



# Laparoscopic Spleen-Preserving Decapsulation of a Primary Splenic Cyst in a 9-Year-Old Girl: A Case Report and Literature Review

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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**Case Report**

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## ABSTRACT

Splenic cysts are rare and can be classified as true cysts or pseudocysts. True cysts are further categorized into primary parasitic and non-parasitic types. Among primary congenital cysts, epithelial, epidermoid, and dermoid cysts are noted.

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These cysts are often asymptomatic and are typically discovered incidentally through imaging studies such as ultrasonography, CT, or MRI.

Laparoscopic surgery is considered a safe and effective option for the management of splenic cysts, with spleen preservation being preferred whenever feasible. Various laparoscopic techniques are available, including partial splenectomy, decapsulation, cyst fenestration, and unroofing of the cyst.

We report a rare case of a primary splenic epithelial cyst in a 9-year-old girl, diagnosed via CT imaging of the abdomen. Laparoscopic decapsulation was successfully performed, preserving the spleen and achieving effective management of the cyst.

**Keywords:** Primary splenic cyst; laparoscopic decapsulation; splenic-preserving surgery; pseudocyst.

## 1. INTRODUCTION

According to existing literature, the first case of a primary splenic epithelial cyst was reported by Andral in 1992. This condition is extremely rare, with an incidence rate of approximately 0.07%. Primary splenic cysts are most commonly observed in children, adolescents, and young adults, with a higher prevalence in females [1,2,3,4].

### 1.1 Classification

In 1958, Martin classified splenic cysts into two categories: Type I and Type II.

- Type I (True Cysts): These cysts have an epithelial lining and are further subdivided into:
  1. Parasitic Cysts: Common in endemic regions, typically caused by *Echinococcus granulosus* infection.
  2. Non-Parasitic Cysts: These are congenital in origin and include epithelial, epidermoid, and dermoid cysts.
- Type II (Pseudocysts): These cysts lack an epithelial lining and are usually secondary to trauma, infection (such as splenic abscess), or splenic infarction.

Primary splenic cysts account for approximately 20% of cases, while pseudocysts make up about 80% of reported splenic cysts [1,2,5].

### 1.2 Pathophysiology

The pathogenesis of primary splenic cysts remains uncertain; however, several hypotheses have been proposed:

#### 1.2.1 Mesothelial invagination theory

- During embryonic development, mesothelial cells may invade the splenic

capsule or become trapped in the splenic sulci.

- These cells have a tendency to undergo metaplasia and produce fluid, leading to cyst formation.
- Cysts formed through this mechanism are known as mesothelial cysts and typically exhibit a low cuboidal to low columnar epithelial lining, characteristic of primary epithelial cysts.

#### 1.2.2 Lymph space theory

- This theory suggests that cysts may develop from the normal lymphatic spaces within the spleen.

#### 1.2.3 Endodermal inclusion theory

- This hypothesis posits that epithelial splenic cysts arise from true metaplasia of heterotopic endodermal inclusions within the spleen.
- The pluripotent nature of mesothelium allows it to differentiate into various epithelial linings, such as squamous or columnar epithelium.
- This theory also explains the presence of dermoid cysts in the spleen, which may contain skin appendages, hair follicles, and sebaceous glands [1,2,6,7].

### 1.3 Diagnosis

**Ultrasound:** Typically reveals a well-defined intrasplenic lesion that appears anechoic to hyperechoic. Internal echoes may be observed due to the presence of debris.

**CT Scan:** Demonstrates a hypoattenuating, well-defined intrasplenic lesion with a thin wall that is sharply demarcated from the splenic parenchyma. Wall calcification may also be present.

**MRI:** Shows a well-defined cystic lesion with homogenous fluid signal intensity. It appears as a low signal on T1-weighted images and a very high signal on T2-weighted images [2,5,7].

