ORIGINAL ARTICLE

Surgical Manifestations of Hepatobiliarypancreatic Tuberculosis (HBPTB)

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ABSTRACT

Background and Objectives. Hepatobiliarypancreatic tuberculosis (HBPTB) is a less common form of tuberculosis that often presents as malignancy or lithiasis. Advances in diagnostics and minimally invasive procedures have led to the detection of more patients with milder forms of TB requiring surgical management. Due to the low incidence rates and lack of standardized approaches, additional studies are needed to improve patient outcomes. This study examined the risk factors, diagnostic methods, and treatments for HBPTB patients at the University of the Philippines – Philippine General Hospital (UP-PGH) from January 1, 2014 to December 31, 2021.

Methods. This retrospective descriptive study utilized our institutional database to identify patients who underwent a surgical procedure for HBPTB and their associated risk factors. Inclusion criteria required biopsy or microbiologic proof of tuberculous involvement of the biliary tract or nearby structures.

Results. Among a total of 45 patients, the most common admitting diagnosis were HBP tuberculosis (37.8%) and malignancy (35.6%). 47.6% of patients had a previous or concurrent TB exposure. Sixty percent had subclinical malnutrition indicated by normal weight and low albumin. The liver (37.8%) and the bile ducts (33.3%) were the most common organs involved. The most common surgical procedures done were ultrasound-guided liver biopsy, biliary enteric anastomosis, percutaneous transhepatic biliary drainage (PTBD), and endoscopic retrograde cholangiopancreatography with or without stenting (ERCP).

Conclusions. This study provides additional data for clinicians to tailor diagnostic and treatment plans accordingly. Striking a balance between surgical procedures and appropriate anti-tuberculous therapy (ATT) is essential for successful treatment. Local data can be useful to help identify tuberculosis patterns unique to Filipinos and highlight socio-economic factors contributing to this rare presentation of TB.

Keywords: extrapulmonary tuberculosis, biliary tract diseases, general surgery, acute care surgery, liver diseases, pancreas

INTRODUCTION

Tuberculosis, often known as the great imitator, presents with a variety of manifestations across different organ systems. It also manifests with constitutional symptoms and physical findings that can mimic a malignancy. While the lungs are most often affected, involvement of all other organ systems has been well documented – particularly in the gastrointestinal system, skeletal system, lymphatic system, skin, and reproductive system. Descriptions of liver, bile duct, and pancreatic involvement have also been published but to a significantly lesser extent.

The documentation of HBPTB is sporadic at most, with no large center studies to provide baseline data regarding this rare presentation of tuberculosis. Most published works are in the form of case studies or limited case series. A number of these studies draw conclusions based on clinical diagnosis

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alone with no histopathologic proof of tubercular involvement of the biliary tract and surrounding structures.

The first line therapy for treating this disease is through appropriate anti-tuberculous therapy (ATT). Depending on the involved anatomic structures or a suspicion of malignancy, a certain subset of these cases requires varied degrees of surgical intervention. These may be diagnostic (biopsy or laparoscopy) or therapeutic (insertion of drains, stents, bypass procedures or outright resection). The lack of a standardized approach may present a challenge to physicians who encounter this disease. An expansive review of case-to-case treatment approaches may provide the needed direction for improving patient outcomes.

OBJECTIVES

This study describes the clinicopathologic profile and outcomes of surgically managed HBPTB at the Philippine General Hospital (PGH) from January 1, 2014 to December 31, 2021. Specifically, it aims to describe the study population in terms of demographic factors, clinical and pathologic presentation; as well as describe specific surgical procedures and outcomes for the various forms of HBPTB encountered.

MATERIALS AND METHOD

Study Design

This is a retrospective descriptive, single-center study conducted at PGH, a tertiary referral center for pediatric surgical cases. The study reviewed relevant patient records from January 1, 2014 to December 31, 2021.

