Serologic and urinary characteristics of laboratory-confirmed genitourinary tuberculosis at a tertiary hospital in the Philippines
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Abstract

Background: Genitourinary tuberculosis (GUTB) is known to cause high rates of structural organ damage, however, literature on its biochemical manifestations is limited. Additionally, local studies in the Philippine setting, where cases are rampant, are few and dated. This study aimed to determine the serologic and urinary profile of patients with GUTB admitted at a tertiary hospital within January 2009 to March 2020 and their association with short-term outcomes.

Methods: This retrospective study included 112 patients with laboratory-confirmed GUTB (i.e., positivity in acid-fast smear, polymerase chain reaction, culture, or histology). Demographic data, clinical characteristics, laboratory and radiologic findings, histopathology reports, treatment, and short-term outcomes were recorded.

Results: Bladder (54.5%) and kidney (36.4%) were the most affected organs. The male:female ratio was 1:1.15, and the mean age was 35.79 ± 18.29 years. Weakness (14.29%) was the most common chief complaint. A majority presented with anemia (83.04%), while several had leukocytosis (41.96%) and thrombocytosis (26.79%). Hypoalbuminemia (58.10%), impairment of renal function (36.94%), and electrolyte abnormalities such as hyponatremia (50.93%), hypercalcemia (20.19%), and hypokalemia (21.82%) were common. Proteinuria (67.96%) and pyuria (67.96%) were the most frequent abnormal findings, followed by hematuria (51.46%), acidic urine (45.63%) and low specific gravity (31.07%). Age, leukocytosis, and the need for pressors were all significantly associated with mortality (p values of <0.001, 0.010, and <0.001, respectively).

Conclusions: The young age at presentation with severe clinical and laboratory manifestations may reflect local epidemiology as TB continues to be widespread in the country. Apart from the more commonly cited abnormalities in literature, multiple electrolyte imbalances and urinary concentration defects were also observed in many cases, possibly indicating tubulointerstitial involvement—a complication increasingly mentioned in case reports. As several patient characteristics were found to be associated with the high mortality rates observed in the study, further research is recommended to explore predictive modeling.

Keywords: Genitourinary tuberculosis, Electrolytes, Urinalysis, Association

Introduction

Tuberculosis (TB) remains an important global epidemic, with latest estimates of disease burden amounting to 10.0 (range, 9.0–11.1) million people in 2018 [1]. Extrapulmonary TB (EPTB) is reported to comprise
around 16.5–25% of all cases, attributing 4.5–27% to genitourinary TB (GUTB) [2–4]. GUTB historically pertains to the infection of the urogenital system organs in any combination by *Mycobacterium tuberculosis* (MTB) or *Mycobacterium bovis* [5–8]. It presents with insidious and late-onset symptoms, making its diagnosis and treatment difficult and delayed, and consequently leading to high rates of structural organ damage and kidney failure [9, 10]. Some physicians advocate the term *urogenital TB* (UGTB) as kidney TB is the most relevant infection and is more frequently diagnosed than genital TB [5, 6, 11].

Philippines ranked 4th among the countries with high TB burden in 2018, accounting 6% of the global total. It has a TB incidence rate of 554 (311–866) per 100,000 population, and a mortality rate of 24.57 (20–32) per 100,000 population [1]. This high disease prevalence in the country is multifactorial, attributing to high poverty rate, marked social inequities, and rise in slum housing and crowded living conditions from rapid urbanization [12]. In the Filipino pediatric population, GUTB is found to cause 3% of extrapulmonary TB cases admitted in a tertiary hospital [13].

Despite these figures, there is paucity in literature regarding local experience on GUTB, especially with regards to serologic and urinary findings [14–16]. The last available reference was published 25 years ago, which also needs to be updated. The study aims to determine the serologic and urinary profile of patients with genitourinary TB admitted at a tertiary government hospital in Philippines and their association with short-term outcomes.

**Methods**

**Study design and population**

This is a single-center, retrospective study performed at the Philippine General Hospital (PGH; 1500 beds). This study included GUTB patients diagnosed from January 2009 to March 2020 through positivity in at least one of the following: (1) urine acid-fast bacilli (AFB) staining, (2) urine or tissue polymerase chain reaction (PCR) for *Mycobacterium tuberculosis*, (3) urine or tissue *M. tuberculosis* culture, and (4) histologic findings of granulomatous inflammation (granulomas composed of epithelioid cells and Langhans giant cells with or without caseous necrosis) [14, 15, 17–19]. Culture-positive samples solely involving the female genital tract without urologic involvement, out-patients, in-patients without baseline serologic and urinary tests, and those who got discharged against medical advice were excluded. This study was approved by the University of the Philippines Manila Research Ethics Board and the requirement for informed consent was waived since the investigators evaluated anonymized data.

**Data collection and definition of variables**

Data collection was done through chart review of patient medical records. This included patient demographics; comorbidities; clinical symptoms; complete blood counts; serum chemistries; urinalysis; results of microbial smears and cultures, diagnostics, and histopathology; treatment; and short-term outcomes. Organ involvement was distinguished in those with tissue samples obtained from biopsies or operations.

Serologic abnormalities were defined as follows: (1) anemia as hemoglobin of <150 g/L in neonates 0–30 days old, <105 g/L in 1–23 months of age, <115 g/L in children 2–9 years of age, <125 g/L in males 10–17 years of age, <120 g/L in non-pregnant females 10 years of age and above, <110 g/L in pregnant women, and <130 g/L in men 15 years of age and above [20, 21]; (2) thrombocytopenia as platelets <84,000/µL in newborns ≤1 week old, and <150,000/µL for the rest of the age groups [21, 22]; (3) thrombocytosis as platelets >450,000/µL [22]; (4) leukocytosis as white blood cells >34,000/µL in neonates 0–30 days, >14,000/µL in infants 1–23 months of age, >12,000/µL in 2–9 years of age, >10,500/µL in 10–18 years of age, and >11,000/µL in adults [21, 23]; (5) leukopenia as white blood cells <9100/µL in neonates 0–30 days, <6000/µL in infants 1–23 months of age, <4000/µL in 2–18 years of age, and <4400/µL in adults [21, 23]; (6) hypoalbuminemia as serum albumin <18 g/L in premature neonates 1 day old, <25 g/L in full term neonates <6 days old, <19 g/L in 8 days-1 year old, <34 g/L in 1–3 years of age, <35 g/L in 4–19 years of age, and <34 g/L in adults [21]; (7) impaired renal function as estimated glomerular filtration rate <60 mL/min/1.73 m² [2]; (8) hyperkalemia as plasma K⁺ concentration ≥5.5 mM [22], (2) hypokalemia as plasma K⁺ concentration <3.5 mM [22], (9) hyponatremia as plasma Na⁺ concentration <135 mM [22], and (10) hypercalcemia as total serum calcium concentration ≥10.4 mg/dL [24].

Urinary findings were defined as: (1) acidic urine as urine pH ≤5.5 [24], (2) low specific gravity as urine specific gravity ≤1.010, (3) hematuria as three or more erythrocytes per high-power field [24], (4) proteinuria as detection of proteinuria by dipstick examination [22], and (5) pyuria as detection of more than 5 white blood cells per high-power field in urine microscopy or positive leukocyte esterase dipstick testing [15, 24].
Table 1  Proportion of patients with GUTB

| Diagnosis                  | No. of patients (%) (n = 112) |
|----------------------------|--------------------------------|
| Urine AFB smear-positive   | 56 (50.00%)                    |
| Urine PCR-positive         | 16 (14.29%)                    |
| Urine culture-confirmed    | 18 (16.07%)                    |
| Histopathology             | 22 (19.64%)                    |
| Bladder                    | 12                             |
| Kidney                     | 6                              |
| Kidney and ureter          | 2                              |
| Ureter                     | 2                              |

Table 2  Laterality of organ involvement in GUTB patients confirmed by histopathology

| Organ                  | No. of patients (%) (n = 10) |
|------------------------|------------------------------|
|                        | Right | Left | Unspecified |
| Kidney                 | 1     | 4    | 1           |
| Kidney and ureter      | 0     | 2    | 0           |
| Ureter                 | 1     | 0    | 1           |
| Total                  | 2 (20.0%) | 6 (60.0%) | 2 (20.0%) |

Table 3  Clinical characteristics of patients with GUTB

| Clinical characteristics | No. of patients (%) (n = 112) |
|--------------------------|--------------------------------|
| Gender                   | M 52 (46.43%) | F 60 (53.57%) |
| Age                      | 0 months–1 year: 1 (0.89%) | 1 year–5 years: 2 (1.79%) | 6 years–10 years: 4 (3.57%) | 11 years–18 years: 18 (16.07%) | 19 years–29 years: 21 (18.75%) | 30 years–49 years: 35 (31.25%) | 50 years–69 years: 27 (24.11%) | 70 years or older: 4 (3.57%) |
| Marital status           | Single/widowed: 68 (61.61%) | Married: 43 (38.39%) |
| Occupation               | Employed: 19 (16.96%) | Unemployed: 58 (51.79%) | Not applicable (i.e., pediatric): 26 (23.21%) | Unspecified: 9 (8.04%) |
| Location                 | Urban: 60 (53.57%) | Rural: 48 (42.86%) | Unspecified: 4 (3.57%) |
| Co-morbidity             | Previous TB: 14 (12.50%) | Diabetes mellitus: 5 (4.46%) | HIV/AIDS: 12 (10.71%) | Steroid use (e.g., SLE, NS): 9 (8.04%) | Malignancy: 1 (0.89%) | Chronic kidney disease: 5 (4.46%) | History of urolithiasis: 8 (7.14%) | RTA Type 1: 1 (0.89%) | COPD: 2 (1.79%) | Bronchial asthma: 2 (1.79%) | Hypertension: 13 (11.61%) | Heart failure: 2 (1.79%) | Cerebrovascular disease: 1 (0.89%) | Other organ involvement: 64 (57.14%) | Pulmonary: 57 (50.89%) | Gastrointestinal: 28 (25.00%) | Abdominopelvic: 11 (9.82%) | Central nervous system: 7 (6.25%) | Bone: 4 (3.57%) | Lymph node: 8 (7.14%) | Ear: 2 (1.79%) | Psoriasis: 2 (1.79%) | Cutaneous/wound: 3 (2.68%) |

Fig. 1  Flow diagram of study selection. DAMA discharged against medical advice

Statistical analysis

Descriptive statistics were used in the analysis of this study. Frequency and percentage were used to describe categorical variables and proportions of patients who improved, expired, or developed short-term outcomes such as the need for pressors or renal replacement therapy. Continuous variables were expressed as median. Associations were determined by bivariate analysis using Fisher’s exact test for characteristics involving 2 categories or Chi-square test for those with >2 categories.
and kidney (n = 8, 36.4%) were the most involved genitourinary organs. Among those with kidney and ureter involvement, left laterality was observed in 60% (Table 2).

### Patient characteristics

Baseline clinical characteristics of the patients with GUTB are shown in Table 3. The mean age (± SD) was 35.79 ± 18.29 years (range, 1–82 years) and the male-to-female ratio was 1:1.15 (52:60). Most patients were single or widowed (61.61%) and lived in urban areas (53.57%). Fourteen patients (12.5%) had a previous history of tuberculosis, while 64 patients (57.14%) had present categories. Mean lengths of hospital stay between those with and without the identified clinical, serologic, and urinary characteristics were compared using Mann–Whitney U-test for characteristics involving 2 categories or Kruskal–Wallis test for those with > 2 categories. For all tests, p value of at most 0.05 indicate significance.

### Results

A total of 228 patients with laboratory-confirmed GUTB were identified. Ninety-six charts were irretrievable due to institutional limitations in records retention, while 20 cases met the exclusion criteria (Fig. 1). Among the 112 patients included in the study, half (50.0%) had positive smears for urine AFB (Table 1). In those with histopathologic evidence of infection, bladder (n = 12, 54.5%)

### Table 3 (continued)

| Clinical characteristics | No. of patients (%) (n = 112) |
|--------------------------|--------------------------------|
| **Chief complaint**      |                                |
| Weakness                 | 16 (14.29%)                    |
| Difficulty of breathing  | 14 (12.50%)                    |
| Flank pain               | 13 (11.61%)                    |
| Abdominal pain           | 11 (9.82%)                     |
| Hematuria                | 9 (8.04%)                      |
| Dysuria                  | 9 (8.04%)                      |
| Fever                    | 8 (7.14%)                      |
| Abdominal/pelvic mass on diagnostic | 5 (4.46%) |
| Pedal edema              | 4 (3.57%)                      |
| Umbilical discharge      | 3 (2.68%)                      |
| Gluteal pain             | 2 (1.79%)                      |
| Vaginal bleeding         | 2 (1.79%)                      |
| Cough                    | 2 (1.79%)                      |
| Seizure                  | 2 (1.79%)                      |
| Urinary retention        | 1 (0.89%)                      |
| Inguinal pain            | 1 (0.89%)                      |
| Fistula formation (ureterocutaneous) | 1 (0.89%) |
| Scrotal discharge        | 1 (0.89%)                      |
| Double J stent reinsertion | 1 (0.89%)                  |
| Decrease in sensorium    | 1 (0.89%)                      |
| Vomiting                 | 1 (0.89%)                      |
| Others                   | 5 (4.46%)                      |

COPD chronic obstructive pulmonary disease, F female, HIV/AIDS human immunodeficiency virus or acquired immunodeficiency syndrome, M male, NS nephrotic syndrome, RTA Type 1 renal tubular acidosis Type 1, SLE systemic lupus erythematosus, TB tuberculosis

### Table 4 Serologic characteristics of patients with GUTB

| Serologic abnormalities | No. of patients (%) |
|-------------------------|---------------------|
| Anemia                  | 93 (83.04%, n = 112) |
| Thrombocytopenia        | 6 (5.36%, n = 112)   |
| Thrombocytosis          | 30 (26.79%, n = 112) |
| Leukocytosis            | 47 (41.96%, n = 112) |
| Leukopenia              | 6 (5.36%, n = 112)   |
| Hypoaalbuminemia        | 61 (58.10%, n = 105) |
| Renal function impairment | 41 (36.94%, n = 111) |
| Hyperkalemia            | 9 (8.18%, n = 110)   |
| Hypokalemia             | 24 (21.82%, n = 110) |
| Hyponatremia            | 55 (50.93%, n = 108) |
| Hypercalcemia           | 21 (20.19%, n = 104) |