#### 1.4 Signs and Symptoms

Small splenic cysts, typically less than 5 cm in size, are usually asymptomatic. In 30-40% of cases, the primary presentation is a painless mass in the left hypochondriac region. Larger cysts, exceeding 8 to 10 cm, may cause localized pain or referred pain to the left shoulder due to the mass effect on the diaphragm. Initial symptoms often arise from pressure effects, such as nausea and vomiting. Occasionally, pleuritic pain and persistent cough are reported. Complications, including infection, rupture, or hemorrhage, may also occur. Physical examination may reveal a palpable mass or lump in the left hypochondriac region. Routine hematological and biochemical investigations are generally within normal limits [2,5].

#### 1.5 Tumor Markers

Serum tumor markers such as carcinoembryonic antigen (CEA) and carbohydrate antigen CA 19.9 may be elevated and immunohistochemical analysis. However definitive diagnosis is confirmed by histopathology [1,2].

### 2. CASE PRESENTATION

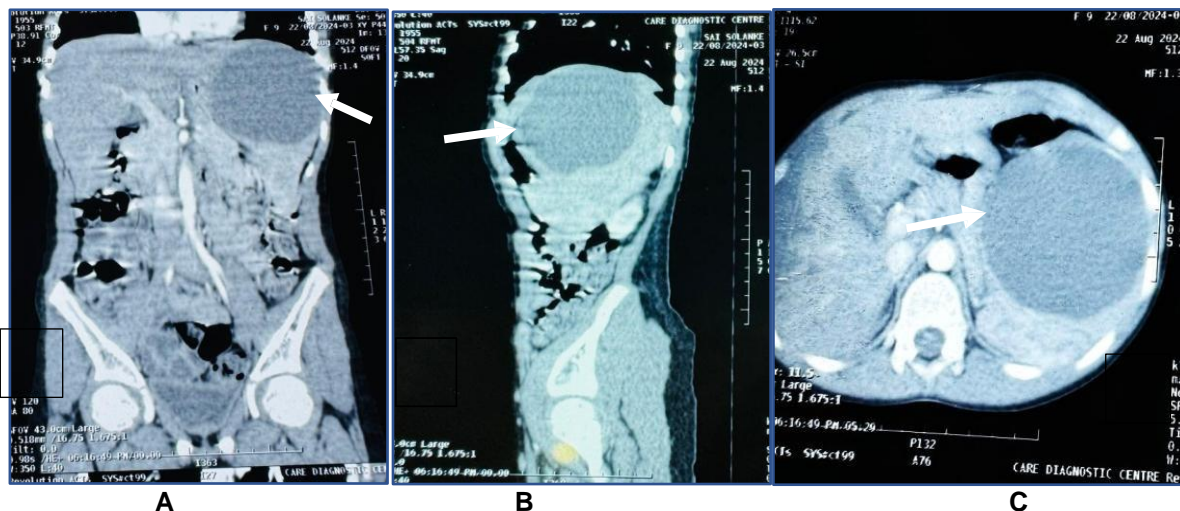
A 9-year-old girl was admitted to our center on 11/09/2024 with complaints of pain and a lump in the left hypochondrium. On physical examination,

a palpable intra-abdominal mass was noted, extending two finger-widths below the left costal margin. The mass was well-defined and non-tender. All blood investigations were within normal limits, and serological testing for *Echinococcus* was negative.

A CT scan of the abdomen revealed a cystic mass measuring 12 × 10 × 9 cm at the upper pole of the spleen. The cyst contained homogenous fluid and showed no septation. The first dose of the pneumococcal vaccine was administered 15 days prior to surgery.

Under general anesthesia, spleen-preserving surgery was performed. The patient was positioned in a modified recumbent right lateral position. A Veress needle was inserted at the level of infraumbilical incision and maintain 12 intraabdominal pressures with CO<sub>2</sub>. A 10 mm camera port was placed for a 30-degree telescope, along with two 5 mm working ports—one in the epigastrium for the left hand and another at the midclavicular line for the right hand. On entering the abdomen with the 30-degree telescope, a large, solitary and white cyst measuring approximately 12 × 10 cm was observed at the upper pole of the spleen. The cyst was displacing the stomach to the right. Aspiration of 500 mL of straw-colored fluid confirmed the cyst.

