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Laparoscopic surgery for the diagnosis of abdominal effusion in the modern era of imaging – a retrospective study in a low-to-middle-income country

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Introduction: Intraperitoneal ascites is a consequence or combination of many different underlying diseases. Laparoscopy with peritoneal biopsy is a tool for rapid and accurate diagnosis.

Methods: We retrospectively identified patients who could not be diagnosed by clinical examination, laboratory investigations, and imaging tests.

Results: A total of 103 (55 male and 48 female) patients were selected. The median age of the study group was 54 years (range 38–64 years). Typical clinical symptoms included fever (58.2%), abdominal pain (56.3%), and digestive disorders (62.1%). Fever and digestive disorders were higher in the peritoneal tuberculosis (TB) group than in the metastatic cancer group [(62.1% vs. 12.5%, $P=0.009$) and (66.3% vs. 12.5%, $P=0.004$)]. Abdominal pain was more common in the metastatic cancer group than in the other groups (100% vs. 55.8%, $P=0.020$). Patients in the TB and chronic inflammation groups had lower red blood cell counts and blood albumin (41 vs. 42, $P=0.039$) than those in the metastatic cancer group, respectively. The rate of intestinal wall thickening on ultrasound and peritoneal thickening on computed tomography was higher in the cancer group than in the benign group (87.5% vs. 7.4%, $P=0.000$) (75% vs. 23.2%, $P=0.005$), respectively. There was no difference in the median peritoneal fluid volume between the two groups (390 vs. 340, $P=0.058$). Pathological results showed 88.3%, 7.8%, and 3.9% of peritoneal TB, metastatic cancer, and chronic inflammatory lesions, respectively. The median hospital stay did not differ between the two groups (4 vs. 3 days, $P=0.051$). Both groups of patients had no morbidity or mortality.

Conclusion: Unidentified ascites and peritonitis must be difficult for making diagnose by conventional methods. Laparoscopy might be supportive of making a rapid diagnosis and starting early treatment.

Keywords: ascites, carcinoma, laparoscopy, tuberculosis, tuberculous peritonitis

Introduction

Ascites of unknown origin is a condition when the etiology of ascites cannot be established using traditional laboratory tests, including cell count, albumin and total protein levels, Gram stain, culture, cytology, and further imaging procedures, including ultrasound and computed tomography (CT)[1–3]. Intraperitoneal ascites can result from numerous underlying pathologies, including liver cirrhosis, neoplasm, tuberculous peritonitis, pyogenic peritonitis, congestive heart failure, and pancreatic ascites[1,4–7]. In most cases, the etiology of ascites may be detected with standard clinical and laboratory testing; in other cases, additional examinations may be necessary. This poses a significant diagnostic challenge for clinicians[8,9].

Laparoscopic surgery should be performed to determine the cause of effusion, as it allows the surgeon to directly observe abdominal organs. Biopsy, which may be conducted with direct vision, often improves diagnostic accuracy and is a reliable technique for patients with ascites of unknown origin[3,9–12]. This study describes the outcomes of using laparoscopic surgery to investigate the source of abdominal ascites in Vietnam, a developing nation with limited diagnostic facilities[13,14]. This research revealed the difficult-to-diagnose and prevalent causes of ascites. This study will aid in the orientation of pathological lesions and will be an excellent resource for colleagues worldwide.

Patients and methods

This was a retrospective study based on a chart review. We collected 10-year-old data on cases (both male and female) from January 2011 to December 2020 who underwent diagnostic laparoscopy to determine the causes of ascites at two major hospitals in Hanoi, Vietnam.

Inclusion criteria: The patient had a continuous effusion in the abdomen. Full functional investigations, including

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gastrointestinal endoscopy, a CT scan of the abdomen, and a peritoneal puncture, failed to identify the source of the peritoneal effusion (cytopathology). Fluid, PCR tuberculosis (TB), acid-fast bacilli (AFB) mucous, and the tuberculin skin test (TST; called the Mantoux test) also failed to diagnose.

Exclusion criteria: Cases that underwent laparoscopic surgery to evaluate the stage of the disease or were treated using laparoscopic procedures.

After adequate clinical and laboratory investigations including ultrasonography or CT scans failed to establish the source of ascites, laparoscopy was performed on all patients.

