients were under dynamic observation. We collected information on postoperative complications and relapses of the cysts to assess the results of surgical treatment. We also recorded clinical and visual ultrasonographic or tomographic data of each patient. Likewise, we took into account the circumstances of detection, age at diagnosis, cyst size, and change of cyst’s size in those patients who were not operated on. The nature of structural changes in the spleen and surrounding organs in all patients after surgery was also noted. Children who were not operated on were also monitored by surgeons.

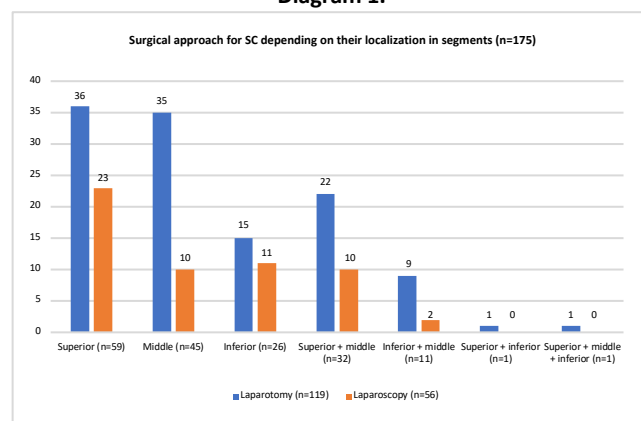
We researched following the principles of the Declaration of Helsinki. The Local Ethics Committees of all

the institutions mentioned in the work approved the research protocol. We obtained informed consent for the research from parents and children.

## Results and discussion

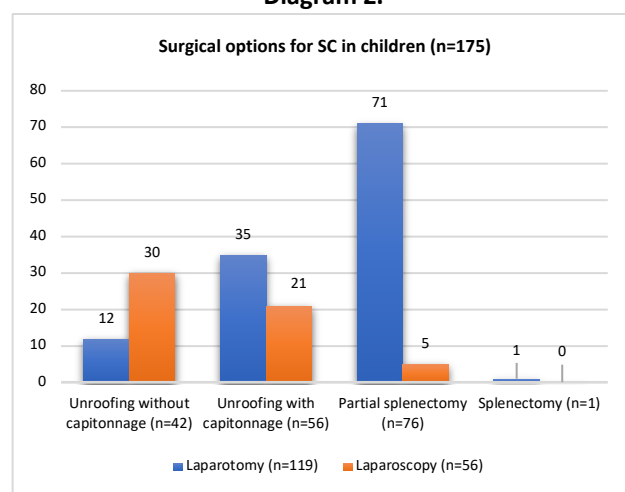
We performed 119 (68.00%) open and 56 (32.00%) mini-invasive operations in children with different segmental localization of cysts (Diagram 1). Lesions of the superior, middle, and combinations of the superior and middle segments of the spleen were the most common, and lesions of the inferior segment were less common. The choice of surgical correction method of SC was made depending on the location, size, nature of the parenchymal lesion, and the ratio of the vessels of the spleen.

**Diagram 1.**



In the treatment of children with SC, we followed the organ-preserving principle. All children underwent various options for operations on the spleen with preservation of the organ with laparotomy or mini-invasive surgery. And only one of our patients with a total cystic lesion of the spleen underwent splenectomy (Diagram 2).