The anterior wall of the cyst was opened, and the cyst wall was circumferentially excised using a harmonic scalpel. Hemostasis was achieved using electrocautery. An omental flap was placed



**Fig. 1. A,B,C -CT Abdomen coronal, Sagittal & Axil view showing A large, Solitary, well defined unilocular cyst in the upper pole of spleen measuring 12x10x9 cm**

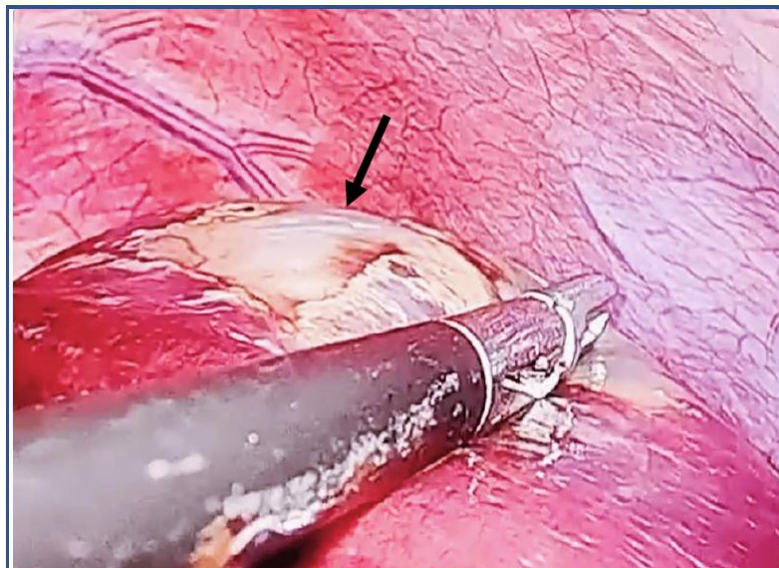
into the cyst cavity to reduce the risk of recurrence. Trocar ports were removed, and closure of the port sites was performed in the standard manner.

The second dose of the pneumococcal vaccine was administered postoperatively. The patient was started on oral fluids the day after surgery. Recovery was uneventful, and she was discharged on the fourth postoperative day.

Gross examination reveals an opened cyst with a trabeculated inner surface, measuring 4.5 x 4

cm. The maximum wall thickness is 0.5 cm, and no significant solid components are observed.

Microscopic examination shows a hemorrhagic cyst wall lined by stratified squamous epithelium. The wall contains splenic lymphoid tissue with interspersed thick-walled blood vessels, fibrosclerotic areas, and focal calcification. No granulomas or parasites are identified, and no cellular atypia is noted. These findings are consistent with an primary epithelial cyst of the spleen [Figs. 1-8].



**Fig. 2. Laparoscopic intraoperative photograph showing white colored cyst arising from upper pole of spleen, in the left hypochondrium**



**Fig. 3. Laparoscopic intraoperative photograph showing aspiration of the splenic cyst**





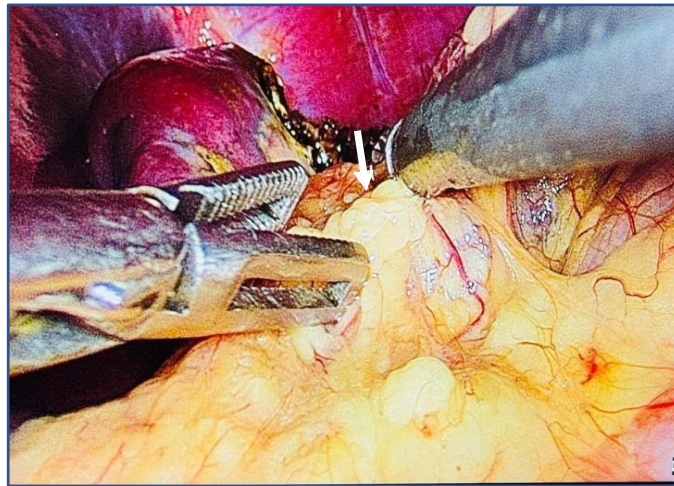
**Fig. 4. Laparoscopic intraoperative photograph showing total decapsulation of cyst with excision**