Participant Selection and Data Collection

Cases were identified through a manual search of all surgical procedures from our institutional database. Relevant in-hospital and out-patient records were reviewed. Due to data storage policies, records from 2013 and later were no longer available for review. The inclusion criteria for this study were as follows: a) all patients of any age with a final diagnosis of HPBTB, b) only cases with confirmed histopathologic or microbiologic involvement, and c) patient must have undergone a diagnostic or therapeutic procedure such as biopsy, endoscopy, laparoscopy, biliary bypass, or outright resection.

Ethical Considerations

The study protocol was reviewed and approved by the University of the Philippines Manila Research Ethics Board prior to any data collection. It was also conducted in accordance with the guidelines of the Helsinki Declaration, the Data Privacy Act of 2012 (RA 10173), and the 2017 National Ethical Guidelines for Privacy and Health-Related Research (NEGHHR). To preserve confidentiality, patients were assigned control numbers for their completed data collection forms. At the end of the data collection period, the collected data was kept in a password-protected folder.

Sampling Method

Total enumeration sampling was used to identify all HBPTB patients from 2014 to 2021.

Study Procedure and Data Analysis

Forty-five (45) patients were identified as fulfilling the inclusion criteria and were included in the study. Unfortunately, only 26.7% had retrievable out-patient charts for review. However, these were still included in the study. All relevant clinical data and demographics, operative notes, and histopathologic reports were encoded in a spreadsheet. The collected data was encoded and analyzed using functions present in Microsoft Excel version 16.2. Measures of central tendency were calculated for identified patient factors, and categorical variables were presented as frequency and percentage tables. Due to the small and highly variable data set, no inferential statistics were used. The distinct categories of HPB involvement – liver, biliary tree, gallbladder, pancreas, and disseminated – were all analyzed using descriptive statistics only.

RESULTS

Demographic Profile

The patient's ages ranged from 16 to 71 years with a median of 43 years. The most common age group was young adults (25 – 44 years), comprising 44.4% of the cohort.

There were 18 males (40%) and 27 females (60%) with a ratio of 0.4:1. Majority of the patients came from Region IVA (44.4%), NCR (17.8%), and Region III (17.8%) – all highly urbanized areas surrounding the referral center. This distribution of demographic and clinical characteristics is seen in Table 1.

Table 1. Demographic and Clinical Characteristics

Variable	Frequency (%)
Age group (years)	
24 and below	8 (17.8)
25-44	20 (44.4)
45-64	14 (31.1)
65 and older	3 (6.7)
Sex	
Male	18 (40)
Female	27 (60)
Present Address	
NCR	8 (17.8)
IVA	20 (44.4)
III	8 (17.8)
Other Regions	9 (21.4)
Nature of Admission	
Emergency	19 (42.2)
Elective	26 (57.8)
Type of Admission	
Charity	34 (75.8)
Pay	11 (24.4)

Past Medical History

Thirty-five patients (83.3%) had no reported medical comorbidities prior to their HBPTB diagnosis. Among those with comorbidities, five had hypertension (11.9%) and two had diabetes mellitus (4.7%). Most of the patients did not have any prior HPB-related procedure (n=35, 77.8%). Among those with such procedures, seven involved biliary tract manipulation, including common bile duct exploration, ERCP, or PTBD. Of the 19 patients tested for chronic Hepatitis B, eight (19.04%) were positive, but only one had been vaccinated. None of the four patients tested for HIV were positive. Most patients had either a normal BMI (67.8%), or were overweight (17.8%). Table 2 shows the previous TB exposures identified. Notably a combined 22 out of 45 patients (48.9%) reported a previous or concurrent TB exposure. Out of these 22, seventeen (17/45 or 37.8%) were pulmonary TB exposures. Sixteen patients had documented TB treatment prior to their HBPTB diagnosis, with 4 not completing the required duration of anti-tuberculous therapy (ATT).

Clinical Presentation

Table 3 shows that most of the patients had a chief complaint of painless jaundice or abdominal pain and had an admitting diagnosis with a suspicion of HPB tuberculosis (37.8%) or malignancy (35.6%). Weight loss as a classic finding of tuberculous infection was only present in 24.4%. Additionally, only three of them had a concurrent diagnosis of cholangitis (6.7%).

