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Case Report

Benign retroperitoneal cystic teratoma: laparoscopic treatment with diaphragm plasty

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ABSTRACT

Retroperitoneal tumors pose diagnostic and treatment challenges due to their deep anatomical location and often minimal early symptoms. This case study details a laparoscopic approach for the removal of a benign retroperitoneal cyst involving diaphragm resection and repair. The patient, who presented with chronic right hypochondrial pain, was initially diagnosed with gallstone disease and based on imaging studies which proposed it as a parasitic cyst in the right liver lobe. But intraoperatively, a retroperitoneal tumor-like mass approximately 5 cm in diameter was found on the posterolateral wall, connected to the right dome of the diaphragm. Using a laparoscopic approach, the mass was excised within healthy tissue margins, followed by resection and plasty of the diaphragm. Histological analysis confirmed the benign nature of the tumor, likely a teratoma with calcified and necrotic areas. The patient's postoperative recovery was smooth, with no complications, and they were discharged in satisfactory condition for further outpatient care.

Keywords: Retroperitoneal neoplasm, Laparoscopic surgery, Diaphragm resection, Minimally invasive surgery, Echinococcal cyst

INTRODUCTION

The retroperitoneum is a crucial anatomical compartment located behind the peritoneal cavity, playing a vital role in housing various organs and structures that lack mesenteric support. This area is classified into three primary compartments: the anterior pararenal space, the posterior pararenal space, and the perirenal space. Each of these compartments contains elements from multiple organ systems, as well as urinary, gastrointestinal, and hormonal system. The posterior border of retroperitoneal region is primarily composed of several key muscles, including the iliacus, quadratus lumborum, psoas, and transverse abdominal muscles. These muscles provide structural support and facilitate various bodily movements. The lateral aspect is defined by the abdominal musculature, while the medial limit along both side of the vertebra is supported by the paraspinous muscles. The iliopsoas muscle serves as the inferior boundary of this compartment, while the diaphragm marks its superior extent, acting as a critical separator between the thoracic and abdominal cavities.[1,2]

Retroperitoneal masses are generally located deep within the space between lumbar muscles and abdominal organs and can be either benign or malignant. Benign masses include lipomas, teratomas, and lymphangiomas, while malignant tumors may arise from various retroperitoneal tissues such as adipose, connective, muscle, or neural tissue, and can also originate from lymph nodes, blood vessels, embryonic remnants, or nerve tissue. Malignant retroperitoneal tumors such as liposarcomas,

fibrosarcoma's, neurolemmomas, and lymphangiosarcomas are relatively rare when compared to malignant tumors arising from other locations.[3]

Retroperitoneal cysts are primarily embryonic in origin, but their development can also be influenced by various factors such as trauma, parasitic infections, lymphatic cell inclusion, and certain genetic disorders. Conditions like Trisomy 21 and Noonan syndrome are particularly associated with the formation of cystic lymphangiomas, which are specific types of retroperitoneal cysts. These cystic masses can be classified based on their morphology: they may present as multilocular lesions, such as pseudomyxoma's, cystic mesotheliomas, and perianal mucinous carcinomas, or as unilocular lesions, like epidermoid cysts and mucinous cystadenomas. Retroperitoneal cystic lesions encompass a spectrum that includes both rare but aggressive malignancies and more commonly encountered benign cysts, such as lymphoceles, which can develop as a complication following surgical interventions. Due to their generally slow-growing nature, retroperitoneal cysts often attain significant sizes before they elicit symptoms. When symptoms do occur, they tend to be nonspecific and may include abdominal distension and discomfort. Bigger cysts will apply pressure on surrounding structures, potentially leading to additional clinical complications, such as obstruction of adjacent organs.[4-6]