### Table 5 Urinary characteristics of patients with GUTB

| Urinary abnormalities | No. of patients (%) |
|-----------------------|---------------------|
| Acidic pH             | 47 (45.63%)         |
| Low specific gravity  | 32 (31.07%)         |
| Proteinuria           | 70 (67.96%)         |
| Negative              | 33 (32.04%)         |
| Trace                 | 15 (14.56%)         |
| 1+                    | 36 (34.95%)         |
| 2+                    | 16 (15.53%)         |
| 3+                    | 3 (2.91%)           |
| Hematuria             | 53 (51.46%)         |
| Pyuria                | 70 (67.96%)         |
| Pyuria + hematuria    | 50 (48.54%)         |
| Casts                 | 17 (16.50%)         |
| Crystals              | 4 (3.88%)           |
### Table 6  Imaging findings associated with GUTB

| Method                              | Findings                                                                                           |
|-------------------------------------|----------------------------------------------------------------------------------------------------|
| **Intravenous pyelography**         | Unilateral renal parenchymal disease                                                             |
|                                     | Non-functioning kidney                                                                             |
|                                     | Calcification of the urinary tract: medullary nephrocalcinosis, nephrolithiasis, ureterolithiasis, cystolithiasis |
|                                     | Bladder wall thickening                                                                            |
| **CT scan**                         | Hypodense renal foci with or without internal septations or peripheral calcifications               |
|                                     | Renal cysts, Bosniak I and II                                                                      |
|                                     | Renal mass                                                                                         |
|                                     | Calcification of the urinary tract: nephrolithiasis, ureteropelvic junction lithiases              |
|                                     | Urinary tract dilatation: hydronephrosis, ureteropelvocalyctasia with possible distal ureteral stricture |
|                                     | Ureteral wall thickening                                                                           |
|                                     | Bladder wall thickening                                                                            |
|                                     | Vesicocutaneous fistulous tract                                                                    |
|                                     | Evidence of extra-renal TB infection:                                                             |
|                                     | Pulmonary tuberculosis with or without endobrochial spread                                          |
|                                     | Distal ileal and ileocecal wall thickening with multiple abscess formation (intraabdominal, pelvic, and prostatic regions) and lymphadenopathies |
|                                     | Multilevel vertebral lesions with disc destruction (Pott’s disease) with abscess formation involving adjacent muscles (psoas, iliopsoas and gluteus maximus) |
| **Ultrasound**                      | Unilateral or bilateral renal parenchymal disease with or without signs of chronicity             |
|                                     | Echogenic renal walls with or without internal echoes suggestive of pyelitis or pyelonephritis     |
|                                     | Pyonephrosis                                                                                       |
|                                     | Renal cysts or mass                                                                                |
|                                     | Calcification of the urinary tract: nephrocalcinosis, nonspecific parenchymal/perinephric/periureteral calcifications, nephrolithiasis, urolithiases, |
|                                     | Urinary tract dilatation: hydronephrosis, focal caliectasia, pelvocalyctasia, ureteropelvocalyctasia |
|                                     | Irregular, diffuse, or heterogeneous bladder wall thickening                                       |
|                                     | Evidence of abdominopelvic Koch’s infection: tobacco pouch appearance of fallopian tube, thickening of uterine serosa and peritoneum, palisading bowel loops, and massive ascites |

### Table 7  Management of admitted patients with GUTB

| Intervention                  | No. of patients (%) (n = 112) |
|-------------------------------|-------------------------------|
| Anti-Koch’s therapy           | 71 (63.39%)                   |
| Operation                     | 29 (25.89%)                   |
| Percutaneous tube nephrostomy | 10 (8.93%)                    |
| Double J stent insertion      | 11 (9.82%)                    |
| Nephrectomy                   | 2 (1.79%)                     |
| Subcapsular nephrectomy       | 5 (4.46%)                     |
| Cytoreductive nephrectomy     | 1 (0.89%)                     |
| Aspiration of renal abscess   | 1 (0.89%)                     |
| Radial nephrolithotomy        | 1 (0.89%)                     |
| Pelvikolithotomy              | 1 (0.89%)                     |
| Uretorototomy                 | 1 (0.89%)                     |
| Ureteroneocystostomy          | 1 (0.89%)                     |
| Bladder mass excision         | 3 (2.68%)                     |
| Transurethral resection of bladder tumor | 1 (0.89%) |

### Table 8  Short-term outcomes of admitted patients with GUTB

| Outcome                                           | No. of patients (%) |
|---------------------------------------------------|---------------------|
| Length of hospital stay in days, median (min–max) | 11 (0.67–90)        |
| Improved, n (%)                                   | 103 (91.96%)        |
| Expired, n (%)                                    | 9 (8.04%)           |
| Need for pressors, n (%)                          | 15 (13.39%)         |
| Need for renal replacement therapy, n (%)         | 1 (0.89%)           |

Evidence of other organ involvement, with lungs (50.89%) being the most concomitantly involved organ. Twenty-four patients (21.43%) exhibited systemic symptoms such as weakness (14.29%) and fever (7.14%), while 57 patients (50.89%) had genitourinary manifestations as their chief complaint. Flank or abdominal pain was the most common presenting genitourinary symptom (21.43%).
### Table 9  Bivariate analysis: clinical characteristics and mortality

| Characteristic                  | Category               | Mortality |          |          |          | p value |
|--------------------------------|------------------------|-----------|----------|----------|----------|---------|
|                                |                        | Survived  |          | Expired  |          |         |
|                                |                        | Count     | Row %    | Count    | Row %    |         |
| Gender                         | Male                   | 48        | 92.3     | 4        | 7.7      | 1.000   |
|                                | Female                 | 55        | 91.7     | 5        | 8.3      |         |
| Age                            | 0 months to 1 year     | 0         | 0.0      | 1        | 100.0    | <0.001  |
|                                | 1–5 years              | 0         | 0.0      | 2        | 100.0    |         |
|                                | 6–10 years             | 4         | 100.0    | 0        | 0.0      |         |
|                                | 11–18 years            | 17        | 94.4     | 1        | 5.6      |         |
|                                | 19–29 years            | 19        | 90.5     | 2        | 9.5      |         |
|                                | 30–49 years            | 33        | 94.3     | 2        | 5.7      |         |
|                                | 50–69 years            | 26        | 96.3     | 1        | 3.7      |         |
|                                | ≥ 70 years             | 4         | 100.0    | 0        | 0.0      |         |
| Marital status                 | Single/widowed         | 63        | 91.3     | 6        | 8.7      | 1.000   |
|                                | Married                | 40        | 93.0     | 3        | 7.0      |         |
| Occupation                     | Employed               | 18        | 94.7     | 1        | 5.3      | 0.394   |
|                                | Unemployed             | 54        | 93.1     | 4        | 6.9      |         |
|                                | Not applicable         | 22        | 84.6     | 4        | 15.4     |         |
|                                | Unspecified            | 9         | 100.0    | 0        | 0.0      |         |
| Location                       | City                   | 55        | 91.7     | 5        | 8.3      | 0.834   |
|                                | Province               | 44        | 91.7     | 4        | 8.3      |         |
|                                | Unspecified            | 4         | 100.0    | 0        | 0.0      |         |
| Co-morbidity                   | Yes                    | 50        | 94.3     | 3        | 5.7      | 0.495   |
|                                | No                     | 53        | 89.8     | 6        | 10.2     |         |
| Diabetes mellitus              | Yes                    | 5         | 100.0    | 0        | 0.0      | 1.000   |
|                                | No                     | 98        | 91.6     | 9        | 8.4      |         |
| Hypertension                   | Yes                    | 13        | 100.0    | 0        | 0.0      | 0.595   |
|                                | No                     | 90        | 90.9     | 9        | 9.1      |         |
| Chronic kidney disease         | Yes                    | 4         | 80.0     | 1        | 20.0     | 0.347   |
|                                | No                     | 99        | 92.5     | 8        | 7.5      |         |
| History of urolithiasis        | Yes                    | 8         | 100.0    | 0        | 0.0      | 1.000   |
|                                | No                     | 95        | 91.3     | 9        | 8.7      |         |
| Malignancy                     | Yes                    | 1         | 100.0    | 0        | 0.0      | 1.000   |
|                                | No                     | 102       | 91.9     | 9        | 8.1      |         |
| HIV/AIDS                       | Yes                    | 10        | 83.3     | 2        | 16.7     | 0.247   |
|                                | No                     | 93        | 93.0     | 7        | 7.0      |         |
| Steroid use                    | Yes                    | 9         | 100.0    | 0        | 0.0      | 1.000   |
|                                | No                     | 94        | 91.3     | 9        | 8.7      |         |
| Systemic lupus erythematous    | Yes                    | 8         | 100.0    | 0        | 0.0      | 1.000   |
|                                | No                     | 95        | 91.3     | 9        | 8.7      |         |
| Nephrotic syndrome             | Yes                    | 1         | 100.0    | 0        | 0.0      | 1.000   |
|                                | No                     | 102       | 91.9     | 9        | 8.1      |         |
| Cerebrovascular disease        | Yes                    | 1         | 100.0    | 0        | 0.0      | 1.000   |
|                                | No                     | 102       | 91.9     | 9        | 8.1      |         |
| Coronary artery disease        | Yes                    | 103       | 92.0     | 9        | 8.0      | No test*|
| Heart failure                  | Yes                    | 2         | 100.0    | 0        | 0.0      | 1.000   |
|                                | No                     | 101       | 91.8     | 9        | 8.2      |         |
| COPD                           | Yes                    | 1         | 100.0    | 0        | 0.0      | 1.000   |
|                                | No                     | 102       | 91.9     | 9        | 8.1      |         |
| Bronchial asthma               | Yes                    | 2         | 100.0    | 0        | 0.0      | 1.000   |
|                                | No                     | 101       | 91.8     | 9        | 8.2      |         |
| Characteristic                          | Category | Mortality | p value |
|----------------------------------------|----------|-----------|---------|
|                                        |          | Survived  | Expired |
|                                        |          | Count     | Row %   | Count    | Row % |
| Spina bifida                           | No       | 103       | 92.0    | 9        | 8.0   | No test* |
| RTA Type 1                             | Yes      | 1         | 100.0   | 0        | 0.0   | 1.000 |
|                                        | No       | 102       | 91.9    | 9        | 8.1   |       |
| Previous TB                            | Yes      | 14        | 100.0   | 0        | 0.0   | 0.599 |
|                                        | No       | 89        | 90.8    | 9        | 9.2   |       |
| Other organ involvement of TB          | Yes      | 57        | 89.1    | 7        | 10.9  | 0.296 |
|                                        | No       | 46        | 95.8    | 2        | 4.2   |       |
| Pulmonary TB                           | Yes      | 50        | 87.7    | 7        | 12.3  | 0.162 |
|                                        | No       | 53        | 96.4    | 2        | 3.6   |       |
| Gastrointestinal TB                    | Yes      | 24        | 85.7    | 4        | 14.3  | 0.224 |
|                                        | No       | 79        | 94.0    | 5        | 6.0   |       |
| Abdominopelvic TB                      | Yes      | 11        | 100.0   | 0        | 0.0   | 0.595 |
|                                        | No       | 92        | 91.1    | 9        | 8.9   |       |
| CNS TB                                 | Yes      | 6         | 85.7    | 1        | 14.3  | 0.453 |
|                                        | No       | 97        | 92.4    | 8        | 7.6   |       |
| Bone TB                                | Yes      | 3         | 75.0    | 1        | 25.0  | 0.288 |
|                                        | No       | 100       | 92.6    | 8        | 7.4   |       |
| Cutaneous/Wound TB                     | Yes      | 3         | 100.0   | 0        | 0.0   | 1.000 |
|                                        | No       | 100       | 91.7    | 9        | 8.3   |       |
| TB Adenitis                            | Yes      | 7         | 87.5    | 1        | 12.5  | 0.500 |
|                                        | No       | 96        | 92.3    | 8        | 7.7   |       |
| Ear TB                                 | Yes      | 1         | 50.0    | 1        | 50.0  | 0.155 |
|                                        | No       | 102       | 92.7    | 8        | 7.3   |       |
| Psoas TB                               | Yes      | 1         | 50.0    | 1        | 50.0  | 0.155 |
|                                        | No       | 102       | 92.7    | 8        | 7.3   |       |
| Dysuria                                | Yes      | 7         | 100.0   | 0        | 0.0   | 1.000 |
|                                        | No       | 82        | 90.1    | 9        | 9.9   |       |
| Hematuria                              | Yes      | 7         | 77.8    | 2        | 22.2  | 0.192 |
|                                        | No       | 82        | 92.1    | 7        | 7.9   |       |
| Urinary retention                      | Yes      | 1         | 100.0   | 0        | 0.0   | 1.000 |
|                                        | No       | 88        | 90.7    | 9        | 9.3   |       |
| Flank pain                             | Yes      | 11        | 100.0   | 0        | 0.0   | 0.592 |
|                                        | No       | 78        | 89.7    | 9        | 10.3  |       |
| Inguinal pain                          | Yes      | 1         | 100.0   | 0        | 0.0   | 1.000 |
|                                        | No       | 88        | 90.7    | 9        | 9.3   |       |
| Umbilical discharge                    | Yes      | 3         | 100.0   | 0        | 0.0   | 1.000 |
|                                        | No       | 86        | 90.5    | 9        | 9.5   |       |
| Fistula (uretero-cutaneous fistula)    | Yes      | 1         | 100.0   | 0        | 0.0   | 1.000 |
|                                        | No       | 88        | 90.7    | 9        | 9.3   |       |
| Scrotal discharge                      | Yes      | 1         | 100.0   | 0        | 0.0   | 1.000 |
|                                        | No       | 88        | 90.7    | 9        | 9.3   |       |
| Double J stent reinsertion             | Yes      | 1         | 100.0   | 0        | 0.0   | 1.000 |
|                                        | No       | 88        | 90.7    | 9        | 9.3   |       |
| Pedal edema                            | Yes      | 4         | 100.0   | 0        | 0.0   | 1.000 |
|                                        | No       | 85        | 90.4    | 9        | 9.6   |       |
| Fever                                  | Yes      | 7         | 100.0   | 0        | 0.0   | 1.000 |
|                                        | No       | 82        | 90.1    | 9        | 9.9   |       |
Table 9 (continued)

| Characteristic                  | Category | Mortality | p value |
|---------------------------------|----------|-----------|---------|
|                                 |          | Survived  | Expired |
|                                 |          | Count     | Row %   | Count     | Row %   |
| Weakness                        | Yes      | 14        | 93.3    | 1         | 6.7     | 1.000   |
|                                 | No       | 75        | 90.4    | 8         | 9.6     |         |
| Abdominal pain                  | Yes      | 6         | 75.0    | 2         | 25.0    | 0.157   |
|                                 | No       | 83        | 92.2    | 7         | 7.8     |         |
| Abdominal/pelvic mass diagnostic| Yes      | 4         | 100.0   | 0         | 0.0     | 1.000   |
|                                 | No       | 85        | 90.4    | 9         | 9.6     |         |
| Vaginal bleeding                | Yes      | 2         | 100.0   | 0         | 0.0     | 1.000   |
|                                 | No       | 87        | 90.6    | 9         | 9.4     |         |
| Difficulty of breathing         | Yes      | 10        | 83.3    | 2         | 16.7    | 0.303   |
|                                 | No       | 79        | 91.9    | 7         | 8.1     |         |
| Others                          | Yes      | 9         | 81.8    | 2         | 18.2    | 0.266   |
|                                 | No       | 80        | 92.0    | 7         | 8.0     |         |