For analysis, preoperative laboratory test variables, and treatment-related and specimen-related variables, postoperative complications, and perioperative data (history and physical examination) were recorded. The data in this study were analyzed using SPSS (Statistical Product and Service Solutions) version 26.0 (IBM, New York, USA).

Written informed consent was obtained from all patients in our study, approved by the Hanoi Medical University Institutional Ethical Review Board, Vietnam (Decision no. 4890/QĐ-ĐHYHN, on 21 October 2022), and the Human Subjects Protection Committee of Bach Mai Hospital (the Director of Bach Mai Hospital signed 126/QĐ-BM on 17 January 2018).

This research conforms to the STROCSS (Strengthening The Reporting Of Cohort Studies in Surgery) 2021 criteria[15].

Surgical procedures

The patient was administered endotracheal anesthesia. Three trocars were used: one 10 mm trocar was placed in the umbilicus, and the other two 5 mm trocars were placed in the bilateral iliac fossa (Fig. 1). However, the positions of the second and third trocars varied in some instances owing to adhesions or inflammation of the peritoneum and intra-abdominal viscera. The surgical procedure was to evaluate the peritoneal and intra-abdominal organs and fluids to detect gross lesions. The fluid was collected to assess cells, bacterial cultures, and biochemical indicators. Peritoneal, omental, and lymph node samples were obtained for pathological assessment.

The visual diagnosis of tuberculous peritonitis was based on the presence of multiple yellowish-white miliary tubercles of uniform size (usually <5 mm) in the visceral and parietal peritoneum. Nodules at least 1 cm in size are usually considered malignant lesions. During the operation, we measured the length of the tumor relative to the end of the Kelly endoscopic instrument. Liver cirrhosis was diagnosed based on irregular nodules with circumferential depression on the liver surface, enlarged vessels on the falciform ligament, and the greater omentum. The histological diagnosis of tuberculous peritonitis was based on caseating or noncaseating granulomas with Langhans giant cells or AFB.

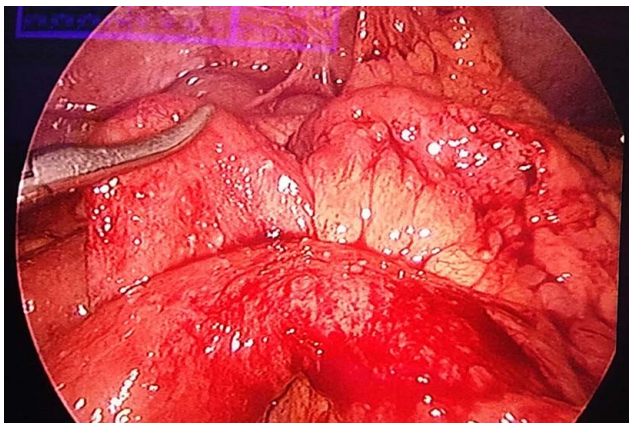

Figure 1. Small intestine and abdominal wall peritoneum visualized by laparoscopy.

Results

A total of 103 (55 male and 48 female) patients were selected. The median age of the study group was 54 years (range 38–64 years). Typical clinical symptoms included fever (58.2%), abdominal pain (56.3%), and digestive disorders (62.1%). Fever and digestive disorders were higher in the peritoneal TB group than in the metastatic cancer group [(62.1% vs. 12.5%, $P=0.009$) and (66.3% vs. 12.5%, $P=0.004$)]. Abdominal pain was more common in the metastatic cancer group than in the other groups (100% vs. 55.8%, $P=0.020$) (Table 1).

Patients in the TB and chronic inflammation groups had lower red blood cell counts and blood albumin (41 vs. 42, $P=0.039$) than those in the metastatic cancer group, respectively. The rate of intestinal wall thickening on ultrasound and peritoneal thickening on CT was higher in the cancer group than in the benign group (87.5% vs. 7.4%, $P=0.000$) (75% vs. 23.2%, $P=0.005$), respectively. There was no difference in the median peritoneal fluid volume between the two groups (390 vs. 340, $P=0.058$). Pathological results showed 88.3%, 7.8%, and 3.9% of peritoneal TB, metastatic cancer, and chronic inflammatory lesions, respectively. The median hospital stay did not differ between the two groups (4 vs. 3 days, $P=0.051$). Both groups of patients had no morbidity or mortality (Table 2).