Diagnostic Work-up

In this study, no particular patient received standardized work-up due to the diverse presentations of the disease. Tuberculin skin testing (TST) was also not done since almost all Filipinos (> 90%) have received BCG vaccinations at birth. Additionally, QuantiFERON-TB Gold+ was not available in our institution during the study period. Instead, comparisons were made between different serum tests based on available data. Documented elevations in liver enzymes were noted for AST (65%), ALT (52.5%), alkaline phosphatase (91.4%), and total bilirubin (80%). Additionally, albumin levels were low in 60% (24 out of 40) of patients. Among those who underwent chest imaging, 41.67% (10 out of 24) exhibited lesions consistent with pulmonary tuberculosis (PTB), such as calcified nodules or opacities, thickened pleura, or parenchymal traction. Other chest findings include pleural effusion (12.5%), pneumonia (8.33%) and normal results (33.3%). Common abdominal imaging findings (ultrasound, abdominal CT/MRCP) include dilated bile ducts (53.3%), liver masses (34.8%), and calcifications (30%).

Histopathologic examination of biopsy specimens revealed chronic granulomatous inflammation with Langhans-Type Giant Cells in 58.5% of cases, and fibrosis or chronic inflammation in 26.8%. Three patients did not have biopsy specimens, but biliary involvement was confirmed by a positive bile TB PCR. Among those tested for TB via sputum, only 10.52% (2 out of 19) were positive, while bile AFB was positive in 22.2% (2 out of 9). No positive results were obtained for urine or stool AFB.

Surgical Presentation

Table 4 shows the primary involved organ necessitating surgical management. Some cases had disseminated disease which affected many structures surrounding the biliary tract with resultant complications. Twelve (26.8%) patients underwent diagnostic procedures, while 33 (73.3%) underwent some form of therapeutic procedure to relieve symptoms. The most common diagnostic procedure done was ultrasound guided liver biopsy with a total of 12 (26.7%). The creation of a biliary enteric anastomosis (9, 20%) and PTBD (8, 17.8%) were the most common therapeutic procedures. ERCP and common bile duct exploration were the third and fourth most

Table 2. Previous TB Exposures Identified

Variable	Frequency (%)
History of TB* (n=45)	
Previous history of PTB	14 (31.1)
Previous history of other TB infection	9 (20)
Concurrent PTB infection	5 (11.1)
Concurrent disseminated TB infection	11 (24.4)
History of Anti-Tuberculous therapy (n=19)	
Completed therapy	14 (73.7)
Incomplete therapy	4 (21.1)

**Overlapping categories*

Table 3. Common Chief Complaints and Admitting Diagnosis

Variable	Frequency (%)
Chief Complaint	
Jaundice	24 (53.3)
Abdominal Pain	17 (37.8)
Others: Mass, pruritus, pallor, elevated liver enzymes	4 (8.9)
Admitting Diagnosis	
HBP Tuberculosis	17 (37.8)
Malignancy	16 (35.6)
Choledocholithiasis	9 (20)
Others: Cholecystitis, pancreatitis, hepatic abscess	3 (6.7)

Table 4. Primary Involved Organ

Involved Organ	Frequency (%)
Liver	17 (37.8)
Bile Duct	15 (33.3)
Gallbladder	5 (11.1)
Disseminated Disease	3 (6.7)
Pancreas	4 (8.9)
Ampulla	1 (2.2)

Table 5. Diagnostic and Therapeutic Procedures Done

Procedures done*	Frequency (%)
Diagnostic	
Ultrasound Guided Liver Biopsy	12 (26.7)
Laparotomy, Biopsy	3 (10.3)
Esophagogastroduodenoscopy ± Biopsy	2 (6.9)
ERCP only	2 (6.9)
Endoscopic Ultrasound-Guided Biopsy	1 (3.5)
Diagnostic Laparoscopy, Biopsy	1 (3.5)
Therapeutic	
Biliary Enteric Anastomosis	9 (20)
PTBD	8 (17.8)
ERCP + sphincterotomy ± stenting	6 (13.3)
Bile Duct Exploration ± Cholecystectomy	6 (13.3)
Cholecystectomy	3 (6.7)
UTZ Guided Aspiration of Abscess	2 (4.4)
Hepatectomy	2 (4.4)

**Overlapping categories*

common at 13.3% each. Summary of these results are shown in Table 5.