Bold values indicate statistically significant differences

*No test was done since all patients were classified under the No category

COPD chronic obstructive pulmonary disease, HIV/AIDS human immunodeficiency virus or acquired immunodeficiency syndrome, RTA Type 1 renal tubular acidosis Type 1, TB tuberculosis, y year

Table 10 Bivariate analysis: serologic characteristics and mortality

| Characteristics                  | Category | Mortality | p value |
|----------------------------------|----------|-----------|---------|
|                                 |          | Survived  | Expired |
|                                 |          | Count     | Row %   | Count     | Row %   |
| Anemia                          | Yes      | 84        | 90.3    | 9         | 9.7     | 0.353   |
|                                 | No       | 19        | 100.0   | 0         | 0.0     |         |
| Thrombocytopenia                | Yes      | 6         | 100.0   | 0         | 0.0     | 1.000   |
|                                 | No       | 97        | 91.5    | 9         | 8.5     |         |
| Thrombocytosis                  | Yes      | 28        | 93.3    | 2         | 6.7     | 1.000   |
|                                 | No       | 75        | 91.5    | 7         | 8.5     |         |
| Leukocytosis                    | Yes      | 47        | 100.0   | 0         | 0.0     | 0.010   |
|                                 | No       | 56        | 86.2    | 9         | 13.8    |         |
| Leukopenia                      | Yes      | 5         | 83.3    | 1         | 16.7    | 0.402   |
|                                 | No       | 98        | 92.5    | 8         | 7.5     |         |
| Hypoalbuminemia                 | Yes      | 54        | 88.5    | 7         | 11.5    | 0.298   |
|                                 | No       | 42        | 95.5    | 2         | 4.5     |         |
| Renal function impairment       | Yes      | 39        | 95.1    | 2         | 4.9     | 0.481   |
|                                 | No       | 63        | 90.0    | 7         | 10.0    |         |
| Hyperkalemia                    | Yes      | 8         | 88.9    | 1         | 11.1    | 0.550   |
|                                 | No       | 93        | 92.1    | 8         | 7.9     |         |
| Hypokalemia                     | Yes      | 23        | 95.8    | 1         | 4.2     | 0.681   |
|                                 | No       | 78        | 90.7    | 8         | 9.3     |         |
| Hyponatremia                    | Yes      | 48        | 87.3    | 7         | 12.7    | 0.162   |
|                                 | No       | 51        | 96.2    | 2         | 3.8     |         |
| Hypercalcemia                   | Yes      | 19        | 90.5    | 2         | 9.5     | 1.000   |
|                                 | No       | 76        | 91.6    | 7         | 8.4     |         |

Bold value indicates statistically significant differences
Table 11  Bivariate analysis: urinary characteristics and mortality

| Characteristics | Category | Mortality | p value |
|-----------------|----------|-----------|---------|
|                 |          | Survived  | Expired |
|                 |          | Count     | Row %   | Count     | Row %   |
| Acidic pH       | Yes      | 44        | 93.6    | 3         | 6.4     | 0.504 |
|                 | No       | 50        | 89.3    | 6         | 10.7    |        |
| Low specific gravity | Yes   | 31        | 96.9    | 1         | 3.1     | 0.268 |
|                 | No       | 63        | 88.7    | 8         | 11.3    |        |
| Proteinuria     | None     | 32        | 97.0    | 1         | 3.0     | 0.355 |
|                 | Trace    | 12        | 80.0    | 3         | 20.0    |        |
|                 | 1+       | 32        | 88.9    | 4         | 11.1    |        |
|                 | 2+       | 15        | 93.8    | 1         | 6.3     |        |
|                 | 3+       | 3         | 100.0   | 0         | 0.0     |        |
| Hematuria       | Yes      | 50        | 94.3    | 3         | 5.7     | 0.310 |
|                 | No       | 44        | 88.0    | 6         | 12.0    |        |
| Pyuria          | Yes      | 64        | 91.4    | 6         | 8.6     | 1.000 |
|                 | No       | 30        | 90.9    | 3         | 9.1     |        |
| Both hematuria and pyuria | Yes   | 48        | 96.0    | 2         | 4.0     | 0.162 |
|                 | No       | 46        | 86.8    | 7         | 13.2    |        |
| Casts           | Yes      | 15        | 88.2    | 2         | 11.8    | 0.640 |
|                 | No       | 79        | 91.9    | 7         | 8.1     |        |
| Crystals        | Yes      | 4         | 100.0   | 0         | 0.0     | 1.000 |
|                 | No       | 90        | 90.9    | 9         | 9.1     |        |

Serologic and urinary characteristics
Majority of patients presented with anemia (83.04%), while several exhibited leukocytosis (41.96%) and thrombocytosis (26.79%) (Table 4). Of the biochemistry data, hypoalbuminemia (58.10%) was the most common, followed by hyponatremia (50.93%), impairment of renal function (36.94%), hypercalcemia (20.19%), and hypokalemia (21.82%). Of those with urine samples, proteinuria (67.96%) and pyuria (67.96%) were the most common abnormal findings, followed by hematuria (51.46%), acidic urine (45.63%), and low specific gravity (31.07%) (Table 5).

Radiological findings
Two patients underwent intravenous pyelography (IVP), with one showing extensive calcifications throughout the urinary tract, while the other revealing non-functioning kidney. Table 6 shows the rest of the imaging findings observed in our investigation.

Treatment
Seventy-one patients (63.39%) were initiated on anti-Koch’s treatment during their admission, while 29 individuals (25.89%) underwent surgery. Double J stent insertion (9.82%) and percutaneous tube nephrostomy (8.93%) were the most performed urologic operations (Table 7).

Short-term outcomes
In-hospital death occurred in 8.04% of the patients. The median hospital length of stay was 11 days, with a minimum hospital stay of 0.67 day to a maximum of 90 days. Fifteen patients (13.39%) required pressors and 1 patient (0.89%) needed renal replacement therapy in the form of hemodialysis throughout their hospital course (Table 8).

Characteristics associated with short-term outcomes
Mortality
Age, leukocytosis, and the need for pressors were all significantly associated with mortality (p values of <0.001, 0.010, and <0.001, respectively) (Tables 9, 10, 13). Other characteristics were not significantly associated with mortality (Tables 9, 10, 11, 12, 13).
Table 12  Bivariate analysis: treatments and mortality

| Characteristics                        | Category | Mortality | p value |
|----------------------------------------|----------|-----------|---------|
|                                        |          | Survived  | Expired |         |
|                                        |          | Count     | Row %   | Count   | Row %   |
| Anti-Kochs treatment                   | Yes      | 64        | 90.1    | 7       | 9.9     | 0.482   |
|                                        | No       | 39        | 95.1    | 2       | 4.9     |         |
| Underwent operation                    | Yes      | 29        | 99.0    | 0       | 1.0     | 0.167   |
|                                        | No       | 74        | 89.0    | 9       | 11.0    |         |
| Percutaneous tube nephrostomy          | Yes      | 10        | 100.0   | 0       | 0.0     | 1.000   |
|                                        | No       | 93        | 91.2    | 9       | 8.8     |         |
| DJS insertion                          | Yes      | 11        | 100.0   | 0       | 0.0     | 0.595   |
|                                        | No       | 92        | 91.1    | 9       | 8.9     |         |
| Transurethral resection of bladder tumor | Yes    | 1         | 100.0   | 0       | 0.0     | 1.000   |
|                                        | No       | 102       | 91.9    | 9       | 8.1     |         |
| Bladder mass excision                  | Yes      | 3         | 100.0   | 0       | 0.0     | 1.000   |
|                                        | No       | 100       | 91.7    | 9       | 8.3     |         |
| Aspiration of abscess                  | Yes      | 1         | 100.0   | 0       | 0.0     | 1.000   |
|                                        | No       | 102       | 91.9    | 9       | 8.1     |         |
| Ureteronecystostomy                    | Yes      | 1         | 100.0   | 0       | 0.0     | 1.000   |
|                                        | No       | 102       | 91.9    | 9       | 8.1     |         |
| Ureterotomy                            | Yes      | 1         | 100.0   | 0       | 0.0     | 1.000   |
|                                        | No       | 102       | 91.9    | 9       | 8.1     |         |
| Pelvolithotomy                         | Yes      | 1         | 100.0   | 0       | 0.0     | 1.000   |
|                                        | No       | 102       | 91.9    | 9       | 8.1     |         |
| Radial nephrolithotomy                 | Yes      | 1         | 100.0   | 0       | 0.0     | 1.000   |
|                                        | No       | 102       | 91.9    | 9       | 8.1     |         |
| Subcapsular nephrectomy                | Yes      | 5         | 100.0   | 0       | 0.0     | 1.000   |
|                                        | No       | 98        | 91.6    | 9       | 8.4     |         |
| Cytoreductive nephrectomy              | Yes      | 1         | 100.0   | 0       | 0.0     | 1.000   |
|                                        | No       | 102       | 91.9    | 9       | 8.1     |         |
| Nephrectomy                            | Yes      | 2         | 100.0   | 0       | 0.0     | 1.000   |
|                                        | No       | 101       | 91.8    | 9       | 8.2     |         |

Table 13  Bivariate analysis: other outcomes and mortality

| Characteristics                        | Category | Mortality | p value |
|----------------------------------------|----------|-----------|---------|
|                                        |          | Survived  | Expired |         |
|                                        |          | Count     | Row %   | Count   | Row %   |
| Need for renal replacement therapy     | Yes      | 1         | 100.0   | 0       | 0.0     | 1.000   |
|                                        | No       | 102       | 91.9    | 9       | 8.1     |         |
| Need for pressors                      | Yes      | 8         | 53.3    | 7       | 46.7    | <0.001  |
|                                        | No       | 95        | 97.9    | 2       | 2.1     |         |