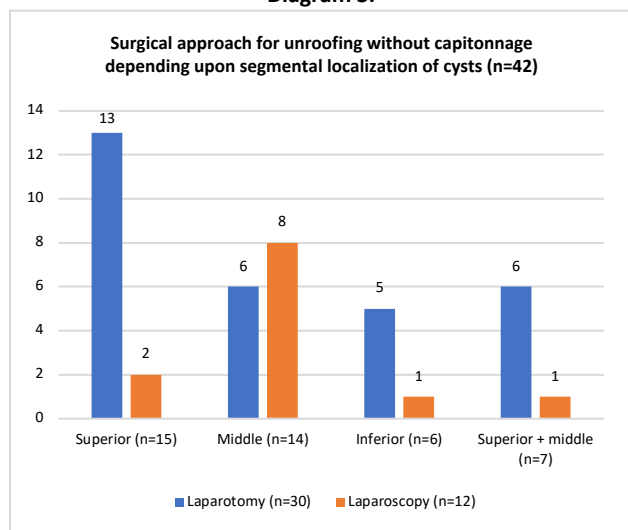
**Diagram 2.**



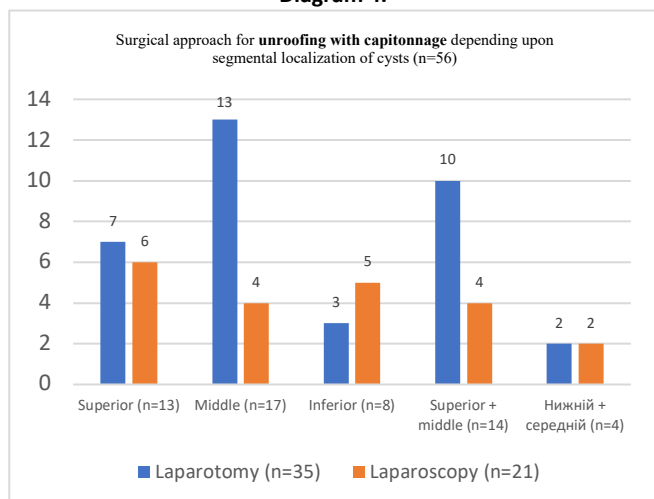
With the use of laparotomy, we eliminated SC in 119 (68.00%) patients (Diagrams 3, 4). The segmental distribution of operations for cysts is as follows: 36 patients underwent surgery for cysts of the superior segment of the spleen, 35 operations were on the middle segment (including – 5 in the area of splenic hilum). Twelve children underwent surgery for cysts of the inferior segment. The combination of superior and middle segments was in 22

cases, middle and inferior segments – in 9, superior and inferior – in 1, superior, middle, and inferior segments – in 1 child. The operation of unroofing through open access without capitonnage was performed in 12 patients with SC, unroofing with capitonnage – in 35, partial splenectomy – in 71, and splenectomy – in 1 child.

**Diagram 3.**



**Diagram 4.**



Mini-invasive correction of SC was performed in 56 (32.00%) children. We corrected the cysts of the superior segment of the spleen in 23 patients using laparoscopy, the cysts of middle segment – in 10 (including – 4 in the area of the spleen), inferior segment – in 11. We performed operations on cysts of superior and middle segments in 10 children, middle and inferior segments – in 2 children. Furthermore, we performed a laparoscopic unroofing without capitonnage on 30 children with SC, an unroofing operation with capitonnage on 21 patients, and a partial resection of the spleen on 5 children.

Summarizing the use of different methods of surgical correction of SC, which was performed from open access, we note that in such ways it is possible to surely eliminate lesions of different localization. Recurrence of SC after open correction of cysts in the area of splenic hilum using unroofing with capitonnage was observed in 2 (1.68%) of 119 patients. We eliminated the relapse by repeated unroofing with capitonnage from open access in both cases. A small

residual cavity remained in 9 (7.56%) of 119 children in the remote period after open surgery on the SC. This cavity disappeared without intervention within 1-2 years.

Using open access, we had a better opportunity to take into account the peculiarities of the segmental blood supply to the spleen and choose the most effective method of radical correction of SC. This possibility is limited in a mini-invasive approach. Therefore, not in all cases, there is a possibility of guaranteed radical minimally invasive correction of SC, even in the presence of a large variety of necessary tools and devices. In our opinion, careful and thorough selection is necessary for laparoscopic correction of SC. The information we received using the ultrasound, CT or MRI helped in choosing the method of correction of the cyst. Before planning laparoscopic surgery, it is important to consider the location, size of the SC, its position relative to the architecture of the main vessels, and the degree of damage to the parenchyma.

Analyzing the intraoperative picture and drawing correlations with the results of preoperative radiological studies, we noted a certain pattern. The deep location of the cyst in the parenchyma of the spleen, as well as its location near the main vessels, does not allow to radically perform all the necessary options for its minimally invasive removal. “Crater”, which is created in the parenchyma of the spleen as a result of unroofing, is the cause of recurrence of the cyst in the early stages. Therefore, the operation of unroofing cannot be considered a radical method of surgical treatment of SC, and partial resection of the spleen, in this case, is impossible.