Retroperitoneal masses are often classified into five subgroups based on imaging characteristics: vascular or hyper vascular (e.g., solitary fibrous tumors, paragangliomas, pelvic arteriovenous malformations, Klippel-Trénaunay-Weber syndrome, and extraintestinal gastrointestinal stromal tumors [GISTs]), fat-containing (e.g., lipomas, liposarcomas, myelolipomas, presacral teratomas), calcified (e. g., calcified lymphoceles, calcified rejected transplant kidneys, rare sarcomas), and myxoid (e.g., schwannomas, plexiform neurofibromas, myxomas). In our case study we had fat containing teratomas with calcification.[7]

Due to their anatomical complexity and frequently asymptomatic nature, retroperitoneal cystic lesions present diagnostic, therapeutic, and management challenges. These lesions may either cause symptoms from compression of adjacent organs or be detected incidentally during routine imaging, such as abdominal ultrasound. Standard imaging modalities include nuclear magnetic resonance (NMR) and computed tomography (CT), which are crucial for evaluating size, location, and morphology of these lesions. In addition, above mentioned investigation method used to obtain detailed characterization and determine any impacts on surrounding tissues. In cases where intervention is needed, laparoscopic techniques, ultrasonography-guided drainage or surgical excision may serve diagnostic and therapeutic purposes. Fine-needle aspiration or biopsy may be performed for cytological analysis to exclude malignancy, with histopathology providing definitive diagnosis after surgical removal. Prompt diagnosis and regular monitoring is essential to ensure timely intervention and to prevent potential complications.[5,8]

CASE REPORT

Upon arrival at the Grodno university clinic in Grodno, Belarus, the patient conveyed concerns. Patient X (male, 58 years old) hospitalized to the department of organ and tissue transplantation, plastic and endocrine surgery at the Grodno university clinic, referred from a regional outpatient clinic with complaints of intermittent pain in the right hypochondrium over the past three years. During outpatient care, an ultrasound examination of the abdominal organs was performed, leading to diagnosis of gallstone disease, chronic calculous cholecystitis, and a cyst in the sixth segment of the right liver lobe.

Upon admission, the patient's condition was satisfactory. A physical examination showed no liver enlargement, the gallbladder was not palpable, bowel sounds were audible, and the abdomen was soft and painless.

A comprehensive set of laboratory and instrumental diagnostic methods was performed, including (MRI) magnetic resonance imaging of the abdominal cavity (Figure 1).

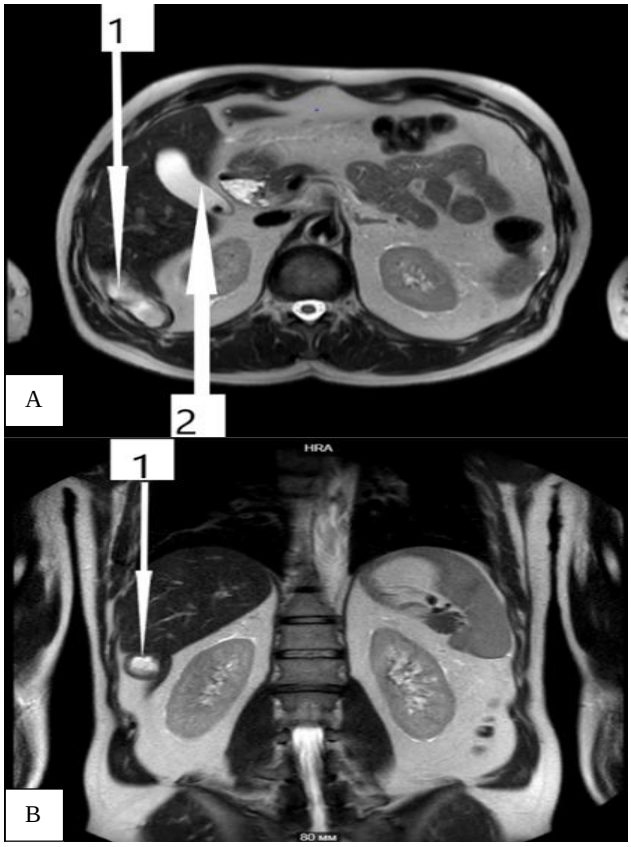

Figure 1 (A and B): Patient X. MRI of the abdominal organs.