Discussion

The causes of ascites include several pathological conditions that may arise primarily in several intraperitoneal or extraperitoneal

Table 1

Clinical features

Characteristics	Total patients ($n=103$)	Tuberculosis and nonmalignant metastasis ($n=95$)	Malignant metastasis ($n=8$)	*P*
Age, median (IQR)	54 (38–64)	54 (37–64)	63 (59.5–64)	0.042
Sex (male/female)	52/48	48/47	7/1	0.065
Medical history				
Diabetes	9 (8.7)	2 (2.1)	7 (87.5)	0.000
Hypertension	12 (11.7)	12 (12.6)	0 (0)	
Pulmonary TB	6 (5.8)	6 (6.4)	0 (0)	
Appendectomy	9 (8.7)	9 (9.5)	0 (0)	
Cesarean section	3 (2.9)	3 (3.2)	0 (0)	
Ovarian cyst removal	3 (2.9)	3 (3.2)	0 (0)	
Signs, *n* (%)				
Fever	60 (58.2)	59 (62.1)	1 (12.5)	0.009
Abdominal pains	58 (56.3)	53 (55.8)	8 (100)	0.020
Digestive disorders	64 (62.1)	63 (66.3)	1 (12.5)	0.004

IQR, interquartile range; TB, tuberculosis.

organs. Ascites is the pathological accumulation of fluid in the peritoneal cavity. It is a symptom of numerous medical conditions and has broad differential diagnoses[1,4,9]. Nevertheless, in several cases, the clinical picture appears more complex, or the routine tests fail to disclose the source of fluid collection[5,16]. In such cases, a malignant tumor or a rare and potentially fatal cause of ascites may be present within the peritoneal cavity[11]. Ascites can be classified by the underlying pathophysiological mechanism: portal hypertension, peritoneal disease, hypoalbuminemia, and miscellaneous disorders[4]. Liver cirrhosis (75%) is the most common cause in adults in the Western world, followed by malignancy (10%), heart failure (3%), TB (2%), and pancreatitis (1%)[4,7]. Ascites can be classified as mild ascites detectable only by ultrasound (grade 1), moderate ascites evident by moderate symmetrical distension of the abdomen (grade 2), and significant or gross ascites with marked abdominal distension (grade 3)[4]. The ascites type is divided into exudates and transudates: ascitic protein concentration greater than 2.5 g/dl or less than 2.5 g/dl, respectively. In our study, all patients had high protein (>2.5 g/dl) ascites. Tuberculous peritonitis and carcinomatosis peritonei contain exudates, while ascites of liver cirrhosis, heart failure, and renal failure are transudates. However, diseases believed to exclusively cause exudative ascites may present with transudates and vice versa. Diagnosing peritoneal TB may be challenging for physicians because of the nonspecific clinical and laboratory findings. Patients may show signs and symptoms similar to those of peritoneal carcinomatosis, and sometimes they can be confusing[5]. The rest of the approaches are less sensitive and time consuming, such as ascitic fluid smear (3–10%), AFB culture (20–50%), and PCR (48%). CT reveals characteristic features such as ascites, nodules (a few millimeters), and thickening of the peritoneum and omentum; however, it is difficult to rule out malignancy[1,2,6].

Although there were significant differences between the benign and malignant disease groups in clinical characteristics, such as fever ($P=0.009$), abdominal pain ($P=0.020$), and gastrointestinal disorders ($P=0.004$), there were only a few patients with malignant disease ($n=8$) (Table 1). Therefore, additional research is necessary for this clinical aspect to determine the origin of ascites. The ultrasound characteristics of slight intestinal wall thickening ($P=0.000$) and the CT characteristics of peritoneal wall thickening ($P=0.005$) were distinct between the two groups. This is also consistent with the invasive characteristics of malignancies in advanced stages and peritoneal metastases (Table 2). We also performed diagnostic laparoscopy to obtain samples for histopathological examination in order to confirm the diagnosis (Fig. 1). Laparoscopy is a minimally invasive tool for investigating undiagnosed or doubtful cases[8,12,17]. This provides a detailed and magnified view of the peritoneal cavity (Fig. 2). It enables surgeons to obtain biopsy specimens for histological diagnosis without causing significant morbidity, even in elderly and frail patients. Physicians can also use fine-needle aspiration cytology or fine-needle aspiration biopsy of the involved area for diagnostic purposes. Image-directed fine-needle aspiration cytology is considered a safe, reliable, and accurate method for mass diagnosis, but it has been limited because of the increased malignancy risk. Tissue biopsy is the most sensitive and specific diagnostic procedure for laparotomy or laparoscopy. Microscopically, peritoneal TB is defined by numerous giant confluent granulomas composed of epithelioid cells, with a peripheral zone of lymphocytes and Langhans giant cells with central caseous cell necrosis, as we found in our cases. Compared