Bold value indicates statistically significant differences
| Characteristic                          | Category                  | Mortality | p value |
|----------------------------------------|---------------------------|-----------|---------|
|                                        | Survived                  | Expired   |         |
|                                        | Count | Row % | Count | Row % |         |
| Gender                                 |       |       |       |       |         |
| Male                                   | 8     | 15.1  | 45    | 84.9  | 1.000   |
| Female                                 | 10    | 15.4  | 55    | 84.6  |         |
| Age                                    |       |       |       |       |         |
| 0 months to 1 year                     | 1     | 100.0 | 0     | 0.0   | 0.019   |
| 1–5 years                              | 2     | 66.7  | 1     | 33.3  |         |
| 6–10 years                             | 0     | 0.0   | 4     | 100.0 |         |
| 11–18 years                            | 4     | 21.1  | 15    | 78.9  |         |
| 19–29 years                            | 5     | 21.7  | 18    | 78.3  |         |
| 30–49 years                            | 3     | 8.1   | 34    | 91.9  |         |
| 50–69 years                            | 2     | 7.4   | 25    | 92.6  |         |
| ≥70 years                              | 1     | 25.0  | 3     | 75.0  |         |
| Marital status                         |       |       |       |       |         |
| Single/widowed                         | 13    | 17.6  | 61    | 82.4  | 0.436   |
| Married                                | 5     | 11.4  | 39    | 88.6  |         |
| Occupation                             |       |       |       |       |         |
| Employed                               | 3     | 15.0  | 17    | 85.0  | 0.762   |
| Unemployed                             | 8     | 13.1  | 53    | 86.9  |         |
| Not applicable                         | 6     | 21.4  | 22    | 78.6  |         |
| Unspecified                            | 1     | 11.1  | 8     | 88.9  |         |
| Location                               |       |       |       |       |         |
| City                                   | 10    | 16.1  | 52    | 83.9  | 0.898   |
| Province                               | 7     | 13.7  | 44    | 86.3  |         |
| Unspecified                            | 1     | 20.0  | 4     | 80.0  |         |
| Co-morbidity                           |       |       |       |       |         |
| Yes                                    | 8     | 14.5  | 47    | 85.5  | 1.000   |
| No                                     | 10    | 15.9  | 53    | 84.1  |         |
| Diabetes mellitus                      |       |       |       |       |         |
| Yes                                    | 0     | 0.0   | 5     | 100.0 | 1.000   |
| No                                     | 18    | 15.9  | 95    | 84.1  |         |
| Hypertension                           |       |       |       |       |         |
| Yes                                    | 0     | 0.0   | 13    | 100.0 | 0.214   |
| No                                     | 18    | 17.1  | 87    | 82.9  |         |
| Chronic kidney disease                 |       |       |       |       |         |
| Yes                                    | 2     | 33.3  | 4     | 66.7  | 0.227   |
| No                                     | 16    | 14.3  | 96    | 85.7  |         |
| History of urolithiasis                |       |       |       |       |         |
| Yes                                    | 2     | 25.0  | 6     | 75.0  | 0.352   |
| No                                     | 16    | 14.5  | 94    | 85.5  |         |
| Malignancy                             |       |       |       |       |         |
| Yes                                    | 0     | 0.0   | 1     | 100.0 | 1.000   |
| No                                     | 18    | 15.4  | 99    | 84.6  |         |
| HIV/AIDS                               |       |       |       |       |         |
| Yes                                    | 2     | 15.4  | 11    | 84.6  | 1.000   |
| No                                     | 16    | 15.2  | 89    | 84.8  |         |
| Steroid use                            |       |       |       |       |         |
| Yes                                    | 3     | 33.3  | 6     | 66.7  | 0.139   |
| No                                     | 15    | 13.8  | 94    | 86.2  |         |
| Systemic lupus erythematosus           |       |       |       |       |         |
| Yes                                    | 2     | 25.0  | 6     | 75.0  | 0.352   |
| No                                     | 16    | 14.5  | 94    | 85.5  |         |
| Nephrotic syndrome                     |       |       |       |       |         |
| Yes                                    | 1     | 100.0 | 0     | 0.0   | 0.153   |
| No                                     | 17    | 14.5  | 100   | 85.5  |         |
| Cerebrovascular disease                |       |       |       |       |         |
| Yes                                    | 0     | 0.0   | 1     | 100.0 | 1.000   |
| No                                     | 18    | 15.4  | 99    | 84.6  |         |
| Coronary artery disease                |       |       |       |       |         |
| Yes                                    | 18    | 15.3  | 100   | 84.7  | No test*|
| Heart failure                          |       |       |       |       |         |
| Yes                                    | 0     | 0.0   | 2     | 100.0 | 1.000   |
| No                                     | 18    | 15.5  | 98    | 84.5  |         |
| COPD                                   |       |       |       |       |         |
| Yes                                    | 0     | 0.0   | 1     | 100.0 | 1.000   |
| No                                     | 18    | 15.4  | 99    | 84.6  |         |
| Bronchial asthma                       |       |       |       |       |         |
| Yes                                    | 0     | 0.0   | 2     | 100.0 | 1.000   |
| No                                     | 18    | 15.5  | 98    | 84.5  |         |
| Characteristic                          | Category  | Mortality          | p value |
|---------------------------------------|-----------|--------------------|---------|
|                                       |           | Survived           | Expired |
|                                       |           | Count  | Row %  | Count  | Row %  |
| Spina bifida                          | No        | 18     | 15.3   | 100    | 84.7   | No test* |
| RTA Type 1                            | Yes       | 0      | 0.0    | 1      | 100.0  | 1.000    |
|                                       | No        | 18     | 15.4   | 99     | 84.6   | 1.000    |
| Previous TB                           | No        | 0      | 0.0    | 14     | 100.0  | 0.124    |
|                                       | No        | 18     | 17.3   | 86     | 82.7   | 1.000    |
| Other organ involvement of TB         | Yes       | 15     | 21.4   | 55     | 78.6   | 0.035    |
|                                       | No        | 3      | 6.3    | 45     | 93.8   | 1.000    |
| Pulmonary TB                          | Yes       | 13     | 21.0   | 49     | 79.0   | 0.079    |
|                                       | No        | 5      | 8.9    | 51     | 91.1   | 1.000    |
| Gastrointestinal TB                   | Yes       | 10     | 32.3   | 21     | 67.7   | 0.006    |
|                                       | No        | 8      | 9.2    | 79     | 90.8   | 1.000    |
| Abdominopelvic TB                     | Yes       | 3      | 23.1   | 10     | 76.9   | 0.417    |
|                                       | No        | 15     | 14.3   | 90     | 85.7   | 1.000    |
| CNS TB                                | Yes       | 3      | 37.5   | 5      | 62.5   | 0.102    |
|                                       | No        | 15     | 13.6   | 95     | 86.4   | 1.000    |
| Bone TB                               | Yes       | 1      | 25.0   | 3      | 75.0   | 0.489    |
|                                       | No        | 17     | 14.9   | 97     | 85.1   | 1.000    |
| Cutaneous/Wound TB                    | Yes       | 3      | 100.0  | 0      | 0      | 0.003    |
|                                       | No        | 15     | 13.0   | 100    | 87.0   | 1.000    |
| TB Adenitis                           | Yes       | 1      | 10.0   | 9      | 90.0   | 1.000    |
|                                       | No        | 17     | 15.7   | 91     | 84.3   | 1.000    |
| Ear TB                                | Yes       | 1      | 50.0   | 1      | 50.0   | 0.283    |
|                                       | No        | 17     | 14.7   | 99     | 85.3   | 1.000    |
| Psoas TB                              | Yes       | 2      | 28.6   | 5      | 71.4   | 0.603    |
|                                       | No        | 16     | 16.7   | 80     | 83.3   | 1.000    |
| Dysuria                               | Yes       | 1      | 11.1   | 8      | 88.9   | 1.000    |
|                                       | No        | 17     | 18.1   | 77     | 81.9   | 1.000    |
| Hematuria                             | Yes       | 0      | 0.0    | 1      | 100.0  | 1.000    |
|                                       | No        | 18     | 17.6   | 84     | 82.4   | 1.000    |
| Urinary retention                     | Yes       | 1      | 8.3    | 11     | 91.7   | 0.687    |
|                                       | No        | 17     | 18.7   | 74     | 81.3   | 1.000    |
| Flank pain                            | Yes       | 0      | 0.0    | 1      | 100.0  | 1.000    |
|                                       | No        | 18     | 17.6   | 84     | 82.4   | 1.000    |
| Inguinal pain                         | Yes       | 0      | 0.0    | 3      | 100.0  | 1.000    |
|                                       | No        | 18     | 18.0   | 82     | 82.0   | 1.000    |
| Umbilical discharge                   | Yes       | 0      | 0.0    | 1      | 100.0  | 1.000    |
|                                       | No        | 18     | 17.6   | 84     | 82.4   | 1.000    |
| Fistula (uretero-cutaneous fistula)   | Yes       | 0      | 0.0    | 1      | 100.0  | 1.000    |
|                                       | No        | 18     | 17.6   | 84     | 82.4   | 1.000    |
| Scrotal discharge                     | Yes       | 0      | 0.0    | 1      | 100.0  | 1.000    |
|                                       | No        | 18     | 17.6   | 84     | 82.4   | 1.000    |
| Double J stent reinsertion            | Yes       | 0      | 0.0    | 1      | 100.0  | 1.000    |
|                                       | No        | 18     | 17.6   | 84     | 82.4   | 1.000    |
| Pedal edema                           | Yes       | 1      | 25.0   | 3      | 75.0   | 0.542    |
|                                       | No        | 17     | 17.2   | 82     | 82.8   | 1.000    |
| Fever                                 | Yes       | 0      | 0.0    | 7      | 100.0  | 0.349    |
|                                       | No        | 18     | 18.8   | 78     | 81.3   | 1.000    |
Table 14 (continued)

| Characteristic                  | Category | Mortality | p value |
|--------------------------------|----------|-----------|---------|
|                                |          | Survived  | Expired |
|                                |          | Count     | Row %   | Count     | Row %   |
| Weakness                       | Yes      | 2         | 13.3    | 13         | 86.7    | 1.000   |
|                                | No       | 16        | 18.2    | 72         | 81.8    |         |
| Abdominal pain                 | Yes      | 3         | 27.3    | 8          | 72.7    | 0.402   |
|                                | No       | 15        | 16.3    | 77         | 83.7    |         |
| Abdominal/pelvic mass on       | Yes      | 0         | 0.0     | 4          | 100.0   | 1.000   |
| diagnostic                     | No       | 18        | 18.2    | 81         | 81.8    |         |
| Vaginal bleeding               | Yes      | 0         | 0.0     | 2          | 100.0   | 1.000   |
|                                | No       | 18        | 18.2    | 83         | 82.2    |         |
| Difficulty of breathing        | Yes      | 4         | 30.8    | 9          | 69.2    | 0.235   |
|                                | No       | 14        | 15.6    | 76         | 84.4    |         |
| Others                         | Yes      | 4         | 36.4    | 7          | 63.6    | 0.098   |
|                                | No       | 14        | 15.2    | 78         | 84.8    |         |

Bold values indicate statistically significant differences
*No test was done since all patients were classified under the No category

COPD chronic obstructive pulmonary disease, HIV/AIDS human immunodeficiency virus or acquired immunodeficiency syndrome, RTA Type 1 renal tubular acidosis Type 1, TB tuberculosis, y year

Table 15 Bivariate analysis: serologic characteristics and need for pressors

| Characteristics            | Category | Mortality | p value |
|----------------------------|----------|-----------|---------|
|                            |          | Survived  | Expired |
|                            |          | Count     | Row %   | Count     | Row %   |
| Anemia                     | Yes      | 16        | 16.2    | 83         | 83.8    | 0.734   |
|                            | No       | 2         | 10.5    | 17         | 89.5    |         |
| Thrombocytopenia           | Yes      | 1         | 16.7    | 5          | 83.3    | 1.000   |
|                            | No       | 17        | 15.2    | 95         | 84.8    |         |
| Thrombocytosis             | Yes      | 4         | 13.3    | 26         | 86.7    | 1.000   |
|                            | No       | 14        | 15.9    | 74         | 84.1    |         |
| Leukocytosis               | Yes      | 8         | 15.4    | 44         | 84.6    | 1.000   |
|                            | No       | 10        | 15.2    | 56         | 84.8    |         |
| Leukopenia                 | Yes      | 1         | 16.7    | 5          | 83.3    | 1.000   |
|                            | No       | 17        | 15.2    | 95         | 84.8    |         |
| Hypoalbuminemia           | Yes      | 14        | 21.2    | 52         | 78.8    | 0.116   |
|                            | No       | 4         | 8.9     | 41         | 91.1    |         |
| Renal function impairment  | Yes      | 7         | 16.7    | 35         | 83.3    | 0.794   |
|                            | No       | 11        | 14.7    | 64         | 85.3    |         |
| Hyperkalemia               | Yes      | 2         | 22.2    | 7          | 77.8    | 0.628   |
|                            | No       | 16        | 15.0    | 91         | 85.0    |         |
| Hypokalemia                | Yes      | 4         | 16.7    | 20         | 83.3    | 1.000   |
|                            | No       | 14        | 15.2    | 78         | 84.8    |         |
| Hyponatremia               | Yes      | 12        | 20.3    | 47         | 79.7    | 0.204   |
|                            | No       | 6         | 10.9    | 49         | 89.1    |         |
| Hypercalcemia              | Yes      | 4         | 16.7    | 20         | 83.3    | 1.000   |
|                            | No       | 13        | 15.1    | 73         | 84.9    |         |
Table 16  Bivariate analysis: urinary characteristics and need for pressors

| Characteristics                  | Category | Mortality | p value |
|----------------------------------|----------|-----------|---------|
|                                  |          | Survived  | Expired |
|                                  |          | Count     | Row %   | Count     | Row %   |
| Acetic pH                        | Yes      | 9         | 18.0    | 41        | 82.0    | 0.798   |
|                                  | No       | 9         | 15.3    | 50        | 84.7    |         |
| Low specific gravity             | Yes      | 2         | 5.9     | 32        | 94.1    | 0.053   |
|                                  | No       | 16        | 21.3    | 59        | 78.7    |         |
| Proteinuria                      | None     | 4         | 11.4    | 31        | 88.6    | 0.727   |
|                                  | Trace    | 2         | 13.3    | 13        | 86.7    |         |
|                                  | 1+       | 7         | 17.9    | 32        | 82.1    |         |
|                                  | 2+       | 4         | 23.5    | 13        | 76.5    |         |
|                                  | 3+       | 1         | 33.3    | 2         | 66.7    |         |
| Hematuria                        | Yes      | 8         | 14.8    | 46        | 85.2    | 0.797   |
|                                  | No       | 10        | 18.2    | 45        | 81.8    |         |
| Pyuria                           | Yes      | 11        | 15.3    | 61        | 84.7    | 0.786   |
|                                  | No       | 7         | 18.9    | 30        | 81.1    |         |
| Both hematuria and pyuria        | Yes      | 7         | 14.0    | 43        | 86.0    | 0.609   |
|                                  | No       | 11        | 18.6    | 48        | 81.4    |         |
| Casts                            | Yes      | 4         | 22.2    | 14        | 77.8    | 0.493   |
|                                  | No       | 14        | 15.4    | 77        | 84.6    |         |
| Crystals                         | Yes      | 0         | 0.0     | 4         | 100.0   | 1.000   |
|                                  | No       | 18        | 17.1    | 87        | 82.9    |         |
### Table 17  Bivariate analysis: treatments and need for pressors

| Characteristics                        | Category | Mortality | p value |
|----------------------------------------|----------|-----------|---------|
|                                        |          | Survived  |         |
|                                        |          | Count     | Row %   |
|                                        |          | Expired   |         |
|                                        |          | Count     | Row %   |
| Anti-Kochs treatment                   | Yes      | 14        | 18.7    | 61      | 81.3 | 0.196 |
|                                        | No       | 4         | 9.3     | 39      | 90.7 |
| Underwent operation                    | Yes      | 1         | 3.3     | 29      | 96.7 | 0.095 |
|                                        | No       | 17        | 19.3    | 71      | 80.7 |
| Percutaneous tube nephrostomy          | Yes      | 1         | 10.0    | 9       | 90.0 | 1.000 |
|                                        | No       | 17        | 15.7    | 91      | 84.3 |
| DJ's insertion                         | Yes      | 0         | 0.0     | 12      | 100.0 | 0.209 |
|                                        | No       | 18        | 17.0    | 88      | 83.0 |
| Transurethral resection of bladder     | Yes      | 0         | 0.0     | 1       | 100.0 | 1.000 |
| tumor                                  | No       | 18        | 15.4    | 99      | 84.6 |
| Bladder mass excision                  | Yes      | 0         | 0.0     | 3       | 100.0 | 1.000 |
|                                        | No       | 18        | 15.7    | 97      | 84.3 |
| Aspiration of abscess                  | Yes      | 0         | 0.0     | 1       | 100.0 | 1.000 |
|                                        | No       | 18        | 15.4    | 99      | 84.6 |
| Ureteroneocystostomy                   | Yes      | 0         | 0.0     | 1       | 100.0 | 1.000 |
|                                        | No       | 18        | 15.4    | 99      | 84.6 |
| Ureterotomy                           | Yes      | 0         | 0.0     | 1       | 100.0 | 1.000 |
|                                        | No       | 18        | 15.4    | 99      | 84.6 |
| Pelvolithotomy                         | Yes      | 0         | 0.0     | 1       | 100.0 | 1.000 |
|                                        | No       | 18        | 15.4    | 99      | 84.6 |
| Radial nephrolithotomy                 | Yes      | 0         | 0.0     | 1       | 100.0 | 1.000 |
|                                        | No       | 18        | 15.4    | 99      | 84.6 |
| Subcapsular nephrectomy                | Yes      | 0         | 0.0     | 5       | 100.0 | 1.000 |
|                                        | No       | 18        | 15.9    | 95      | 84.1 |
| Cytoreductive nephrectomy              | Yes      | 0         | 0.0     | 1       | 100.0 | 1.000 |
|                                        | No       | 18        | 15.4    | 99      | 84.6 |
| Nephrectomy                            | Yes      | 0         | 0.0     | 2       | 100.0 | 1.000 |
|                                        | No       | 18        | 15.5    | 98      | 84.5 |