1-liver with heterogeneous liquid formation and 2-gallbladder with stones.

According to the MRI data

The findings indicate that the liver exhibits a normal anatomical shape, with the right lobe measuring up to 160 mm along the midclavicular line, while the left lobe measures approximately 34 mm. Notably, a heterogeneous fluid collection is observed on the lower posterior aspect of the liver, measuring about 30×26×62 mm. This fluid formation has walls of varying thickness, reaching up to 4 mm, and contains additional septa. Importantly, the intrahepatic bile ducts remain non-dilated, suggesting normal biliary drainage.

In terms of the gallbladder, its width is measured at 20 mm, characterized by clear contours and uniformly thick walls. However, its lumen contains a stone measuring up to 6 mm. The common bile duct is also noted to be non-dilated, indicating no obstruction in the biliary pathway.

Pancreas positioned normally, exhibiting clear and irregular contours, with no evidence of focal lesions/ abnormalities, which is indicative of healthy pancreatic tissue.

Early conclusion

Signs of gallstone disease-a stone in the gallbladder, and a fluid formation on the lower surface of the liver (likely of parasitic origin).

According to the blood biochemistry analysis

Notable alterations were detected in the patient's serum transaminases, indicating liver involvement or injury. Specifically, the levels of aspartate aminotransferase were elevated to 135 U/L, while alanine aminotransferase showed an even more pronounced increase at 173 U/L. These elevations are significant, as they often correlate with liver cell damage, inflammation, or hepatic stress.

Further analysis revealed an elevated C-reactive protein (CRP) level of 80 mg/L. C-reactive protein is an acute stage reactant produced by the liver due to inflammation, and its elevation often indicates an inflammatory process occurring within the body.

Based on the comprehensive laboratory and instrumental studies conducted, the patient was initially diagnosed with gallstone disease, chronic calculous cholecystitis, and an echinococcal cyst located in 6th segment of the right liver lobe when he hospitalized.

To manage these conditions, a laparoscopic cholecystectomy-removal of gallbladder with a laparoscopic resection of 6th segment of the right liver lobe containing the echinococcal cyst were scheduled as part of the treatment plan.

The surgical procedure commenced under general anesthesia. A trocar and laparoscope were inserted through a small incision in the periumbilical area, which is a common entry point in laparoscopic surgeries due to its accessibility and minimal post-operative discomfort.

Upon examination of the gallbladder, significant signs of chronic inflammation were observed. This condition often results from prolonged irritation due to gallstones, leading to inflammation and thickening of the gallbladder wall. To facilitate the cholecystectomy, additional surgical instruments were introduced, allowing for the secure clipping of the cystic duct and artery, and ensuring that the gallbladder can be safely removed. The coagulation of the gallbladder bed was performed.

During the mobilization of the right liver lobe, a notable tumor-like formation approximately 5 cm in diameter was visualized on the posterolateral wall of the abdominal cavity. This mass was located in the retroperitoneal space and was found to be connected by fibrous bands to the right lobe of the liver (Figure 2).

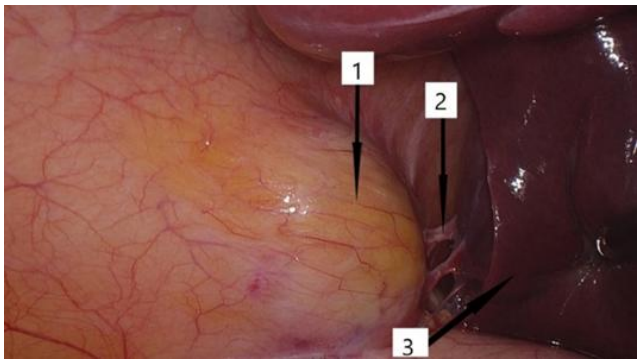

Figure 2: Visualization of tumor-like formation (operative field photo).
1-tumor-like formation; 2-fibrous bands and 3-right side lobe of liver.