Table 2

Blood test parameters, imaging, and the time of hospitalization

Characteristics	Total patients ($n=103$)	Tuberculosis and nonmalignant metastasis ($n=95$)	Malignant metastasis ($n=8$)	*P*
Blood tests, median (IQR)				
RBC (T/l)	4.2 (3.7–4.7)	4.2 (3.7–4.7)	5.4 (3.8–6.2)	0.044
WBC (G/l)	7.8 (6.7–8.8)	7.8 (6.7–8.8)	6.3 (6.3–8.4)	0.096
PLT (G/l)		265 (186–302)	320 (271–320)	0.125
Urea (mmol/l)	4.7 (4.2–5.3)	4.7 (4.2–5.3)	5.7 (4.3–6.1)	0.031
Creatinine (μmol/l)	71 (61–84)	71 (61–84)	92.5 (73.5–97)	0.010
GOT (U/l)	22 (17–31)	22 (17–31)	24 (19.5–24.7)	0.897
GPT (U/l)	23 (16–27)	23 (16–27)	15 (15–25.5)	0.180
Albumin (g/l)	41 (38–43.1)	41 (38–43.2)	42 (42 –46.5)	0.039
Protein ascites (g/l)	39.7 (33.8–47.8)	39.4 (33.8–47.8)	39.9 (37.5–39.9)	0.763
PCR tuberculosis (+)	0 (0)	–	–	–
AFB mucous (+)	0 (0)	–	–	–
Rivalta (+)	103 (100)	95 (100)	8 (100)	1.000
Image characteristics, *n* (%)				
Thickened bowel walls ultrasonography	14 (13.6)	7 (7.4)	7 (87.5)	0.000
Thickened bowel walls	19 (18.4)	17 (17.9)	2 (25)	0.638
Thickening of the peritoneum	28 (27.2)	22 (23.2)	6 (75)	0.005
Intra-abdominal lymph nodes	41 (39.8)	35 (36.8)	6 (75)	0.056
X-ray of pulmonary TB (+)	6 (6)	6 (6.3)	0 (0)	1.000
Abdominal fluid (ml)	380 (300–520)	390 (300–550)	340 (192.5–375)	0.058
Pathology				
TB	91 (88.3)	–	–	–
Malignant metastasis	8 (7.8)	–	–	–
Chronic inflammation	4 (3.9)	–	–	–
Hospitalization day	4 (4–5)	4 (4–5)	3 (3–5.25)	0.051

AFB, acid-fast bacillus; GOT, glutamic-oxaloacetic transaminase; GPT, glutamic-pyruvate transaminase; IQR, interquartile range; PLT, platelet; RBC, red blood cell; TB, tuberculosis; WBC, white blood cell.

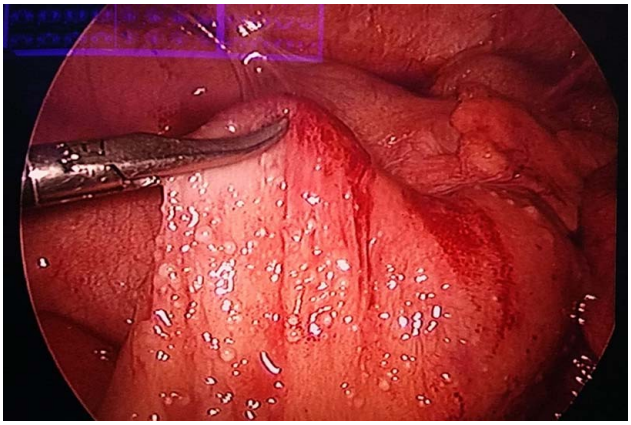

Figure 2. Tuberculosis peritoneal lesions are characterized by tiny white tubercles throughout the peritoneum and small bowel wall.

to conventional methods, laparoscopy is a more accurate and effective approach for diagnosing and treating tuberculous peritonitis. The characteristic intraperitoneal features, such as white nodules and thickened omentum, are highly sensitive (93%) and specific (98%) when combined with histological findings[3,6]. In terms of safety, laparoscopic complications are rare (<3%: bleeding, infection, and bowel perforation), with a reported mortality of up to 0.04%[6,7].

