

Tuberculosis Effects in Urinary Tract by using Ultrasound in Sudan

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Background and study aim:

Tuberculosis (TB) is a huge public concern in Sudan. According to the world health organization (WHO), Sudan alone carries 15% of the TB burden in the Eastern Mediterranean Region. This study was designed with the aim to evaluate the clinical value of sonography in the diagnosis and determine the effects of TB in the urinary tract (kidneys, ureters and urinary bladder) of infected and untreated Sudanese subjects.

Patients and Methods: This prospective study was conducted at Al-Nihood Teaching Hospital in West Kurdufan State- Sudan. It spanned a period of 4 years from January 2008 to January 2012, involving 200 untreated Sudanese patients (118; 59% males and 82; 41% females) and aged 1 to 85 years; mean age of 37 ± 2.9 years. Samples proved to have TB either by one urine culture positive for Mycobacterium TB, or a histopathological confirmation of caseating necrotic lesions in a biopsy or surgery specimen. Sonography was performed using Toshiba Just Vision 200

and Tokimec CS-2020 fitted with 3.5 MHz convex transducers.

Results: In TB patients, ultrasound findings in kidneys were varied and included wide spectrum of abnormalities like renal stones (24%), hydronephrosis (17%), renal cavitations (8%), renal cyst (16%), Pyelonephritis (12%), parenchymal renal disease (9%), renal abscess (3%), atrophied kidneys (5%), renal solid mass, end stage kidney disease and non visualized kidneys (2%). Findings in ureters include hydroureter (8%) and in urinary bladder (UB) ultrasound detected UB wall thickening (12.5%), vesicle stone (1%) and UB mass (0.5%).

Conclusion: Urinary tract sonography is a quick and non invasive method of evaluating the urinary tract in miliary TB conditions. Therefore, after proven TB infection either by urine culture or histological confirmation, ultrasound can be used widely to determine its effects in urinary tract and to monitor the therapeutic efficacy in a clinical situation.

INTRODUCTION

Tuberculosis (TB) remains a global health problem, with one-third of the world population infected and ~9.4 million new cases reported in 2008. 75% of the infected individuals are aged 15-54 years [1]. TB of the kidney and urinary tract is, like other forms of the disease, caused by members of the Mycobacterium TB complex [2]. The mechanisms of the spread to the kidney and urinary tract of miliary TB which involves the urinary system with a rather high incidence, and, if not detected, may result in a functionless kidney for the

often nonspecific symptomatology. These considerations account for the seriousness of the problem of urinary TB, whose great topical interest is unfortunately proven not only in the African continent where it is particularly common, but also in Europe [3].

Flank pain, back pain and hematuria are seen. However, fever, weight loss and night sweats are usually absent. The definitive diagnosis of urinary TB depends on a positive urine culture, acid fast staining and histological diagnosis [2,4]. Early diagnosis of renal TB is important and can prevent

occurrence of renal failure as TB is still common with rising incidence in certain countries, especially Middle East and Africa [5].

Ardalan et al. determined the radiological findings in renal TB where the most common findings were ureteral stricture and dilation (13/25, 52%), bladder involvement 13/25 (52%), autonephrectomy 12/25 (48%) and renal parenchymal calcification 10/25 (40%). The most common combined pattern was ureteral stricture-dilation with contralateral autonephrectomy and bladder irregularities. Also they reported that: "Kidney TB remains undiagnosed until the advanced stages and awareness about the intravenous urography (IVU) imaging pattern could help in early diagnosis of this entity" [6].

Profile of renal TB was studied by Najar et al. where they conclude that: Renal TB should not be a difficult diagnosis to make in patients with urinary symptoms plus abnormal urine analysis that should be screened for TB after routine urine cultures have been found to be negative [7].

In renal TB hydrocele, hydronephrosis with or without debris, loss of corticomedullary differentiation, cortical thinning, and calcification are seen on sonography, echogenic rim are reported as the most common findings [8, 9].

PATIENTS AND METHODS

This was a prospective study that spanned a 4 years period from January 2008 to January 2012, involving 200 untreated Sudanese patients proved to have TB (aged 1 to 85 years; mean age of 37 ± 2.9 years) were selected from the outflow of the patients at Al-Nihood Teaching Hospital, Radiology and Medical Imaging Department, West Kurdufan State, Sudan.

At inclusion, we included samples had urinary tract TB proven either by at least one urine culture positive for Mycobacterium TB, or a histopathological confirmation of caseating necrotic lesions in a biopsy or surgery specimen. The medical records of such 200 qualified patients were analyzed with regard to age, sex, medical history and symptoms. The remaining patients had been treated on strong clinical suspicion alone and were, therefore, excluded from the study. An informed consent was obtained from all the subjects before scanning but, in addition, a review and authorization of the study protocols was done by the Ethical

Committee available at Al-Nihood Teaching Hospital.

Urinary tract sonography was performed using Toshiba Just Vision 200 and Tokimec CS-2020 fitted with 3.5 MHz convex array transducers. Ultrasound machines used were connected with digital graphic printer, 100 V; 1.5 A; and 50/60 Hz, with serial number of 3-619-GBI-01 and made by Sony Corporation- Japan.

The examination begins with the patient in the supine position. The highest frequency transducer permitting adequate penetration is used. A phased array sector probe with its small footprint permits subcostal and intercostal scanning. Scans were performed in the sagittal and transverse planes from the anterior approach using the liver and spleen as acoustic windows. Various maneuvers may enhance demonstration of the kidneys: left lateral decubitus or lateral oblique positions for the right kidney and right lateral decubitus or lateral oblique positions for the left kidney. Coronal longitudinal and transverse scans may also be obtained and are recommended for evaluating the renal pelvis and proximal ureter on hydronephrotic patients [10].