Given the intraoperative findings, the surgical team made the decision to excise the tumor while ensuring that healthy tissue margins were preserved. Using monopolar coagulation, the peritoneum above the mass was carefully dissected to have access to the tumor (Figure 3).

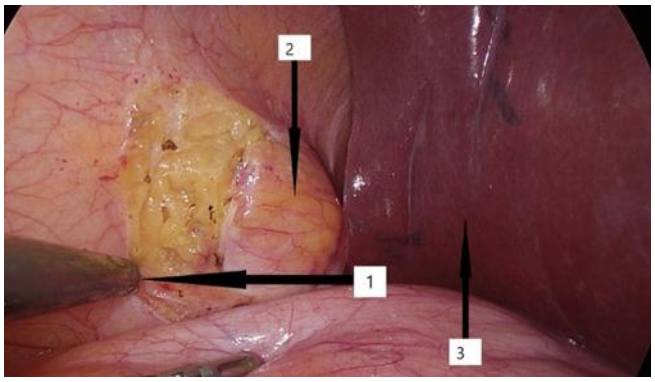

Figure 3: Steps of mobilization (operation field photo).
1-separated peritoneum; 2-tumor like structure bounded by capsule and 3-right-side lobe of liver.

Upon performing instrumental palpation, the mass was found to have a dense consistency and was encased in a capsule, indicating that it was likely a well-defined lesion. The capsule's presence suggests that the tumor might be benign or at least demarcated from adjacent tissues, which can facilitate its removal. However, the mass was noted to be adherent to the surrounding tissues, making separation challenging. This finding is uncommon in cases of retroperitoneal tumors, which often exhibit such characteristics due to their deep anatomical location and the surrounding fibrous tissue (Figure 4).

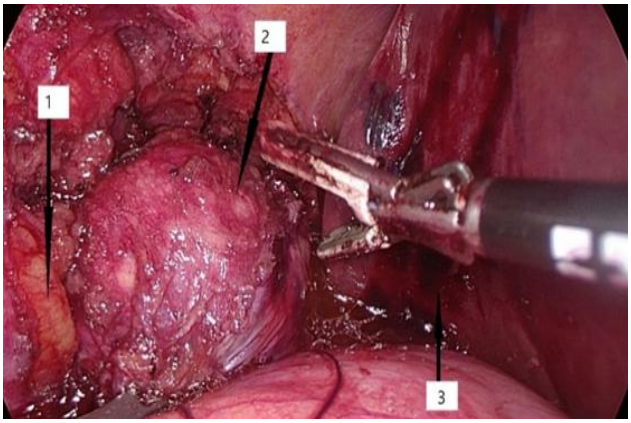

Figure 4: Invasion of the tumor into the right dome of the diaphragm (intraoperative photo).
1-the right dome of the diaphragm; 2-tumor-like formation and 3-the right lobe of the liver.

As the mobilization of the tumor continued, it became evident that it was closely connected to the right dome of the diaphragm (Figure 5).

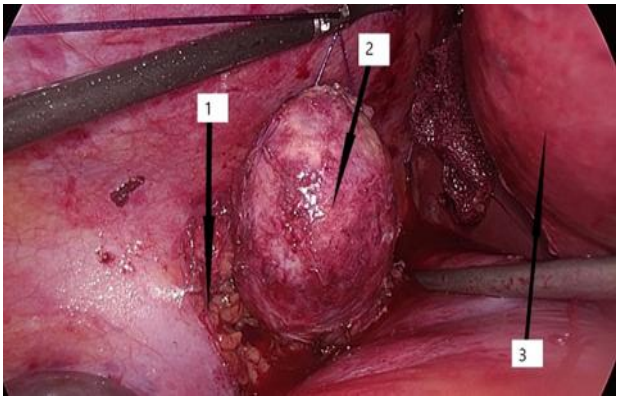

Figure 5: Invasion of the tumor into the right dome of the diaphragm (operation field photo).
1-the right dome of the diaphragm; 2-tumor like structure and 3-right side lobe of the liver.