TB is an airborne disease that can be transmitted from human to human and cause severe damage to different organs[3,6]. TB has been a leading health and economic burden worldwide, especially in low-to-middle-income countries, with a global incidence rate of 127 cases per 100 000 people recorded in 2020[13,18]. Vietnam remains among the 30 countries with the highest prevalence rates of TB, despite efforts by the Vietnam National TB Program to decrease the disease burden over the past decade[13,14]. The Vietnam National TB Program is facing considerable challenges in eliminating TB by 2030, with the coronavirus disease 2019 pandemic negatively impacting routine TB services at all administrative levels. A total of 400 370 TB patients with evidence of bacterial involvement were included in the study. We estimated that the prevalence of TB in Vietnam was 414.67 cases per 100 000 population. Hanoi, Da Nang, and Ho Chi Minh City were predicted to be likely epidemiological hotspots[18]. Peritoneal TB is an extrapulmonary TB that occurs in 1–2% of patients and its incidence is higher in developing countries[5]. The mechanism of peritoneal TB may be the hematogenous spread of *Mycobacterium tuberculosis* from a pulmonary infection to the abdominal cavity. Usually, the primary focus in the lungs heals entirely, and no clinical or radiological signs are detected. The complication rate of intestinal obstruction is ~11–20%. Treatment for tuberculous peritonitis generally takes 6 months with first-line anti-TB drugs (isoniazid, rifampicin, ethambutol, and pyrazinamide) in proportion to pulmonary TB[6]. To date, some studies have shown that the sensitivity and specificity of Interferon-gamma (IFN-γ) kits are higher than skin tests[19,20]. But in Vietnam, this test has only been applied since the end of 2019 at some major hospitals, with a price of about 1 800 000 VND (Vietnamese Dong) [~70–100 USD (United States Dollar)/per test]. Therefore, during the period from 2010 to 2020, the patient group of this study was not tested for IFN-γ. In 2010, the US Food and Drug Administration approved the QuantiFERON-TB Gold test (QFT-G) (Cellestis Limited, Carnegie, Victoria, Australia) as a screening test for *M. tuberculosis* infection[19].

Our study has certain limitations. This was a retrospective study with a small sample size from two hospitals. There were some selection biases in this study. In the future, we will continue to focus on this issue. The number of patients in the two groups was compared in a nonrandomized and imbalanced manner. Additionally, this is a restriction when comparing research outcomes.

Conclusion

Diagnostic laparoscopy is a safe, rapid, effective, and accurate method for diagnosing the cause of intra-abdominal diseases when the results of clinical examinations and laboratory investigations are inconclusive.

Ethical approval

Written informed consent was obtained from all the patients in our study, which was approved by the Hanoi Medical University Institutional Ethical Review Board, Vietnam (Decision no. 4890/QĐ-ĐHYHN, on 21 October 2022) and the Human Subjects Protection Committee of Bach Mai Hospital (the Director of Bach Mai Hospital signed 126/QĐ-BM on 17 January 2018).

Patient consent

Written informed consent was obtained from the patient for the publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Patient perspective

None.

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None.

Conflicts of interest disclosure

The authors declare that they have no conflicts of interest.

Author contribution

D.Q.A.: the attending surgeon, conceived the idea, designed the study, conducted a literature search, data collection, data analysis and interpretation, drafted the manuscript, and created the illustrations. T.Q.S.: the principal surgeon, conceived the idea, designed the study, conducted a literature search, data collection, data analysis and interpretation, drafted the manuscript, and created the illustrations. H.T.T.H.: conceived the idea, designed the study, conducted a literature search, data collection, drafted the manuscript, and created the illustrations. All authors read and approved the final manuscript.

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