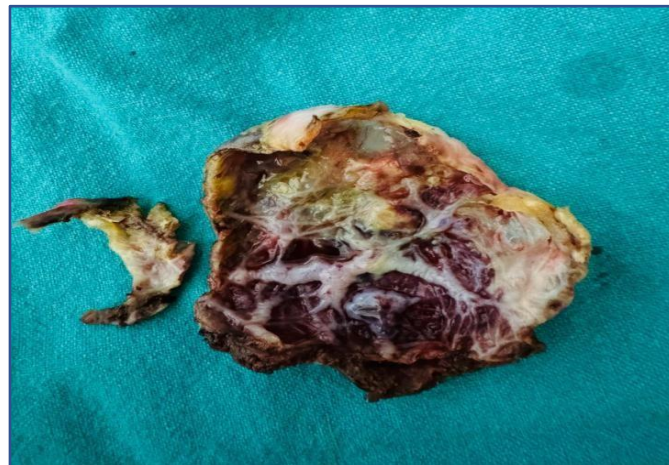
**Fig. 5. Laparoscopic intraoperative photograph showing total decapsulation of cyst with spleen preservation**



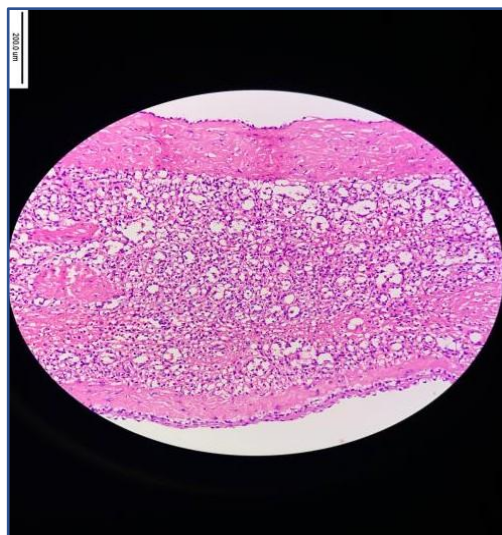
**Fig. 6. Laparoscopic intraoperative photograph showing total excision of splenic cyst**



**Fig. 7. Laparoscopic intraoperative photograph showing omentopexy**



**Fig. 8. Photograph showing Gross aspect of the splenic cyst, glistening inner surface with trabeculated appearance**



**Fig. 9. Histopathology report – showing squamous epithelial lining features are consistent with a primary epithelial splenic cyst**

### 3. DISCUSSION

#### 3.1 Review and Management

Due to the rarity of primary splenic cysts, their surgical management encompasses a variety of techniques, including open or laparoscopic total splenectomy, partial splenectomy, splenic fenestration, decapsulation, deroofting, and marsupialization [1,2,3].

Cysts smaller than 5 cm that are small and asymptomatic Cysts: These are usually monitored with serial ultrasound (US) or CT scans, as spontaneous resolution of traumatic pseudocysts can occur.

Whereas surgical intervention is usually considered for cysts larger than 5 cm that present with symptoms. Spleen-preserving surgery is preferred for cysts located at the upper pole or laterally, while splenectomy is recommended for multiple cysts, very large cysts, cysts located in the hilum of the spleen, or intra-splenic cysts [2,8,7].