An intraoperative consultation with a thoracic surgeon was conducted. It was decided to remove the mass along with resection of the diaphragm using a laparoscopic approach. Blunt and sharp dissection with the LigaSure device was used to remove the mass within healthy tissue margins, along with resection of the right dome of the diaphragm (Figure 6).

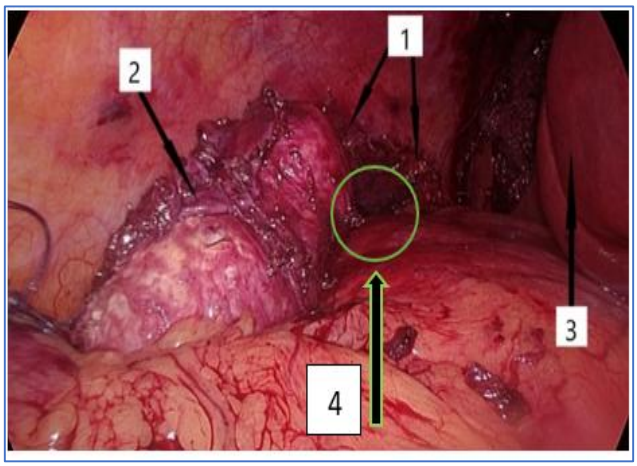

Figure 6: The condition after resection of the diaphragm dome (intraoperative photo).
1-diaphragm plastic; 2-removed tumor-like formation; 3-the right lobe of the liver and 4-hole in the diaphragm.

Under laparoscopic visual control through the diaphragm defect, drainage of the right pleural cavity was performed via an incision, followed by diaphragm plasty with a continuous suture (Figure 7).

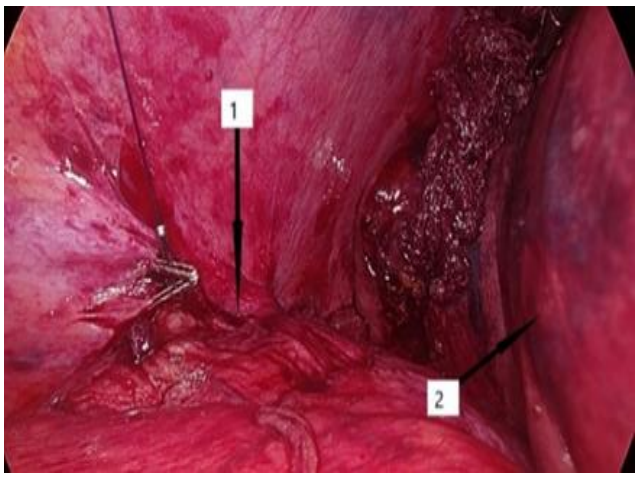

Figure 7: Diaphragm plasty. (operation field photo).
1-diaphragm plasty with uninterrupted suture; 2-right side lobe of the liver.

The abdominal cavity was sanitized, and drainage tubes were placed in the subhepatic and subdiaphragmatic spaces on the right side. Gallbladder together with tumor-like formation were removed from the abdominal cavity through an incision above the umbilicus.

Macroscopic specimen

A tumor-like formation measuring 3×7 cm, of dense consistency, covered with a connective tissue capsule and containing detritus within (Figure 8).