### Table 18  Bivariate analysis: other outcomes and need for pressors

| Characteristics                        | Category | Need for pressors | p value |
|----------------------------------------|----------|-------------------|---------|
|                                        |          | Yes               | No      |
|                                        | Count    | Row %             | Count   | Row % |
| Need for renal replacement therapy     | Yes      | 0                 | 0.0     | 1      | 100.0 | 1.000 |
|                                        | No       | 18                | 15.4    | 99     | 84.6 |
### Table 19 Comparison of mean hospital stay by clinical characteristics

| Characteristic      | Category                           | Hospital length of stay (in days) | \( p \) value |
|---------------------|------------------------------------|-----------------------------------|---------------|
|                     |                                    | Mean    | SD     |               |
| Gender              | Male                               | 15.5    | 16.1   | 0.914         |
|                     | Female                             | 13.5    | 9.5    |               |
| Age                 | 0 months to 1 years                | 23.0    |        | 0.444         |
|                     | 1–5 years                          | 35.0    | 47.9   |               |
|                     | 6–10 years                         | 9.5     | 9.4    |               |
|                     | 11–18 years                        | 19.6    | 16.7   |               |
|                     | 19–29 years                        | 13.6    | 9.5    |               |
|                     | 30–49 years                        | 13.2    | 9.9    |               |
|                     | 50–69 years                        | 12.1    | 7.6    |               |
|                     | \( \geq 70 \) years               | 7.0     | 4.2    |               |
| Marital status      | Single/widowed                     | 17.2    | 14.8   | 0.001         |
|                     | Married                            | 9.6     | 6.2    |               |
| Occupation          | Employed                           | 12.2    | 11.7   | 0.506         |
|                     | Unemployed                         | 13.6    | 9.0    |               |
|                     | Not applicable                     | 18.4    | 20.1   |               |
|                     | Unspecified                        | 12.4    | 6.8    |               |
| Location            | City                               | 15.3    | 15.4   | 0.915         |
|                     | Province                           | 13.3    | 9.3    |               |
|                     | Unspecified                        | 15.0    | 10.8   |               |
| Co-morbidity        | Yes                                | 15.3    | 12.4   | 0.338         |
|                     | No                                 | 13.6    | 13.3   |               |
| Diabetes mellitus   | Yes                                | 7.8     | 4.8    | 0.143         |
|                     | No                                 | 14.7    | 13.0   |               |
| Hypertension        | Yes                                | 13.3    | 9.4    | 0.897         |
|                     | No                                 | 14.5    | 13.3   |               |
| Chronic kidney disease | Yes                             | 16.5    | 9.7    | 0.333         |
|                     | No                                 | 14.3    | 13.0   |               |
| History of urolithiasis | Yes                          | 9.4     | 5.1    | 0.297         |
|                     | No                                 | 14.8    | 13.2   |               |
| Malignancy          | Yes                                | 17.0    |        | 0.427         |
|                     | No                                 | 14.4    | 12.9   |               |
| HIV/AIDS            | Yes                                | 14.5    | 10.9   | 0.740         |
|                     | No                                 | 14.4    | 13.1   |               |
| Steroid use         | Yes                                | 28.7    | 18.5   | 0.002         |
|                     | No                                 | 13.2    | 11.6   |               |
| Systemic lupus erythematosus | Yes                      | 23.5    | 10.9   | 0.008         |
|                     | No                                 | 13.7    | 12.8   |               |
| Nephrotic syndrome  | Yes                                | 70.0    |        | 0.091         |
|                     | No                                 | 13.9    | 11.8   |               |
| Cerebrovascular disease | Yes                          | 5.0     |        | 0.270         |
|                     | No                                 | 14.5    | 12.9   |               |
| Coronary artery disease | Yes                          |        |        | No test*      |
|                     | No                                 | 14.4    | 12.9   |               |
| Heart failure       | Yes                                | 19.0    | 18.4   | 0.669         |
|                     | No                                 | 14.3    | 12.8   |               |
Table 19 (continued)

| Characteristic               | Category | Hospital length of stay (in days) | p value |
|------------------------------|----------|----------------------------------|---------|
|                              |          | Mean    | SD      |
| COPD                         | Yes      | 11.0    | 0.953   |
|                              | No       | 14.4    | 12.9    |
| Bronchial asthma             | Yes      | 5.5     | 2.1     | 0.150   |
|                              | No       | 14.5    | 12.9    |
| Spina bifida                 | Yes      | 14.4    | 12.9    | No test* |
|                              | No       | 14.4    | 12.9    |
| RTA Type 1                   | Yes      | 11.0    | 0.953   |
|                              | No       | 14.4    | 12.9    |
| Previous TB                  | Yes      | 9.9     | 5.6     | 0.204   |
|                              | No       | 15.0    | 13.4    |
| Other organ involvement of TB| Yes      | 16.4    | 14.6    | 0.030   |
|                              | No       | 11.5    | 9.2     |
| Pulmonary TB                 | Yes      | 17.1    | 15.3    | 0.021   |
|                              | No       | 11.4    | 8.6     |
| Gastrointestinal TB          | Yes      | 17.7    | 19.1    | 0.489   |
|                              | No       | 13.2    | 9.6     |
| Abdominopelvic TB            | Yes      | 16.0    | 10.4    | 0.273   |
|                              | No       | 14.2    | 13.2    |
| CNS TB                       | Yes      | 22.5    | 27.7    | 0.309   |
|                              | No       | 13.8    | 11.1    |
| Bone TB                      | Yes      | 34.5    | 37.8    | 0.157   |
|                              | No       | 13.7    | 10.9    |
| Cutaneous/Wound TB           | Yes      | 19.7    | 7.1     | 0.161   |
|                              | No       | 14.3    | 13.0    |
| TB Adenitis                  | Yes      | 13.8    | 12.8    | 0.642   |
|                              | No       | 14.4    | 12.9    |
| Ear TB                       | Yes      | 51.5    | 54.4    | 0.159   |
|                              | No       | 13.8    | 10.9    |
| Psoas TB                     | Yes      | 61.0    | 41.0    | 0.022   |
|                              | No       | 13.6    | 10.7    |

Bold values indicate statistically significant differences

*No test was done since all patients were classified under the No category

COPD chronic obstructive pulmonary disease, HIV/AIDS human immunodeficiency virus or acquired immunodeficiency syndrome, RTA Type 1 renal tubular acidosis Type 1, TB tuberculosis, y year

Need for pressors
Age, other organ involvement of MTB, gastrointestinal TB, and cutaneous or wound TB, were significantly associated with the need for pressors (p-values of 0.019, 0.035, 0.006, and 0.003, respectively) (Table 14). Other characteristics were not significantly associated with the need for pressors (Tables 14, 15, 16, 17, 18).

Mean hospital stay
Marital status, steroid use, systemic lupus erythematosus (SLE), other organ involvement of MTB, pulmonary TB, psoas TB, the presence of anemia, leukocytosis, hypoalbuminemia, hyponatremia, hypercalcemia, and anti-Koch’s treatment had a statistically longer mean length of hospital stay compared to those without these characteristics (Tables 19, 20, 22). Other characteristics were not significantly associated with a longer mean length of hospital stay (Tables 19, 20, 21, 22, 23).
### Table 20 Comparison of mean hospital stay by serologic characteristics

| Characteristic                  | Category | Hospital length of stay (in days) | p value |
|---------------------------------|----------|-----------------------------------|---------|
|                                 |          | Mean | SD |                  |
| Anemia                          | Yes      | 15.7 | 13.5 | **0.001**        |
|                                 | No       | 7.6  | 4.6  |                  |
| Thrombocytopenia                | Yes      | 14.2 | 14.3 | 0.708             |
|                                 | No       | 14.4 | 12.8 |                  |
| Thrombocytosis                  | Yes      | 17.9 | 19.2 | 0.315             |
|                                 | No       | 13.2 | 9.7  |                  |
| Leukocytosis                    | Yes      | 15.6 | 11.3 | **0.027**        |
|                                 | No       | 13.4 | 14.0 |                  |
| Leukopenia                      | Yes      | 16.7 | 14.1 | 0.690             |
|                                 | No       | 14.3 | 12.8 |                  |
| Hypoalbuminemia                 | Yes      | 17.0 | 15.3 | **0.029**        |
|                                 | No       | 11.3 | 8.0  |                  |
| Renal function impairment       | Yes      | 15.5 | 10.3 | 0.123             |
|                                 | No       | 13.9 | 14.1 |                  |
| Hyperkalemia                    | Yes      | 10.2 | 5.2  | 0.411             |
|                                 | No       | 14.9 | 13.3 |                  |
| Hypokalemia                     | Yes      | 11.4 | 6.8  | 0.373             |
|                                 | No       | 15.4 | 14.0 |                  |
| Hyponatremia                    | Yes      | 16.0 | 13.5 | **0.046**        |
|                                 | No       | 13.1 | 12.4 |                  |
| Hypercalcemia                   | Yes      | 16.6 | 7.6  | **0.015**        |
|                                 | No       | 14.3 | 14.3 |                  |

Bold values indicate statistically significant differences

### Table 21 Comparison of mean hospital stay by urinary characteristics

| Characteristic                  | Category | Hospital length of stay (in days) | p value |
|---------------------------------|----------|-----------------------------------|---------|
|                                 |          | Mean | Standard Deviation |                  |
| Acidic pH                       | Yes      | 14.3 | 11.8 | 0.745             |
|                                 | No       | 14.3 | 13.5 |                  |
| Low specific gravity            | Yes      | 13.3 | 9.9  | 0.724             |
|                                 | No       | 14.8 | 13.8 |                  |
| Proteinuria                     | None     | 14.6 | 8.0  | 0.145             |
|                                 | Trace    | 8.5  | 5.5  |                  |
|                                 | 1+       | 15.3 | 15.9 |                  |
|                                 | 2+       | 14.4 | 8.7  |                  |
|                                 | 3+       | 26.0 | 38.3 |                  |
| Hematuria                       | Yes      | 12.9 | 8.2  | 0.709             |
|                                 | No       | 15.7 | 15.8 |                  |
| Pyuria                          | Yes      | 14.0 | 12.7 | 0.679             |
|                                 | No       | 14.9 | 12.8 |                  |
| Both hematuria and pyuria       | Yes      | 12.7 | 8.2  | 0.609             |
|                                 | No       | 15.7 | 15.4 |                  |
| Casts                           | Yes      | 15.6 | 16.7 | 0.722             |
|                                 | No       | 14.1 | 11.8 |                  |
| Crystals                        | Yes      | 10.3 | 3.2  | 0.693             |
|                                 | No       | 14.5 | 12.9 |                  |
Discussion

Genitourinary TB is the second and third most common form of EPTB in countries with high and low TB burden, respectively [9, 19, 25]. According to other registers, however, GUTB is only seen in 1.7–6.5% of the total TB cases reported [26]. In the Philippines, a 5-year retrospective study reported GUTB to have caused 3% of pediatric EPTB cases admitted in a tertiary government hospital [13]. It is important to emphasize that this infection is underdiagnosed in most health care centers, as GUTB remains a diagnostic challenge [9, 19, 25–27].

Diagnosis of GUTB is often delayed due to the insidious nature of the disease, non-specificity of symptoms, poor health-seeking behavior of patients, and lack of clinician awareness [28, 29]. In autopsy studies, only half of patients with renal involvement had symptoms, while only 18% were diagnosed clinically [30]. The four pillars to GUTB diagnosis are bacteriology, pathomorphology, radiology, and provocative test with therapy ex juvantibus [6, 19, 31], with culture as the gold standard [25, 29, 32]. In world literature, most cases of GUTB (64.2%) were diagnosed through identification of MTB.