A deep intraparenchymal posterolateral location of the SC with the capsule's surface adjacent to the diaphragm or the posterior or lateral abdominal wall creates a significant complication. The operation of unroofing under such conditions is more likely to lead to the recurrence of the cyst when the rigid “crater” of the inner surface of the cyst becomes covered by the diaphragm or abdominal wall. Capitonnage in the form of suturing of a cyst cavity or by a method of omentoplasty at such localization does not guarantee the complete elimination of a cyst cavity. The residual cavity remains after this intervention, or there is a relapse of SC.

From our own experience, we observed 3 cases of cyst recurrence under such conditions of cyst location and learned about 6 cases from other clinics. Only with good elasticity of the parenchyma of the spleen, a full-fledged capitonnage of the cyst cavity with its own tissues is possible in such a situation. Filling the cyst cavity with omentum is not rational in all cases, which we encountered in 3 more patients. Partial splenectomy with a deep intraparenchymal location of the cyst, even with sufficient technical support of electrosurgery and the presence of argon coagulation is a very traumatic method. It is necessary to dissect a large thickness of the parenchyma, which is the cause of severe intraoperative bleeding.

In total, we noted the recurrence of the cyst in the remote period after laparoscopy in 3 (5.36%) of 56 patients. These were children after unroofing surgery without capitonnage (n = 2) and after unroofing surgery with the

filling of the cyst cavity with omentum strand (n = 1). We corrected this complication by re-unroofing with capitonage: laparoscopy in one case and laparotomy in the other two.

In 7 (12.50%) of 56 children after laparoscopic correction of SC minimal residual cyst cavity remained in the remote period. The cavity healed on its own for 1-2 years.

Thus, to perform "unroofing" you need to clearly consider the location and size of the cyst, as well as the nature of the lesion of the splenic parenchyma. To choose the option of accomplishing the operation "unroofing" (without capitonage or with capitonage) it is necessary to take into account the shape (depth) of the "crater" in the tissue of the organ and the location of blood vessels. Therefore, we believe that subcapsular localization of the cyst with superficial involvement of the surrounding tissues is optimal to perform "unroofing". Such options are available for surgical correction in both the mini-invasive method and laparotomy. We believe that it is necessary to perform capitonage during the operation "unroofing" to minimize the volume of the residual cavity of the cyst in the presence of a deep "crater". The methods of capitonage developed by us and implemented in practice provided suturing of the cyst cavity with U-shaped seams with non-absorbable monofilaments. We used pads from the fibrous wall of the cyst or the omentum, and in some cases used stapler suture.

Significant rigidity of the surrounding parenchyma in our cohort of patients was the main limitation for laparoscopic surgery "unroofing" with capitonage, as it hindered the safe convergence of the cyst walls.

During capitonage, suturing of the spleen and fixation of ligatures can lead to intraoperative bleeding from the parenchyma of the organ due to the incision of these sutures. On the other hand, insufficient alignment of the edges of the parenchymal wall of the cyst in capitonage may cause the formation of a residual cavity or recurrence of the cyst. If during the capitonage procedure it was not possible to close the edges of the parenchymal wall of the cyst, then we filled such cavity with a strand of the omentum.

According to our observations, there is no eventual regression of the primary cyst of the parenchyma of the spleen with a diameter of up to 50 mm inclusive (as noted in many sources). Therefore, we do not agree with the opinion of those authors, who claim that conservative management is a solution for all patients with SC with a diameter of up to 50 mm. The size of the cyst should be differentiated according to the patient's age and the ratio of the cyst size to the spleen. However, the smaller the size of the cyst is, the easier it is to choose a guaranteed radical surgery.

## Conclusions

1. The choice of method of surgical treatment of SC should be individual and depend on the location, size, relation to the architecture of the main vessels, and the variant of lesion of the splenic parenchyma.

2. The operation "unroofing" can be used in children with SC by taking into account the location, size, lesions of the parenchyma.

3. To close or minimize the volume of the residual cavity of the cyst, the operation "unroofing" should be supplemented by capitonage.

4. "Unroofing" with or without capitonage with laparoscopy or laparotomy, by taking into account the segmental blood supply of the spleen, can be considered a rational method of treating SC. It radically eliminates the pathology and preserves all important functions of the affected organ.

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