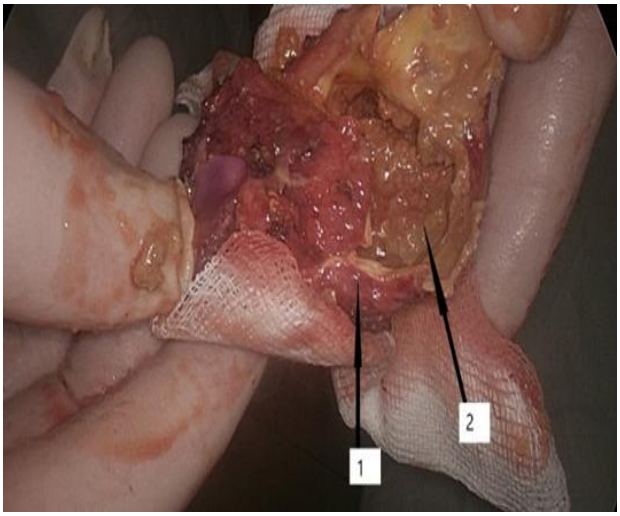

Figure 8: Macro preparation of removed tumor.
1-connective tissue capsules and 2-detritus.

Histological findings

A benign soft tissue neoplasm situated in retroperitoneal space on the right side, 4.5 cm in diameter, with a calcified capsule and necrotic tissues inside. Most likely, it is a teratoma.

The postoperative period was marked by positive dynamics, without complications. The patient was discharged in satisfactory condition on the seventh postoperative day for further outpatient observation and treatment by a surgeon at their place of residence. No repeat visits or admissions were recorded.

DISCUSSION

In retroperitoneal space, organs derived from both ectodermal and endodermal layers are embedded within a loose, extensive connective tissue network. This configuration creates a large potential space, allowing for the silent and often undetected growth of both primary and metastatic tumors until they reach a significant size. Primary retroperitoneal tumors are relatively uncommon, especially when presenting as simple cystic formations, and are often benign in nature. Among these, retroperitoneal cysts containing clear fluid are frequently associated with an origin from the mesonephric duct remnants, which can persist in this region and give rise to fluid-filled cysts. In contrast, other retroperitoneal cysts may contain sebaceous material and are typically classified as teratomas which was observed in our case, reflecting a more complex tissue origin involving various germ cell layers. Additionally, although rare, lymphangiomas can also form within the retroperitoneal space. These benign, fluid-filled lesions arise from lymphatic vessels and can grow within the retroperitoneum, although they are more frequently seen in other anatomical regions. The diversity of retroperitoneal lesions and their potential for silent growth underscore the importance of accurate imaging and histopathological assessment in diagnosis and treatment planning for retroperitoneal masses; because as in our case initially hidden during our diagnosis and later, we confirmed as a cystic teratoma in intraoperative period.[9]

The size of cyst in adults is variable and can reach as large as 41 cm. cyst have been reported to weigh as much as 31.6 kg and contain 3 L of cystic fluid.[10-12] But in our case approximately 5 cm in diameter.

Pathologically, this case exemplifies broader classifications of cystic lesions in retroperitoneal space, which are typically divided into two primary categories: neoplastic and nonneoplastic. Neoplastic retroperitoneal cystic lesions are related to abnormal cellular growths that can either be benign or malignant. Common examples of neoplastic lesions include cystic teratomas, that are composed of mature tissue elements from multiple germ layers; mucinous cystadenomas, which are epithelial tumors containing mucin-producing cells; lymphangiomas, benign tumors derived from lymphatic vessels; and mesotheliomas, which are rare, often aggressive tumors arising from the mesothelial lining of the retroperitoneum. Each type of neoplastic lesion has its own unique histological characteristics, which provide insight into the lesion's behavior, potential for growth, and likelihood of recurrence, making accurate identification essential for developing effective treatment plans.[13] In our case we have Extragonadal teratomas those can be situated in reducing order of frequency: anterior mediastinum, retroperitoneum, pre-sacrum, coccygeal area, intra-cranium and abdomen.[14]