**Table 22** Comparison of mean hospital stay by treatments

| Characteristic                              | Category | Hospital length of stay (in days) | p value |
|---------------------------------------------|----------|----------------------------------|---------|
| Anti-Kochs treatment                        | Yes      | 17.1                             | <0.001  |
|                                             | No       | 9.7                              |         |
| Underwent operation                        | Yes      | 13.0                             | 0.666   |
|                                             | No       | 9.8                              |         |
| Percutaneous tube nephrostomy               | Yes      | 16.1                             | 0.436   |
|                                             | No       | 14.9                             |         |
| DJ S insertion                              | Yes      | 14.4                             | 0.762   |
|                                             | No       | 14.4                             |         |
| Transurethral resection of bladder tumor    | Yes      | 6.0                              | 0.370   |
|                                             | No       | 14.5                             |         |
| Bladder mass excision                       | Yes      | 5.3                              | 0.074   |
|                                             | No       | 14.6                             |         |
| Aspiration of abscess                       | Yes      | 18.0                             | 0.347   |
|                                             | No       | 14.4                             |         |
| Ureteroneocystostomy                        | Yes      | 9.0                              | 0.724   |
|                                             | No       | 14.4                             |         |
| Ureterotomy                                 | Yes      | 5.0                              | 0.270   |
|                                             | No       | 14.5                             |         |
| Pelvolithotomy                              | Yes      | 11.0                             | 0.953   |
|                                             | No       | 14.4                             |         |
| Radial nephrolithotomy                      | Yes      | 11.0                             | 0.953   |
|                                             | No       | 14.4                             |         |
| Subcapsular nephrectomy                     | Yes      | 11.6                             | 0.936   |
|                                             | No       | 14.5                             |         |
| Cytoreductive nephrectomy                   | Yes      | 7.0                              | 0.481   |
|                                             | No       | 14.5                             |         |
| Nephrectomy                                 | Yes      | 17.0                             | 0.602   |
|                                             | No       | 14.3                             |         |

**Table 23** Comparison of mean hospital stay by other outcomes

| Characteristics            | Category | Hospital length of stay (in days) | p value |
|----------------------------|----------|----------------------------------|---------|
| Need for renal replacement therapy | Yes      | 23.0                             | 0.246   |
|                             | No       | 14.3                             |         |
| Need for pressors           | Yes      | 20.2                             | 0.790   |
|                             | No       | 13.3                             |         |
| Study (publication year) | Size | Setting (country) | Population | Outcomes | Method |
|--------------------------|------|-------------------|------------|----------|--------|
| Mishra [33] (2020)       | 53   | Department of Urology, Indira Gandhi Institute of Medical Sciences (India) | Patients with confirmed GUTB | Demographic, clinical presentation Urinary profile, routine blood exams Urine AFB smear test, urine MTB culture Radiological examinations, cystoscopic examination, histopathological examinations | 4-year prospective observational case series |
| Huang [10] (2019)        | 57   | Chang Gung Memorial Hospital-Chiayi (Taiwan) | Patients with diagnosis of GUTB with at least one of the following: positive MTB culture or histologic evidence | Demographics, comorbidities, symptoms and signs Results of mycobacterial smears and cultures, histopathology CBCs, serum biochemistry profile Chest radiography GU tract operations, anti-TB therapy, complications, clinical outcomes | 15-year retrospective study |
| Kim [35] (2018)          | 56   | Severance Hospital, Seoul (South Korea) | Participants older than 18 years diagnosed with GUTB based on presence of any clinical finding plus a positive result for one of the ff: (1) urine AFB, (2) urine MTB culture, (3) urine MTB PCR, or (4) histopathology | Clinical and laboratory data Diagnostic methods, treatment modalities and outcomes | 11-year retrospective study |
| Cao [36] (2017)          | 419  | Peking University First Hospital (China) | All patients with clinical renal TB with microbiologic or histologic confirmation | Demographics, clinical data, complications, treatment Laboratory findings Imaging findings Pathologic features | 15-year retrospective study |
| Krishnamoorthy [8] (2017)| 110  | Chennai, Tamil Nadu (India) | Patients with either (1) proven GUTB based on urine AFB smear, AFB culture, histopathological evidence of TB, and/or by serological methods; or (2) presumed GUTB who had ≥ 2 consistent features on urological imaging or endoscopic evaluation | Clinical history and examination Serum biochemistry Urine culture Imaging findings | 3-year retrospective study |
| Ye [37] (2016)           | 193  | West China Hospital, Sichuan University (China) | Cases with definite UTB based on results of comprehensive diagnosis, including clinical features, laboratory results (i.e., smear microscopy, MTB culture, real-time PCR, and histological patterns), radiological findings, and response to anti-TB therapy | Demographic data, clinical history, prognosis Radiological findings Selected laboratory results | 5-year cross-sectional study |
| Singh [38] (2013)        | 117  | Urology Department of Institute of Post Graduate Medical Education and Research and SSKM Hospital (India) | All cases clinically diagnosed as GUTB | Clinical presentation Urine AFB smear; urine MTB culture, urine PCR for MTB Radiological and histopathological examinations | 13-year retrospective study |
| Study (publication year) | Size | Setting (country) | Population | Outcomes | Method |
|--------------------------|------|-------------------|------------|----------|--------|
| Chandra [39] (2012)      | 25   | Himalayan Institute of Medical Sciences, Uttarkhand State (India) | Male patients with histopathologically confirmed GUTB | Occupation, socioeconomic status, Clinical history, Relevant radiological, laboratory and histopathology findings, Treatment | 13-year retrospective study |
| Hsu [40] (2011)          | 64   | National Taiwan University Hospital and Taipei Medical University – Wan Fang Hospital (Taiwan) | All patients with urine culture-confirmed GUTB | Clinical features, Laboratory characteristics, Treatment outcomes, Genotypic characteristics of MTB isolates | 12-year retrospective study |
| Lee [17] (2011)          | 101  | Department of Urology, Hanyang University College of Medicine (Korea) | Patients diagnosed with GUTB based on the presence of one or more positivity in terms of histopathological findings, urine AFB smear, urine MTB culture, and urine PCR for MTB | Yearly proportion, gender, patient distribution according to age, history of TB, and presence of other organ TB Urinalysis findings | 10-year retrospective study |
| Karnjanawanichkul [41] (2010) | 35 | Prince of Songkla University, Hat Yai, Songkhla (Thailand) | Patients diagnosed with urinary tract TB by demonstration of AFB in urine smear, growth from urine MTB culture, or consistent histopathologic findings | Demographic data, clinical features, Laboratory data, Chest x-ray, intravenous urography, ultrasonography, or endoscopic findings | 10-year retrospective study |
| Takahashi [42] (2007)    | 12   | Urology clinics of six medical centers, Hokkaido (Japan) | Patients diagnosed with urinary TB based on NAAT or histopathology | Demographic data, clinical features, Detection method for MTB, Diagnostic findings, Treatment outcomes, and medication-related adverse events | 5-year retrospective study |
| Hsieh [18] (2006)        | 31   | Kaohsiung Medical University Hospital, Kaohsiung (Taiwan) | Patients diagnosed with GUTB based on microbiological or histological findings plus compatible clinical and roentgenographic findings | Baseline characteristics, underlying diseases, treatment responses, and outcomes | 11-year retrospective study |
| Buccholz [43] (2000)     | 55   | Aga Khan University Hospital (Pakistan) | In-patients with GUTB proven either by urine culture positivity for MTB, or histopathology | Age, sex, concomitant diseases, medical history, symptoms, diagnosis, treatment and follow-up | 13-year retrospective study |
| Ramanathan [34] (1998)   | 38   | Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow (India) | All patients with either: (1) urinary TB based on positive urine or pus cultures for MTB or histopathology, or (2) presumed urinary TB with ≥ 3 consistent features on urological imaging or endoscopy | History and physical examination, Serum chemistry, Urine culture, Chest x-ray and ultrasonography | 8-year retrospective study |
| Dy [16] (1995)           | 61   | Santo Tomas University Hospital (Philippines) | In-patients clinically diagnosed with GUTB | Demographic features, Presenting manifestations, history of previous TB, Diagnostic modalities (radiographic, bacteriologic, histopathologic), Therapeutic modalities | Case series |
Table 24 (continued)

| Study (publication year) | Size | Setting (country) | Population                                                                 | Outcomes                                                                 | Method                                    |
|--------------------------|------|-------------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------|
| Tanchuco [15] (1987)     | 42   | Philippine General Hospital and National Kidney Institute (Philippines) | Patients with discharge diagnosis of urinary tract TB based on the presence of one of the following: positive urine AFB smear, positive urine AFB culture, or consistent histopathologic findings | Clinical and laboratory parameters      | 6-year retrospective study               |

GU genitourinary, MTB Mycobacterium tuberculosis, NAAT nucleic acid amplification test, PTB pulmonary tuberculosis, UTB urinary tuberculosis
Table 25  Studies in the Asia–Pacific region describing the demographic features of patients with GUTB

| Study (publication year) | Age | Male-to-female ratio | Demographic | Genitourinary organs involved (n) | Associated comorbidities (%) |
|-------------------------|-----|----------------------|-------------|----------------------------------|------------------------------|
| Mishra [33] (2020)      | Mean, 39.15 ± 12.62 y | 1:1.21 (24.29) | Socioeconomic class: lower (88.7%), middle (9.4%), upper (1.9%) | Kidney (33; 18 unilateral, 15 bilateral involvement), ureter (16; 14 lower ureteral stricture, 1 middle ureteral stricture, 1 multiple strictures), bladder (13) | History of PTB (20.8%) |
| Huang [10] (2019)       | Median, 71 years (range, 33–89 years) | 1.85:1 (37:20) | Kidneys (8), kidney and ureter (4), epididymis (3), epididymis and testis (3), kidney and prostate (2), prostate (2), ureter (1), ureter and bladder (1), testis (1), epididymis and testis and prostate (1), scrotum and penis (1), uterus and cervix (1) | DM type II (35.1%), chronic renal disease (33.3%), underlying malignancies (hepatocellular, prostate, bladder, cervix, rectum, thyroid gland, lymphoma, and skin) (24.6%), adrenal insufficiency (24.6%), corticosteroid use (21.1%), chronic airway disease (19.3%), liver cirrhosis (17.5%), past history of TB (15.8%), alcoholism (8.8%), and autoimmune disease (3.5%) |
| Kim [35] (2018)         | Mean, 52.8 y | 1:1.15 (26:30) | Kidney or ureter (39, 69.6%), bladder (16, 28.6%), epididymis or testis (13, 23.2%), uterus or fallopian tubes (5, 8.9%), prostate (4, 7.1%) | History of TB (42.9%, PTB 37.5%), CVD (28.6%), immunocompromised state (21.4%), pulmonary disease (10.7%), liver disease (7.1%), DM (5.4%), history of gastrectomy (3.6%) |
| Cao [36] (2017)         | Mean, 42.7 ± 13.4 years (range, 12–78 years) | 1:1.29 (183:236) | Unemployed (24.6%), farmer (21%), civil servant (15.5%), worker (10.7%), retiree 9.1%, student (4.3%), other occupations (14.6%) | Left kidney (210, 50.1%), right kidney (171, 40.8%), both (88, 9.1%) | History of PTB (20.3%) |
| Krishnamoorthy [8] (2017)| Mean, 35.4 years (range, 11–67 years) | 1:4.1 (65:45) | Kidney (70), ureters (30), bladder (18), testis and epididymis (6), prostate (4), penis (1) | History of PTB (22.7%), gastrointestinal TB (2.7%) |
| Ye [37] (2016)          | Mean, 42.8 ± 14.95 y | 1:64:1 (12073) | Kidney (76, 56 unilateral, 20 bilateral involvement), ureter (32), bladder (20), prostate (4), scrotal swelling (6) | Extra-urinary TB (36.3%) |
| Singh [38] (2013)       | Third decade of life (63.2%) | 1:1.51 (47:70) | Kidney (76, 56 unilateral, 20 bilateral involvement), ureter (32), bladder (20), prostate (4), scrotal swelling (6) | Past history of PTB (18.9%) |
| Study (publication year) | Age | Male-to-female ratio | Demographic | Genitourinary organs involved (n) | Associated comorbidities (%) |
|-------------------------|-----|----------------------|-------------|---------------------------------|-------------------------------|
| Chandra [39] (2012)     | Mean, 37.7 y | NA; only males were included | Location: hilly region of state (68%), non-hilly region of state (32%) | Urinary bladder (7, 28%), prostate (6, 24%), epididymis (3, 12%), testes (3, 12%), kidney (2, 8%), ureter (2, 8%), scrotum (1, 4%) | Previous history of TB (36%), alcoholism (28%), diabetes (12%) |
| Hsu [40] (2011)         | Mean, 60.3 ± 16.1 y | 1.46:1 (38.26) | Bladder (5), ureter (4), kidney (2), kidney/ureter (1), kidney/ureter/bladder (1), epididymis (3), testis/epididymis (2), testis/epididymis/prostate gland (2), epididymis/prostate gland (1), testis (1), prostate gland (1) | 57.8% Disseminated TB (48.4%), PTB (43.8%), DM (2.3%), malignancy (14.1%), COPD (14.1%), previous TB (12.5%), CVD (12.5%), receiving steroids (12.5%), ESRD (6.3%), liver cirrhosis (4.7%), alcoholism (4.7%) |
| Lee [17] (2011)         | Mean, 45.57 ± 12.55 years (range, 19–81 years) | 1:1.53 (40.61) | Kidney and/or ureter (80.20%), epididymis and/or testis (14.85%), bladder (3.96%), prostate (0.99%) | Past history of PTB (21.8%), intestinal TB (0.99%), spine TB (0.99%) |
| Karnjanawanichkul [41] (2010) | Mode, 31–40 years (range, 10–76) | 1:1 (20.15) | Occupation: farmer (34.3%), housewife (20.0%), businessperson (14.3%), government service (14.3%), blue-collar worker (14.3%), and student (29%) | Kidney (7; 3 bilateral, 1 left, 1 right), ureter (7; 3 bilateral, 1 left, 3 right), bladder (4), testis (3; 1 left, 2 right), kidneys to urethra (2), kidney + bladder (2), ureter + bladder (1), bladder + urethra (1), urethra (1) | Active or past history of PTB (34.3%) |
| Takahashi [42] (2007)   | Median, 68.5 years (range, 40–90 years) | 1:1 (6:6) | Kidney (7), bladder (6), ureter (2) | Active PTB (16.7%) |
| Hsieh [18] (2006)       | Mean, M: 54.4 years (range, 32–75 years), F: 61.8 years (range, 31–81 years) | 1:1.21 (14.17) | History of PTB (25.8%) |
| Buccholz [43] (2000)    | Mean, 399 ± 17.1 years (7–81 years) | 3:1 (41:14) | Kidney (28), bladder (15), ureter (13), testes (5), urethra (1) | Active PTB or EPTB on Category I treatment (93%), on Category II (5.4%), on Category III (1.8%), history of EPTB (11%), DM (33%) |
| Ramanathan [34] (1998)  | Mean, 388 years | 13.22 (9.29) | History of PTB (43.2%) |
| Study (publication year) | Age | Male-to-female ratio | Demographic | Genitourinary organs involved (n) | Associated comorbidities (%) |
|--------------------------|-----|----------------------|-------------|----------------------------------|-----------------------------|
| Dy [16] (1995)           | Mean, M: 48.4 ± 17.01 years (range, 21–72), F: 43.3 ± 17.58 years (21–78) | 12.2 (19.42) | Kidneys (50.8%), kidneys + ureter (4.9%), kidneys + ureter + bladder (1.6%), kidneys + prostate (1.6%), pelvis (8.2%), bladder (1.6%), bladder + ureter (1.6%), epididymis (3.3%), epididymis + testis + vas deferens (1.6%), fallopian tube + peritoneum (1.6%) | Active PTB (47.5%), past history of TB (32.8%), hyperuricemia (13.1%), DM (1.6%), HTN (1.6%), DM + HTN (1.6%), hypertensive renal failure (1.6%), liver cirrhosis (1.6%), congestive heart failure (1.6%), myelofibrosis (1.6%), osteoarthritis and prostatic cancer (1.6%), rheumatoid arthritis (1.6%) |
| Tanchuco [15] (1987)     | Mean, 39 years (range, 2 to 64) | 13:1 (24:18) | Past history of TB or exposure (28.6%), malnutrition (4.8%), DM (2.4%) | |