Common intraoperative findings for those that underwent surgical exploration or cholangiography include dilated ducts (46.7%), liver nodules/granuloma (26.7%), bile duct lithiasis, strictures, and lymphadenopathy.

Suspicion of Malignancy

Tumor markers, including CA 19-9, AFP, and CEA levels, were assessed in patients suspected of malignancy. For CA 19-9, there was an equal distribution between patients with normal and elevated values, each accounting for 50% (12 out of 24). For AFP, most patients (86.4%) had normal levels. All patients with measured CEA levels had normal results.

Table 6 presents patients who had a mass on imaging coupled with an elevation in a specific tumor marker, with CA 19-9 being the most prevalent. Although these patients were initially suspected of having malignancy, subsequent resection or biopsy revealed a final histopathologic diagnosis of tuberculosis.

Surgical Outcomes

Most of the procedures had lengths less than two hours combined since these included both endoscopic procedures and biopsy procedures, both minimally invasive (Table 7). Length of hospital stay ranged from 2 to 45 days with an average of 14.53 days and a standard deviation of 11.094 days. Average post-op length of stay was 7.47 days. There was an 11.1% overall morbidity rate with no mortalities. Morbidities encountered were health-care associated pneumonia (6.67%), bacteremia (4.44%), surgical site infection (2%), and post-ERCP pancreatitis (2%). All patients were discharged improved after their procedures and were started on anti-tuberculous therapy.

DISCUSSION

Risk Factors and Pathophysiology

Population based studies on prevalence rates of extra-pulmonary tuberculosis (EPTB) mention that it tends to occur far later in adulthood due to the presence of ageing and comorbidities. In this study, most of the patients belonged to the young adult group aged 25-44 (44.4%). The population in this study also has a larger female predominance at 2.5 is to 1. Lin et al. discusses how among PTB patients, females were more likely to have concurrent EPTB.[1] Studies specific for HBPTB on the other hand support a prevalence in either gender: Hepatobiliary tuberculosis and pancreatic TB with a

Table 6. Patients with Mass on Imaging and Elevated Tumor Markers

Age/Sex	Mass on Imaging	Elevated Tumor Marker	Procedure Done	Final Histopathology Report
27/M	Pancreatic Head Mass	AFP 37.52 IU/ml	ERCP, sphincterotomy, stent insertion	Pancreatic Head Mass: chronic granulomatous inflammation with multinucleated giant cells and caseation necrosis
20/M	Periampullary Mass	CA 19-9 50.29 U/ml	Mesenteric biopsy, frozen section, cholecystectomy, Roux-en-Y choledochojejunostomy, JP drain	Peritoneal Implant: chronic granulomatous inflammation with Langhan's-Type giant cells suggestive of tuberculosis
52/F	Hepatic Mass	CA 19-9 151.32 U/ml	Percutaneous transhepatic biliary drainage, liver biopsy	Liver Tissue: chronic granulomatous inflammation with necrosis
51/F	Distal Common Bile Duct Mass	CA 19-9 96.07 U/ml	Exploratory laparotomy, mesenteric lymph node biopsy, frozen section, cholecystojejunostomy	Peritoneal Implant: chronic granulomatous inflammation with Langhan's-Type giant cells suggestive of tuberculosis
61/M	Periampullary Mass	CA 19-9 >1200 U/ml	Laparotomy, intraoperative ultrasonography, biopsy of liver nodule and mesenteric implants, frozen section, cholecystojejunostomy, JP drain	Liver Biopsy: chronic granulomatous inflammation with Langhan's type giant cells and caseation necrosis
52/M	Distal Common Bile Duct Mass	CA 19-9 54.8 U/ml	EL, excision of bile duct with en bloc cholecystectomy, frozen section, Roux-en-Y-hepaticojejeunostomy	Common Bile Duct and Gallbladder: granulomatous choledochocystitis compatible with tuberculous etiology