Nonneoplastic retroperitoneal cystic lesions, on the other hand, do not involve neoplastic growth but rather result from other pathophysiological processes, such as fluid accumulation or trauma. These lesions include pseudocysts, which are fluid-filled sacs often resulting from inflammation or injury; lymphoceles, which are collections of lymph fluid that can accumulate following surgery or trauma; urinomas, which are collections of urine typically arising from urinary tract injury; and hematomas, which are localized collections of blood due to hemorrhage. Although generally benign, these lesions may require intervention if they cause symptoms or compress surrounding structures. The precise identification and differentiation of above-mentioned retroperitoneal lesions are paramount for selecting appropriate treatment strategies and predicting patient outcomes. Differentiating between neoplastic and nonneoplastic lesions allows for targeted surgical planning and can help avoid unnecessary procedures, particularly for benign, nonneoplastic lesions that may be managed conservatively.[13] Risk of malignancy of these neoplasms ranges from 6.8% to 36.3% and increases with age, male sex, and presence of immature tissues and solid components.[10,15,16]

The histological classification of retroperitoneal cysts provides a foundational framework for understanding their origins, with categories including urogenital, mesocolic, traumatic, parasitic, and lymphatic types. This classification is rooted in the work of Handfield-Jones, who defined primary retroperitoneal cysts as lesions located within retroperitoneal fat and notably lacking any direct connections to adult anatomical structures, with only loose areolar tissue linking them to adjacent structures. The developmental origins of retroperitoneal cysts are theorized to include a variety of pathways, such as lymphatic, traumatic, and parasitic origins. Lymphatic cysts, for instance, may arise from embryonic remnants of lymphatic vessels that persist within retroperitoneal tissue, occasionally leading to benign lymphangiomas. Traumatic origins, on the other hand, suggest that injury or surgical manipulation may result in pseudocysts formations, as fluid or blood collects within retroperitoneal tissues. Parasitic cysts, though rare, may also form within this space, typically resulting from infections by parasitic organisms, particularly in regions where such infections are endemic. For instance, echinococcal cysts are frequently the main retroperitoneal parasite cysts. Echinococcus infections happen in childhood, although symptoms don't show up until maturity; stomach mass, stomach discomfort, back pain, and urinary tract symptoms are some of the symptoms that a patient with a retroperitoneal cyst may exhibit.[17] This was observed in our case, where the patient was initially diagnosed with echinococcal cyst in sixth segment of the right liver lobe.

Despite these theories, no definitive evidence has yet established a mesothelial origin for primary retroperitoneal cysts. Mesothelial cysts are generally associated with peritoneal or pleural linings rather than the retroperitoneal space. This absence of a clear mesothelial connection further distinguishes primary retroperitoneal cysts from other cystic lesions and highlights the unique, somewhat isolated nature of these structures within the retroperitoneal compartment. Understanding these varied origins is essential for clinicians when evaluating retroperitoneal cysts, as it aids in accurate diagnosis, guides appropriate treatment strategies, and informs prognostic expectations.[18,19]