COPD chronic obstructive pulmonary disease, CVD cardiovascular disease, DM diabetes mellitus, ESRD end-stage renal disease, F female, HTN hypertension, M male, NA not applicable, PTB pulmonary tuberculosis
| Study (publication year) | Time from symptom onset to diagnosis | Systemic symptoms                                                                 | Genitourinary manifestations                                                                 |
|-------------------------|-------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Mishra [33] (2020)      |                                     | Constitutional symptoms (28.3%)                                                  | Irritative voiding symptoms (69.8%), hematuria (56.9%), flank pain (56.6%), associated renal failure (13.2%), infertility and hemospermia (5.6%), scrotal mass (1.9%) |
| Huang [10] (2019)       | Median, 4 m (range, 0.5–50 m)      | 75.4% Fever (56.1%), malaise/fatigue (36.8%), weight loss (31.6%), night sweats (88%) | Gross hematuria (40.4%), frequency/urgency (33.3%), dysuria (29.8%), flank pain (26.3%)          |
| Kim [35] (2018)         |                                     | Nonspecific symptoms (fever, anorexia, weight loss, sweating, weakness, peripheral lymphadenopathy) (12.5%) | Urinary frequency or dysuria, urethral pain, or irritable voiding symptoms (55.4%), loin or abdominal pain (42.9%), gross hematuria (33.9%), scrotal pain/mass (19.6%), abscess or fistula (5.4%), vaginal bleeding (3.6%) |
| Cao [36] (2017)         |                                     | Constitutional symptoms including weight loss, fever, night sweats, and/or fatigue (38.9%) | Lower urinary tract symptoms including frequency, urgency, and odynuria (65.2%), flank pain (37.9%), gross hematuria (26.3%) |
| Krishnamoorthy [8] (2017)|                                     | Nonspecific symptoms (fever, anorexia, weight loss, sweating, weakness, peripheral lymphadenopathy) (12.5%) | Loin pain (27.0%), storage symptoms (25.5%), hematuria (12.0%), stone disease (9.1%), palpable mass (8.2%), scrotal sinus (5.5%), infertility (2.7%), gastrointestinal symptoms (2.7%), urosepsis (1.8%), renal failure (1.8%), calcified kidney (0.9%), urinoma (0.9%) |
| Ye [37] (2016)          | Fever (26.4%), night sweat (13.0%), weight loss (10.9%) | 32.6%                                                                          | Urinary irritation (61.1%), lumbago (49.2%)                                                    |
| Singh [38] (2013)       |                                     | Irritative voiding symptoms (66.4%), hematuria (47.6%), flank pain (33.8%), recurrent urinary tract symptoms (18.9%), scrotal mass (5.1%), colocutaneous fistula (0.8%), nephroureteral fistula (1.8%), associated renal failure (14.7%), infertility or hemospermia (3.4%) | Urgency and increased frequency of micturition (56%), lumbar pain (56%), dysuria (52%), hematuria (44%), pyuria (40%), infertility (12%), renal failure (8%), recurrent abscess (8%), scrotal lump (8%), scrotal sinus (4%) |
| Chandra [39] (2012)     | Fever and malaise (32.0%)           |                                                                                 |                                                                                               |
| Hsu [40] (2011)         | 182.0±311.1 d (range, 5 to 124.5 d)| 51.6% Fever (43.8%), fatigue (37.5%), body weight loss (12.5%)                | Dysuria (31.3%), frequency (31.3%), flank pain (28.1%), hematuria (17.2%), scrotal pain or mass (10.9%) |
| Lee [17] (2011)         | Fever (3.0%)                        |                                                                                 | Frequency (40.6%), hematuria (33.7%), dysuria (16.8%), flank pain (16.8%), scrotal swelling (3%) |
| Karnjanawanichkul [41] (2010)| <6 m (65.7%), 6–12 m (17.1%), >1 years (8.6%), uncertain data (8.6%) |                                                                                 | Frequency (48.6%), dysuria (42.9%), hematuria (31.4%), abdominal pain or mass (25.7%), urethral pain (20.0%), retention (14.3%), colocutaneous fistula (14.3%), renal failure (5.7%) |
| Takahashi [42] (2007)   | Median duration between initial symptoms and clinic visit: 1.20 d (range, 3–360 d); between clinic visit and diagnosis: 14 d (7–150 d) |                                                                                 | Chief complaint: frequency (58.3%), hematuria (25.0%), positive nuclear matrix protein 22 on screening test for bladder cancer (8.3%), incidental right renal tumor (8.3%) |
Table 26 (continued)

| Study (publication year) | Time from symptom onset to diagnosis | Systemic symptoms | Genitourinary manifestations |
|--------------------------|--------------------------------------|-------------------|-----------------------------|
| Hsieh [18] (2006)        | Mean, 2 m (range, 5 d to 18 m)       | Fever (29.0%), malaise/fatigue (12.9%), night sweats (3.2%), body weight loss (3.2%) | Frequency/urgency (61.3%), dysuria (58.1%), flank pain (35.5%), gross hematuria (32.2%), scrotal mass/pain (16.1%) |
| Buccholz [43] (2000)     | Fever (36.0%), lassitude (13.0%), weight loss (13.0%) | Dysuria (49%), frequency (40%), flank pain (36%), gross hematuria (31%), urgency (15%), testicular swelling (13%), suprapubic pain (9%), renal colic (1%) |
| Ramanathan [34] (1998)   | Pain (63.6%), hematuria (61.3%), lump (18.2%) | Dysuria (32.8%), flank pain (27.9%), hematuria (19.6%), hypogastric pain (19.6%), nocturia (19.6%), frequency (18%), edema (14.8%), vaginal spotting (13.1%), costovertebral angle tenderness (11.4%), urgency (9.8%), hesitancy (6.6%) |
| Dy [16] (1995)           | Mean, M: 30.4±42.09 m (range, 0.25–180), F: 27.8±35.2 m (0.5–168) | Fever (29.5%), weight loss (18.0%), chills (98%), nausea/vomiting (66%), anorexia (6.6%) | Dysuria (71.5%), hematuria (62.0%), flank pain (44.5%), turbid urine (47.6%), frequency (40.5%), hypogastric pain 23.8%, edema (4.8%) |
| Tanchuco [15] (1987)     | Fever (52.4%), weight loss (26.2%), chills (21.4%), malaise (11.9%), night sweats (2.4%) | |
|                          |                                      |                   |                             |
### Table 27  Studies in the Asia–Pacific region showing serologic and urinary profiles of patients with GUTB

| Study (publication year) | Hematologic data | Biochemistry | Urinalysis |
|--------------------------|-------------------|--------------|------------|
| Mishra [33] (2020)       | Acidic urine (98.1%), sterile pyuria (81.1%), pyuria (69.8%), hematuria (5.8%), alkaline urine (1.9%) |
| Huang [10] (2019)        | Anemia (< 10 g/dL) (28.1%), thrombocytopenia (< 150 x 10^12/L) (26.3%) |
|                          | Hypoalbuminemia (< 2.5 g/dL) (40.4%) |
| Hsu [40] (2011)          | Anemia (Hb < 12 g/dL) (46.9%), leukocytosis (WBC > 10,000/µL) (17.2%) |
|                          | Pyuria or hematuria (WBC > 10/HPF, x 400, RBC > 5/HPF, x 400) (64.1%), aseptic pyuria (5.1%) |
| Karnjanawanichkul [41] (2010) | Poor renal function (Cr > 1.5 mg/dL) (18.8%), liver function impairment (ALT > 40 IU/L) (17.2%) |
| Dy [16] (1995)           | Pyuria (56%), hematuria (56%), sterile pyuria (56%) |
| Tanchuco [15] (1987)     | Creatinine clearance < 30 ml/min (75.0%), elevated BUN (> 0.53 mmol/L) (3.8%), elevated serum Cr (> 176.8 mmol/L) (3.5%) |

ALT alanine aminotransferase, Cr serum creatinine, Hb hemoglobin, HPF high-power field, RBC red blood cell, WBC white blood cell
in the urine, mostly establishing the diagnosis via positive urine culture [9]. Similarly, most retrospective studies in the Asia–Pacific region diagnosed infection based on bacteriologic and histologic findings with consistent clinical history, while a few depended mainly on clinical-radiologic evaluation (Table 24). In our study, the lack of clinical registries of GUTB in our hospital prompted us to instead use laboratory registries for case finding, noting majority of cases being diagnosed based on positivity for urine AFB smear (50.00%). In contrast, one local study observed mycobacterial culture being sent in only 22.2% of urologic cases and in 11.1% of gynecology cases, relying more heavily on clinical, radiographic, and histopathologic assessment [16]. Despite being a recognized tool for diagnosis of GUTB, imaging is particularly useful only during the later stages of the disease when calcifications or cavernous forms have already developed [19, 33]. Nonetheless, this diversity in practice standards is expected in developing countries because of the disproportionate availability of medical facilities and services [34].

Many reviews of the world literature [28, 29] noted kidneys to be the most frequently affected organ, which is consistent with most studies done in the Asia–Pacific region (Table 25). In contrast, some reports observed the bladder to be the most frequently affected genitourinary organ [38, 40], similar to our investigation. Renal involvement of TB infection can either be a localized urogenital disease or a part of a disseminated infection [6]. In literature, up to 10% of affected individuals have concomitant active pulmonary TB, suggesting hematogenous or lymphatic spread to this highly vascularized organ [28]. The latent period between pulmonary infection and development of clinical GUTB is described to range from 1 to 46 years, averaging around 22 years [29]. Infection may also be acquired hematogenously from the gut [28]. Other genitourinary organs may become affected through ascent or descent of MTB from a source elsewhere in the genitourinary tract, or from contact with the bacilli shed into the urine [26]. They may also get involved from descending spread from the lymphatics [29] or from sexual intercourse [28].

Unilateral organ involvement is commonly shown in retrospective, clinical, and autopsy studies [28, 33, 36, 38, 41]. In our investigation, left laterality was observed in 60% of those with kidney and ureter involvement, consistent with other reports [36, 41]. Renal lesions are initially described to be bilateral attributing to hematogenous spread. They generally undergo a period of cicatrization then enter a latent phase of infection, only reactivating the moment an individual becomes immunocompromised. From a single focus, infection eventually progresses, affecting one kidney while sparing the other. This phenomenon accounts for the greater frequency of unilateral renal TB [9].

**Patient characteristics**

Our investigation noted several patients having chronic diseases (e.g., diabetes mellitus, hypertension, chronic kidney disease), immunocompromised conditions (e.g., HIV/AIDS, steroid use), history of tuberculosis, or presence of TB in other organs. Traditionally, risk factors for developing TB include malnutrition, immunosuppression, HIV infection, diabetes, chronic kidney or liver disease, smoking, and low socioeconomic status [25, 28]. Factors considered high-risk for GUTB include past or present TB infection, recurrent or resistant urinary tract infection, and fistulas involving the scrotum, perineum, or lumbar area [5]. Emergence of drug-resistant strains of TB as well as anatomical abnormalities of the urogenital tract from congenital conditions, renal cysts, and urolithiasis also predispose to its development [19]. In our study, a substantial number of patients were single or widowed (61.61%), lived in urban areas (53.57%), and were unemployed (51.79%). In comparison, several studies reported most patients to be living in the hilly region of the state (68%), working as farmers (21–56%) or unemployed (20.0–24.6%), and having low socioeconomic status (80.0–88.7%) [33, 36, 39, 41].