Table 7. Surgical Outcomes

Outcome	Frequency (%)
OR time (hours)	
<2	25 (55.6)
2-6	11 (24.4)
>6	9 (20)
Planned staged procedure	2 (4.44)
Intraoperative blood transfusion	5 (11.1)
Post-op ICU admission	1 (2.2)
Overall morbidity	5 (11.1)

male predominance and gallbladder TB in women.[2-4] A study done in Nepal comparing rates of PTB and EPTB suggest that EPTB is more common among young women <25.[5] In all cases, gender specific roles (i.e., stay at home work) play a role in transmission.

An examination of the chief complaint for patients in this sample show that 53.3% brought up jaundice as the reason for consult; usually spanning for a 2-3 month period. 37.8% on the other hand had varying forms of abdominal pain even if they did not have concurrent cholecystitis. Due to the similarities of the constitutional symptoms for tuberculosis and malignancy, it is not surprising that the admitting diagnosis for this subset of patients is almost similar (malignancy at 35.6% and HBP tuberculosis at 37.8%). Hepatic TB can be nonspecific which can lead to a diagnostic delay but most often presents as hepatomegaly, fever, abdominal pain, and weight loss.[6] Pancreatic tuberculosis on the other hand may mimic a pancreatic carcinoma[7] and while the presentation includes constitutional symptoms attributable to tuberculosis, the diagnosis is often detected incidentally after resection[8].

This study suggests that surgical HBPTB cases may not present with clinical malnutrition, as only four patients (14.28%) were underweight while most had normal BMI. Despite tuberculosis being classically associated with weight loss, 60% of patients had low serum albumin levels only, indicating subclinical malnutrition, which may either be an effect of or risk factor for HBPTB. Gupta et al. describe how malnutrition magnifies the effects of tuberculosis, leading to secondary immunodeficiency and increased susceptibility to infection.[9] Previous exposure to tuberculosis has been cited as a risk factor for HBPTB. Saluja mentions how active PTB has been reported in 6-38% of cases.[10] In this sample, we see 5 (11.1%) with a concurrent pulmonary TB infection and 14 (31.1%) with a previous pulmonary TB infection – both similar to reports in literature. The presence of any tuberculosis exposure (whether past or concurrent) was documented only in 22 patients (or 48.9%). While the pathophysiology of HBPTB is thought to occur via seeding from primary sources[10], other mechanism might be responsible particularly in the context of subclinical malnutrition with no apparent primary infection. Possibilities include 1) an undetected dormant primary source or 2) direct infection of the gastrointestinal tract that ends up in the hepatic/biliary systems. This phenomenon is particularly significant since the area is generally hostile for TB bacteria.[7,11]

Diagnosis

Out of the 24 patients with chest radiographs (CXR), only eight had normal findings (33.3%), aligning with published estimates that up to 25% of patients may have normal chest radiographs.[3] There are various presentations of HBPTB but the usual findings of strictures, calcifications, and lymphadenopathy are highlighted in this study. However, for some patients, a biopsy may still be required since imaging may not be able to fully rule out malignancy. Laboratory abnormalities reflect the direct effect of the tuberculous process on the hepatobiliary tract and pancreas, and secondary effects caused by anatomical distortions like obstructive masses, strictures, and stones. The occurrence of elevated CA 19-9 with a tuberculous pancreatic/distal CBD/periampullary mass is very rare, underscoring the mimic nature of tuberculosis regarding malignancy. Diagnosis can only be confirmed after resection, thus oncologic surgical planning is recommended, especially in non-TB endemic settings.