This case report further underscores the essential role of preoperative imaging in the treatment of retroperitoneal teratomas, given the high perioperative complication rate associated with these tumors due to their proximity to major vascular structures and their potential to distort adjacent organs. Advanced imaging modalities, such as CT and MRI, provide detailed anatomical insights that are invaluable for surgical planning and risk assessment. A retrospective study of 152 childhood cases of retroperitoneal teratomas reported perioperative complications in 41% of patients, often due to challenges such as vascular distortion and organ displacement, which significantly increased the complexity of intraoperative management of cases like these, preoperative imaging is indispensable, as it allows the surgical team to anticipate structural displacements and vascular involvement, thus enabling them to develop a more targeted and cautious approach. This preparation not only facilitates safer tumor resection but also minimizes the likelihood of unintended injury to surrounding tissues, thereby improving surgical outcomes. From a histological perspective, retroperitoneal teratomas frequently appear on CT imaging as well-defined masses containing fluid, fat, and calcifications. These distinct radiological characteristics are particularly useful for preoperative diagnosis, as they aid in differentiating teratomas from other retroperitoneal masses. Such differentiation is crucial, as it allows clinicians to adapt their surgical strategies accordingly, tailoring the approach to the tumor's unique structure and location, while in our case; the first diagnosis of a parasitic liver cyst was revised during surgery to a retroperitoneal cyst attached to the liver and diaphragm, underscoring the challenges in accurately diagnosing retroperitoneal cysts.[19,20] Although MRI was not part of the evaluation in this patient, MRI may have a role of demonstrating invasion of the adjacent organs and delineating cyst contents such as fat which is highly suggestive of teratoma. CT-guided biopsy may be helpful in the diagnosis of such cases; however, it may not sample all the areas with the possibility of missing on the immature and malignant tissues that may be present.[21,22] Overall, the integration of preoperative imaging with histopathological understanding supports a more precise and effective surgical intervention, ultimately leading to better patient outcomes in the management of retroperitoneal teratomas

In 1995, the first laparoscopic removal of a benign retroperitoneal teratoma was reported.[23] This case contributes to the expanding body of evidence affirming laparoscopic excision as an effective and safe approach for managing retroperitoneal tumors. The advantages observed in this case, including reduced postoperative pain, faster recovery, and fewer complications, are consistent with findings from international research. Studies such as Santos et al emphasize the benefits of laparoscopic management, particularly for benign retroperitoneal tumors, highlighting how minimally invasive techniques not only preserve patient comfort but also enhance overall recovery outcomes. The findings in this case further reinforce the utility of laparoscopy as a preferred approach for benign retroperitoneal tumors, demonstrating that this technique can achieve effective tumor removal with minimal morbidity, shorter hospital stays, and lower complication rates.[24] Such outcomes support the broader adoption of laparoscopic excision as a standard approach in managing similar cases.[25]

Finally, this case highlights the need for further research into laparoscopic resection techniques for rare, benign retroperitoneal masses, particularly those involving diaphragmatic attachment. Laparoscopic resection for such tumors has gained acceptance since its initial reports

in 1997 by Tokuda et al with studies indicating regional variations in its prevalence. Notably, most procedures were documented in China, Japan, and the United States. Current literature, including Oliveira et al and Bennett et al calls for large, multicenter trials to further refine patient selection criteria, optimize surgical techniques, and establish evidence-based guidelines for managing of retroperitoneal tumors with diaphragm involvement. The success of this case reaffirms the efficacy of minimally invasive approaches for anatomically challenging cases, yet it also signals the need for further studies on long-term outcomes and recurrence rates in similar cases.[26]

CONCLUSION

This case report underscores the complexity and diversity of retroperitoneal cystic lesions, emphasizing the importance of accurate imaging and histopathological assessment in diagnosis and treatment planning. Retroperitoneal tumors, though relatively uncommon, can present significant diagnostic challenges due to their silent growth and potential for misdiagnosis, as illustrated by the initial misclassification of the cystic teratoma in this case. The case highlights the critical role of advanced imaging modalities, such as CT and MRI, in preoperative planning, particularly for tumors located near major vascular structures or involving adjacent organs like the diaphragm. These imaging techniques are invaluable for anticipating surgical challenges and minimizing perioperative complications.

The successful laparoscopic removal of the retroperitoneal teratoma in this case further supports the growing body of evidence favoring minimally invasive techniques for managing benign retroperitoneal tumors. Laparoscopic excision offers several advantages, including reduced postoperative pain, quicker recovery, and lesser complication rates, making it a preferred approach for such cases. However, the case also highlights the need for further research, particularly in refining surgical techniques and establishing evidence-based guidelines for managing retroperitoneal tumors with diaphragmatic involvement.

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