Worldwide, cases encountered between developed and developing countries exhibit different patterns. In developed countries, GUTB mainly affects the elderly, ethnic minorities, and immigrants [6, 9]. On the other hand, patients from developing countries are younger due to higher incidence and severity of TB disease. They present with more specific symptoms and complications which are further exacerbated by delays in diagnosis [9]. Our data demonstrated a mean age of 35.79 ± 18.29 years, with 22.32% belonging to the pediatric population. These findings are consistent with most studies in the region (Table 25). GUTB generally has the propensity to infect both men and women of child-bearing age (20–40 years old), with a mean age of 40.7 years (range, 5–88 years) [25, 29]. We also report a male-to-female ratio of 1:1.15 (52:60). A proper estimate is controversial since there is a lack of controlled epidemiological and clinical studies [28]. While some report more men to be affected than women (2:1) [29], others report women to be affected twice as many as men [28]. Even among past local data, sex distribution was inconsistent [15, 16]. Variation between geographical regions might reflect local TB endemicity or study bias, thereby making accurate epidemiological and clinical data on GUTB difficult to obtain [28].
Clinical manifestations
GUTB does not present with any specific clinical feature and may in fact be asymptomatic [6]. Up to 50% of cases are incidentally diagnosed when patients undergo work-up for other genitourinary disorders [28]. In those with symptoms, storage symptoms (e.g., urinary frequency, urgency, incontinence, nocturia) were the most common presentation on admission, followed by dysuria, hematuria, and lumbar pain [9, 26, 29]. In our study, we recorded 50.89% of patients to have genitourinary manifestations as their chief complaint, with 21.43% having flank or abdominal pain. Several studies also mentioned abdominal or hypogastric pain to be common (19.6%-42.9%) [15, 16, 35, 41].

We noted 21.43% of patients to have systemic symptoms such as weakness and fever as their initial complaints, while 12.50% manifested with difficulty of breathing. Such findings might be explained by the high rates of TB infection in other organ systems (57.14%), with lungs being the most common extra-genitourinary site (50.89%). In some literature, constitutional symptoms such as fever, weight loss, and night sweats are uncommon and, if present, are indicative of concomitant TB outside the genitourinary system. Some patients may initially present with a myriad of symptoms reflective of other concomitant infections like PTB and hence GUTB symptoms and signs are not always defined by the anatomical site of disease [28]. Moreover, secondary bacterial infections can concurrently occur in up to 50% of patients with GUTB [25, 28]. Our data is consistent with most studies in the Asia–Pacific region, with the exception of those done in South Korea where systemic symptoms are relatively uncommon (3–12.5%) [17, 35]. Systemic manifestations are otherwise present in many reports (28.3–75.4%), with fever being the most cited symptom (29–56.1%) (Table 26). Delays in diagnosis may result in disease progression and severe complications seen at presentation [28].

Hematologic abnormalities
Hematological and biochemical tests are considered nonspecific and are instead utilized as adjuncts to GUTB management [28]. In our study, majority of patients presented with anemia (83.04%), while several exhibited leukocytosis (41.96%) and thrombocytosis (26.79%). This is similar to past local data, where anemia and leukocytosis were found in 60.0% and 37.0% of patients, respectively [15]. These estimates are higher than what is recorded in literature, where 15.6–46.9% of patients exhibited anemia and 13.0–25.8% had leukocytosis (Table 27). Thrombocytopenia (26.3%) occurred more frequently in some populations [10]. It is important to note that these studies applied different definitions of hematologic abnormalities, making comparison difficult.

TB infection is traditionally known to affect various cell lines. It can cause anemia attributed to four mechanisms: chronic disease, nutritional deficiencies, autoimmune hemolytic anemia, and marrow complications. It is described to commonly affect all subtypes of granulocytes during its course, predominantly affecting neutrophils either quantitatively or qualitatively. It may result in transient neutrophilia or, in extreme cases, leukemoid reaction. TB may also cause leukopenia, especially in females, elderly, or those with recurrent infections. Neutropenia may occur from direct suppression of granulopoiesis by activated T cells [44]. Lymphopenia and lymphocytosis are also commonly reported in active TB [45]. Lastly, TB may result in various platelet abnormalities. Thrombocytosis is frequently reactive in nature and is related to the degree of inflammation. It is mediated by increased levels of endogenous thrombopoietin produced as an acute-phase reactant. Thrombocytopenia, on the other hand, is usually from bone marrow infiltration, disseminated intravascular coagulation, immune thrombocytic purpura, thrombotic thrombocytopenic purpura, or drug-induced [44].

Biochemical abnormalities
Among those with laboratory results, hypoalbuminemia (58.10%) and impairment of renal function (36.94%) were commonly found, similar to those reported in literature, with estimates at 37.5–40.4% and 18.8–75.0%, respectively (Table 27). As plasma creatinine concentration is considered to be normal in the setting of unilateral renal involvement, increased levels may indicate bilateral renal involvement or presence of concomitant disorders such as interstitial nephritis or glomerulonephritis [46, 47]. In a review of 8961 cases, 5.7% of patients with GUTB were reported to develop end-stage renal disease (ESRD) [29]. Likewise, one retrospective study in South Korea reported occurrence of ESRD in 7.1% of GUTB patients, identifying acute renal failure and old age as independent risk factors for chronic kidney disease [35].

We also observed several electrolyte abnormalities, specifically hyponatremia (50.93%), hypercalcemia (20.19%), hypokalemia (21.82%), and hyperkalemia (8.18%). Mild hyponatremia has been reported in the setting of active pulmonary or miliary TB, with incidences ranging from 11 to 51% [27, 48]. Most cases are due to syndrome of inappropriate antidiuretic hormone secretion (SIADH), with a third having reset osmostat wherein the plasma sodium stabilizes at lower concentration.
levels. Mechanisms for such persistent ADH release are yet to be explored, but abnormalities in water handling are demonstrated to resolve following successful treatment of infection [27]. Hyponatremia in TB may also be attributed to adrenal insufficiency. Hyponatremia from this condition is accompanied by hyperkalemia and increased urinary potassium excretion. Cerebral salt wasting is another mechanism for hyponatremia, usually seen in patients with tuberculous meningitis [48]. Lastly, patients with kidney TB may also develop salt-losing nephropathy [49].

Tubulointerstitial nephritis (TIN) is one possible complication of TB which might contribute to the multiple electrolyte abnormalities seen in patients with infection. Several case reports described the development of chronic granulomatous TIN in patients with TB as evidenced by renal biopsy [50–53]. Unlike the other studies, one case series in west London found only 18.7% of those with granulomatous inflammation on renal biopsy to exhibit caseation necrosis [53], whereas another study in France raised the possibility of severe TIN in TB despite the absence of renal granuloma [54]. Although reports on this tubulointerstitial disorder are increasing, mechanisms for its development are poorly understood [55].

Hypercalcemia is another electrolyte abnormality commonly cited in patients with TB. Surveys from different countries show prevalence rates up to 11%-48%, noting that the actual estimates of prevalence are difficult to establish since concurrent serum albumin levels are not consistently reported [48]. Renal or extrarenal TB granulomas accounted for the non-physiologic synthesis of 1,25-dihydroxyvitamin D3 and the ensuing hypercalcemia [56]. Calcification is unusual in the early stages of infection, however, in the advanced stages, nearly all kidneys contains calcification [26].

**Urinary abnormalities**

Urinalysis is abnormal in up to 90% of patients with GUTB, with findings ranging from mild changes to extreme pyuria [6, 29, 57]. Pyuria with or without microscopic hematuria is seen in majority of patients, whereas heavy proteinuria and cellular casts are not generally observed [6, 26]. Persistent sterile pyuria, pyuria in an acidic urine without growth on routine culture, or symptomatic UTI unresponsive to standard antibiotics should prompt suspicion of GUTB [6, 25, 28, 58]. Our study showed proteinuria (67.96%) and pyuria (67.96%) to be the most common urinary findings, consistent with those cited in literature (Table 27). Low specific gravity was also found to be common (31.07%), possibly reflecting poor urinary concentrating ability especially in the setting of chronic kidney disease or tubulopathy.

**Radiological findings**

Various imaging modalities are used to support the diagnosis of GUTB, with findings dependent upon the extent of disease progression. Despite traditionally being used to suggest, and not to confirm or exclude, the presence of the disease, they are still paramount in management and can still be utilized to confidently diagnose GUTB by those with sufficient experience [59].

Intravenous urogram (IVU) is considered the gold standard for imaging in early renal TB [33, 59]. There might be no abnormalities present during early disease, but there usually appear moderate to severe urinary tract changes once patients become symptomatic [59]. Early findings include infundibular narrowing, calyceal erosion or blunting, and papillary necrosis with associated parenchymal scarring and calcification [27]. GUTB is considered if there is simultaneous involvement of both the upper and the lower urinary tracts, especially the kidney and the bladder [27, 29]. Later stages of the disease may demonstrate extensive cavitation, mass lesions, calyceal distortion, cortical scarring, calcification, auto-nephrectomy, perinephric abscess, fistula formation, ureteral strictures, and bladder fibrosis [25, 59]. In our study, both patients who underwent intravenous pyelography showed advanced findings of extensive stone formation and non-functioning kidney.

Triphasic computed tomography (CT) scan remains the mainstay imaging technique for cross-sectional imaging in GUTB [6]. It is the most sensitive modality to detect calcification, and is superior to IVU in detecting multiple small urethelial lesions [25, 60]. Findings suggestive of GUTB include the presence of lesions in other organs beyond the urinary tract, such as liver, lymph nodes, and vertebrae [29], as seen in our study. Although IVU and CT scan are reported to be the more frequently used imaging modalities in GUTB [29], some investigations still heavily rely on ultrasonography [18, 36]. Ultrasonography may only give indirect evidence of GUTB, but it avoids exposure to ionizing radiation and can be conveniently used to guide fine needle aspiration biopsies [5, 25, 59]. In literature, two patterns of GUTB have been described: (1) the infiltrative pattern showing increased echogenicity from calcifications, infected debris, or abscesses; and (2) hydronephrosis or pyonephrosis, involving calyceal dilatation and a small renal pelvis. Another distinguishing feature for GUTB is the visualization of multiple abnormalities in different disease stages with various organ involvement [59]. All these changes were observed in our investigation.

**Treatment**

Medical treatment of GUTB should be initiated promptly when clinical, laboratory, and radiological findings...
suggest a presumptive diagnosis, even prior to the release of microbiologic and histopathologic results [26, 47]. Pharmacologic therapy for drug-sensitive TB consists of an intensive phase of quadruple therapy with first-line anti-TB agents (e.g., isoniazid, rifampicin, pyrazinamide and ethambutol) for 2 months, followed by a continuation phase with two drugs (e.g., isoniazid, rifampicin) for 4 months [28]. In our study, over sixty percent (63.39%) of patients were started on anti-TB therapy during admission, reflecting diverse in-hospital practices wherein several cases were discharged upon resolution of their reasons for encounter, with eventual treatment initiated on an out-patient basis after microbiologic and histopathologic confirmation.

Around half (54.9%) of patients with GUTB require surgery [28, 47]. Indications for surgery include diversion of urologic obstruction, drainage of abscesses, nephrectomy of non-functioning kidneys, reconstruction of affected ureters, and dilation of contracted urinary bladder [26, 28]. A quarter (25.89%) of patients in our study underwent an operation, lower than that observed in a previous local investigation (52%) [15]. This difference might be attributed to the higher proportion of younger individuals involved in our study, whose illness duration may not be long enough to develop complications that would warrant surgical therapy. This finding might signify a changing pattern of disease in the country.

Short-term outcomes
Deaths from tuberculosis are higher in developing (2–3 million deaths per year) than developed countries (40 thousand deaths per year) [9]. In GUTB, mortality rates vary (1.2–28.1%) [10], with most patients succumbing from disseminated infection [15]. In our center, all-cause in-hospital mortality occurred in 8.04% of the included patients. Age, leukocytosis, and need for pressors were all significantly associated with mortality (p values of <0.001, 0.010, and <0.001, respectively). Several researches in Taiwan investigated risk factors for mortality in patients with GUTB. Fever was shown to be positively correlated with mortality (OR = 42.716; 95% CI 1.032–1767.569; p = 0.048), possibly attributed to its high prevalence in elderly patients, those with multiple co-morbidities, and those who had delays in diagnosis [10]. Other poor prognostic factors included genitourinary tract surgery (OR = 0.000; 95% CI 0.000–0.255; p = 0.020) [10], age older than 65 years old (HR = 4.03; 95% CI 1.27–12.76; p = 0.02), cardiovascular disease (HR = 5.96; 95% CI 1.98–17.92; p = 0.001), steroid use (HR = 10.16; 95% CI 2.27–45.47; p = 0.02), and no treatment (HR = 4.81; 95% CI 1.12–20.67; p = 0.04) [40].

It was observed that patients with longer mean lengths of hospital stay did not necessarily develop unfavorable hospital outcomes. Instead, prolonged admission duration seemed to have been influenced by management of co-morbidities (e.g., SLE, pulmonary TB, psoas TB) and correction of various clinically significant laboratory abnormalities (e.g., anemia, leukocytosis, hyponatremia, and hypercalcemia). Awaiting results of TB workups during admission for diagnosis of equivocal cases and for subsequent initiation of definitive therapy might have also contributed since anti-Koch’s treatment had a statistically longer mean length of hospital stay (p <0.001). These findings were reflective of the varying practices in our center, with many cases undergoing surgery for prompt treatment of symptoms and having medical therapy be initiated on an out-patient basis depending on the results of cultures and histopathology.

Limitations
Our study had several limitations. Its retrospective design which was affected by institutional limitations in recordkeeping made data collection restricted, as evidenced by a low chart retrieval rate (57.89%, 132/228). Given the absence of a unified clinical registry and data recording, our case finding was laboratory-based and was subject to selection bias, thereby rendering our results nongeneralizable to a broader patient population. It also proved to be a major barrier preventing inclusion of predictive modeling of study outcomes. Despite these limitations, our research is the largest study in the country to date, involving more accurate diagnosis of GUTB compared to past local studies since all reviewed cases had bacteriologic or histopathologic evidence of infection. It also involved more specific definitions of serologic findings adjusted per age and sex.

Conclusion
Our investigation observed a high prevalence rate of serologic and urinary abnormalities among admitted GUTB patients in the study. Apart from the commonly cited abnormalities in literature, multiple electrolyte abnormalities and urinary concentration defects were observed in many cases, possibly indicating tubulointerstitial involvement. Accordingly, we recommend future research be done on such complications to determine its correlation with disease activity and to possibly help with the diagnosis of infection particularly in low-resource settings. Mortality rate was also noted to be high among admitted patients with GUTB. Age, leukocytosis, and need for pressors were significantly associated with mortality. However, further research is recommended to explore predictive modeling.
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