Surgical Therapy and Outcomes

Most surgical procedures (73.3%) were therapeutic, with biliary enteric anastomosis being the most common procedure. This reflects bile duct obstruction as a common pathology requiring treatment. Minimally invasive options (such as PTBD and ERCP) are preferred such unless more invasive open surgeries were necessary – such as for suspected malignancies or more severe obstruction. The average hospital stay was two weeks, with a prolonged pre-op and post-op period, except for elective admissions, which had shorter stays. Morbidities, mainly hospital-acquired pneumonia (6.67%) and bacteremia (4.44%), were managed medically.

Notably, almost every patient in this study had isolated HBPTB without detectable involvement in other organ systems, had no comorbidities, and normal nutritional status. This differs from non-endemic regions where immune susceptibility, such as HIV, liver cirrhosis, malnutrition, organ transplant, and diabetes, often leads to tuberculous involvement of the liver, pancreas, bile duct, or disseminated abdominal tuberculosis.[2,12] The indolent nature of tuberculosis in a competent immune system may explain the rarity of HBPTB in patients with no previous exposure to TB. Unlike the pulmonary and gastrointestinal tracts which are more susceptible to infection[13], the liver, pancreas, and biliary tract are more hostile to the tubercular bacteria. Tubercular deposition around the biliary tract can lead to inflammation and healing cycles, and subsequent stricture or mass formation.[14]

For patients in endemic and high prevalence areas, the suspicion of HBPTB may be warranted in the presence of a previous TB exposure (whether pulmonary or gastrointestinal) or suspicious imaging findings (bile duct

strictures, liver granuloma, lymphadenopathy, calcifications). Ultrasonography is highly recommended for initial imaging, and combining it with other modalities aids in diagnosis. Computed tomography scans are ideal for evaluating hepatobiliary periportal lymphadenopathy, while magnetic resonance cholangiopancreatography is better suited for assessing strictures, particularly in small ductal involvement seen in biliary tuberculosis.

ATT is the first-line treatment for most tubercular HBP cases. Results of this study show that surgical intervention is warranted for: 1) establishing diagnosis, especially with suspicion for malignancy, 2) sepsis control, 3) symptom relief, and 4) preventing further hepatic injury from biliary obstruction. The latter is particularly notable given ATT's hepatotoxic potential. Liver and the bile ducts are the most involved in surgical HBP tuberculosis, although scarring in the biliary tree would be the culprit for most clinically apparent cases of biliary obstruction.

Limitations

While all HBPTB cases within the study period were identified, poorly documented follow-up and the lack of outpatient charts posed significant limitations. Additionally, the rarity of the disease resulted in a low sample size, which precludes the application of inferential statistics to further identify significant risk factors. Since the study was conducted in a tertiary referral center within a metropolitan area, only patients from nearby urbanized centers were included in the study.

CONCLUSION

With the evolving landscape of tuberculosis in the Philippines, rarer forms of HBPTB are expected to be more prevalent. This study provides additional data for clinicians to tailor diagnostic and treatment plans accordingly. Striking a balance between surgical procedures and appropriate ATT is essential for successful treatment. This local data can help identify tuberculosis patterns unique to Filipinos and highlight socio-economic factors contributing to this rare presentation of TB.

Recommendations

Future studies should include additional centers and review long-term outcomes for a more comprehensive description of HBPTB.

Statement of Authorship

Both authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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REFERENCES