#### 3.2 Literature Review

A review of the literature from **PubMed and Google Scholar**, covering the period from 1980 to 2020, was conducted to identify cases managed with laparoscopic decapsulation for primary splenic cysts. The search for splenic-preserving decapsulation in primary non-parasitic splenic cysts revealed only 11 clearly reported cases, indicating that laparoscopic decapsulation for primary splenic cysts remains a rare but viable approach [5,6,9].

**Salky's Report (1985):** The first laparoscopic treatment of a splenic cyst was reported by Salky's in 1985. Since the mid-1990s, numerous reports have emerged describing laparoscopic fenestration or decapsulation of splenic cysts, often followed by omental packing of the residual cyst cavity.

Delaitre first reported laparoscopic splenectomy in 1991 [9].

Wang et al. Performed laparoscopic partial splenectomy in 11 patients with preservation of splenic function.

A systemic view by Jouloumis et al. reported overall success rate reading up to 96% for laparoscopic decapsulation or fenestration and

98-100% for laparoscopic partial splenectomy [2,5,6].

#### 3.3 Surgical Techniques and Management

There is a growing trend toward preserving the spleen, particularly in young and adolescent patients. Techniques such as partial splenectomy, cyst fenestration, decapsulation, and deroofting aim to preserve splenic function. Spleen preservation is recommended as the standard surgical approach to avoid Overwhelming Post-Splenectomy Infection (OPSI), which has an incidence rate of 3-10% after total splenectomy, with a mortality rate of up to 50%.

1. **PAIR Technique:** The PAIR (Puncture, Aspiration, Injection, Re-aspiration) technique is used for parasitic splenic cysts less than 5 cm in diameter. The cyst contents are aspirated, and the cyst is sterilized using 3% hypertonic saline, alcohol, or 0.5% silver nitrate, followed by re-aspiration. However, para-cystic cysts should not be drained percutaneously due to the risk of seeding or anaphylaxis [10].
2. **Partial Splenectomy:** Partial splenectomy can be performed safely either laparoscopically or through laparotomy, provided at least 25% of the splenic parenchyma is preserved. This allows the spleen to maintain its immune function and ability to regulate blood volume. Partial splenectomy is generally reserved for simple, sizeable cysts [10].
3. **Total Splenectomy:** Total splenectomy may be necessary in cases of deep, polycystic, or giant cysts that are difficult to remove. However, this procedure carries significant risks, including severe postoperative infection (3%) and a mortality rate of up to 70% [10].
4. **Marsupialization:** First described in 1982, marsupialization involves separating the cyst wall from the splenic parenchyma and draining the cyst contents. It can be safely performed laparoscopically for superficial cysts, particularly those at the upper pole, or as part of decapsulation procedures [10].
5. **Fenestration or decapsulation:** Fenestration involves partial cystectomy and unroofing of the cyst, followed by omentoplasty or omental packing of the cyst cavity. The procedure often includes



the aspiration of cyst fluid, opening the anterior cyst wall, and excising the cyst wall circumferentially using a harmonic scalpel, followed by omental packing to fill the cyst cavity [10-14].

**Advantages of Laparoscopic Management**  
Laparoscopic management offers several benefits, including: Reduced pain, smaller incisions, shorter hospitalization, Faster return to work, Preservation of spleen function [5,3,4].

#### 4. CONCLUSION

The laparoscopic approach with spleen preservation is crucial for maintaining optimal immunological function and reducing postoperative mortality, especially in younger patients. The most common procedure is laparoscopic fenestration of the splenic cyst, followed by omental packing of the residual cavity. This method is considered safe for eliminating splenic cysts while preserving spleen function.

Laparoscopic decapsulation of congenital primary epithelial cysts is an effective and safe spleen-preserving procedure. Laparoscopic surgery has become a minimally invasive, highly effective approach for treating splenic cysts, offering several advantages, including shorter hospital stays, reduced postoperative pain, and quicker recovery.

#### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

#### ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

#### CONSENT

As per international standards, parental written consent has been collected and preserved by the author(s).

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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