1. Lin CY, Chen TC, Lu PL, Lai CC, Yang YH, Lin WR, et al. Effects of gender and age on development of concurrent extrapulmonary tuberculosis in patients with pulmonary tuberculosis: a population based study. PLoS One. 2013 May 22;8(5):e63936. doi: 10.1371/journal.pone.0063936. Erratum in: PLoS One. 2013;8(7). doi:10.1371/annotation/c4731438-54d3-48b4-ad22-1b8f0d2d57ef. PMID: 23717513; PMCID: PMC3661599.
2. Bhattacharya P, Talukdar K, Barman B, Jamil M, Phukan P, Mobing H, et al. Clinical Spectrum and Medical Comorbidities in Tuberculosis: A Hospital-Based Study in Northeast India. Cureus. 2020 Sep 21;12(9):e10580. doi: 10.7759/cureus.10580. PMID: 33110716; PMCID: PMC7580495.
3. Xu XF, Yu RS, Qiu LL, Shen J, Dong F, Chen Y. Gallbladder tuberculosis: CT findings with histopathologic correlation. Korean J Radiol. 2011 Mar-Apr;12(2):196-202. doi: 10.3348/kjr.2011.12.2.196. Epub 2011 Mar 3. PMID: 21430936; PMCID: PMC3052610.
4. Chaudhary P. Hepatobiliary tuberculosis. Ann Gastroenterol. 2014;27(3):207-211. PMID: 24976240; PMCID: PMC4073015.
5. Sreeramareddy CT, Panduru KV, Verma SC, Joshi HS, Bates MN. Comparison of pulmonary and extrapulmonary tuberculosis in Nepal- a hospital-based retrospective study. BMC Infect Dis. 2008 Jan 24;8:8. doi: 10.1186/1471-2334-8-8. PMID: 18218115; PMCID: PMC2245948.
6. Hickey AJ, Gounder L, Moosa MY, Drain PK. A systematic review of hepatic tuberculosis with considerations in human immunodeficiency virus co-infection. BMC Infect Dis. 2015 May 6;15:209. doi: 10.1186/s12879-015-0944-6. PMID: 25943103; PMCID: PMC4425874.
7. Chaudhary P, Bhadana U, Arora MP. Pancreatic Tuberculosis. Indian J Surg. 2015 Dec;77(6):517-24. doi: 10.1007/s12262-015-1318-4. Epub 2015 Aug 14. PMID: 26884661; PMCID: PMC4744229.
8. Sharma V, Rana SS, Kumar A, Bhasin DK. Pancreatic tuberculosis. J Gastroenterol Hepatol. 2016 Feb;31(2):310-8. doi: 10.1111/jgh.13174. PMID: 26414325.
9. Gupta KB, Gupta R, Atreja A, Verma M, Vishvkarma S. Tuberculosis and nutrition. Lung India. 2009 Jan;26(1):9-16. doi: 10.4103/0970-2113.45198. PMID: 20165588; PMCID: PMC2813110.
10. Saluja SS, Ray S, Pal S, Kukeraja M, Srivastava DN, Sahni P, et al. Hepatobiliary and pancreatic tuberculosis: a two decade experience. BMC Surg. 2007 Jun 24;7:10. doi: 10.1186/1471-2482-7-10. PMID: 17588265; PMCID: PMC1925057.
11. Zheng J, Guo MH, Peng HW, Cai XL, Wu YL, Peng XE. The role of hepatitis B infection in anti-tuberculosis drug-induced liver injury: a meta-analysis of cohort studies. Epidemiol Infect. 2020 Nov 23;148:e290. doi: 10.1017/S0950268820002861. PMID: 33222713; PMCID: PMC7770377.
12. Jain A. Extra pulmonary tuberculosis: a diagnostic dilemma. Indian J Clin Biochem. 2011 Jul;26(3):269-73. doi: 10.1007/s12291-010-0104-0. Epub 2011 Jan 11. PMID: 22754191; PMCID: PMC3162957.
13. Grosset J. Mycobacterium tuberculosis in the extracellular compartment: an underestimated adversary. Antimicrob Agents Chemother. 2003 Mar;47(3):833-6. doi: 10.1128/AAC.47.3.833-836.2003. PMID: 12604509; PMCID: PMC149338.
14. Baik SJ, Yoo K, Kim TH, Moon IH, Cho MS. A case of obstructive jaundice caused by tuberculous lymphadenitis: a literature review. Clin Mol Hepatol. 2014 Jun;20(2):208-13. doi: 10.3350/cmh.2014.20.2.208. Epub 2014 Jun 30. PMID: 25032188; PMCID: PMC4099337.