The bladder should be full enough. It is important to have the correct degree of bladder fullness since too little fluid may not provide the window necessary for adequate pelvic scanning. A bladder that is too full can compress or displace structures so they are not visualized. An overfull bladder can also create the disappearance of pathology. After the scans are performed, if there is any doubt about the influence of the full urinary bladder on adjacent structures, have the patient partially void and rescan the bladder [11]. Specific ultrasound features used to diagnose TB complications in urinary tract such as masses, cysts; abscess and stricture were according to the international bases of sonographic features that used to diagnose such clinical situations. So to determine positive TB result, first line of diagnosis is clinical and lab tests then to see the complication in the urinary tract, ultrasound should take place immediately.

The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1964.

Results statistical analysis, overviewed in a form of tables and graphs by using Microsoft Office Excel package depend on the frequencies and the percentages of variables among the scanned samples.

RESULTS

A total of 200 Sudanese patients (118; 59% males and 82; 41% females) aged from 1 to 85 years; mean age of 37 ± 2.9 years, proved to have TB either by at least one urine culture positive for *Mycobacterium TB*, or a histopathological confirmation of caseating necrotic lesions in a biopsy or surgery specimen.

The duration of TB symptoms was 4 months to 3 years; mean of 20 months in the scanned subjects. The common clinical features detected in TB patients were loin pain, hematuria, dysuria and frequency, fever, ureteric colic, hypertension and renal failure. Out of 200 untreated TB subjects 72 (36%) presented with loin pain, 20 (10%) presented with hematuria, 24 (12%) presented with dysuria and frequency, 27 (13.5%) presented with fever, 36 (18%) presented with ureteric colic, 18 (10.5%) presented with hypertension (HTN) and 3 (1.5%) had renal failure. There are no co-morbidities detected in whole patient of this study, as diabetes mellitus (DM), and glomerulonephritis and systemic lupus. (Table 1 and Figure 1).

Table 1: Clinical features of urinary tract TB in the scanned samples

Clinical features	Frequency in patients	Percentage
Loin pain	72	(36%)
Hematuria	20	(10%)
Dysuria and frequency	24	(12%)
Fever	27	(13.5%)
Ureteric colic	36	(18%)
Hypertension	18	(9%)
Renal failure	3	(1.5%)
Total	200	(100%)

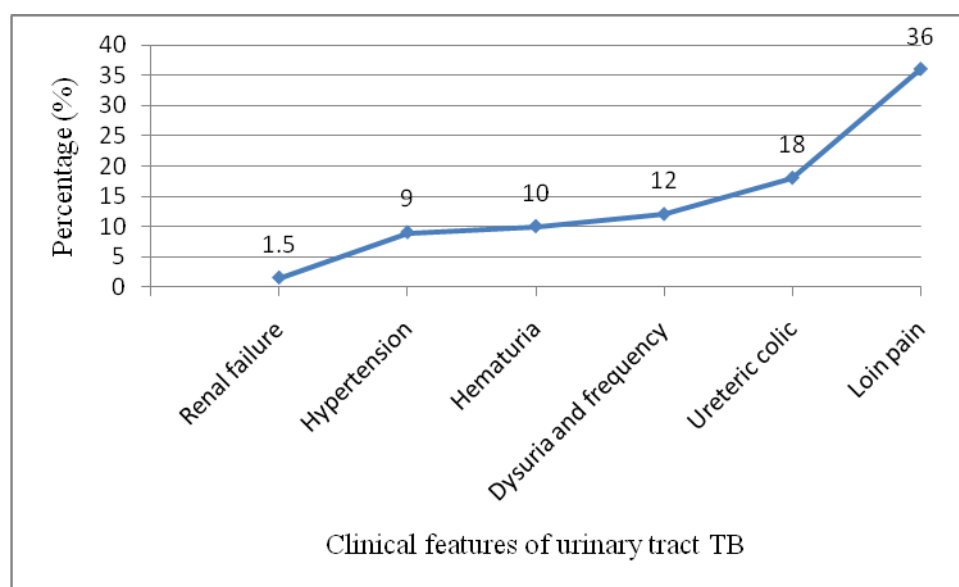


Figure 1: Clinical features of urinary tract TB in the scanned samples

All the patients in this study did have any investigation for natural resistance. The majority of our patients live in the same rooms with other people where 18 (9%) subjects had family members with tuberculosis.

Ultrasound findings in kidneys of untreated TB subjects were varied and included a wide spectrum of abnormalities. In which renal stones in 48 (24%), hydronephrosis in 34 (17%), renal cavitations in 16 (8%), renal cyst in 32 (16%),

pyelonephritis in 24 (12%), parenchymal renal disease in 18 (9%), renal abscess in 6 (3%), atrophied kidney in 10 (5%), renal solid mass, end stage kidney disease and non visualized kidneys in 4 (2%) (Table 2 and Figure 2).

Table 2: Ultrasound findings in kidneys of 200 untreated TB patients in the scanned samples

Kidneys ultrasound findings	Frequency in patients	Percentage
Renal stone	48	(24%)
Hydronephrosis	34	(17%)
Renal cavitations	16	(8%)
Renal cyst	32	(16%)
Pyelonephritis	24	(12%)
Parenchymal renal disease	18	(9%)
Renal abscess	6	(3%)
Atrophied kidney	10	(5%)
Renal solid mass	4	(2%)
End stage kidney	4	(2%)
Non visualized Kidney	4	(2%)
Total	200	100%

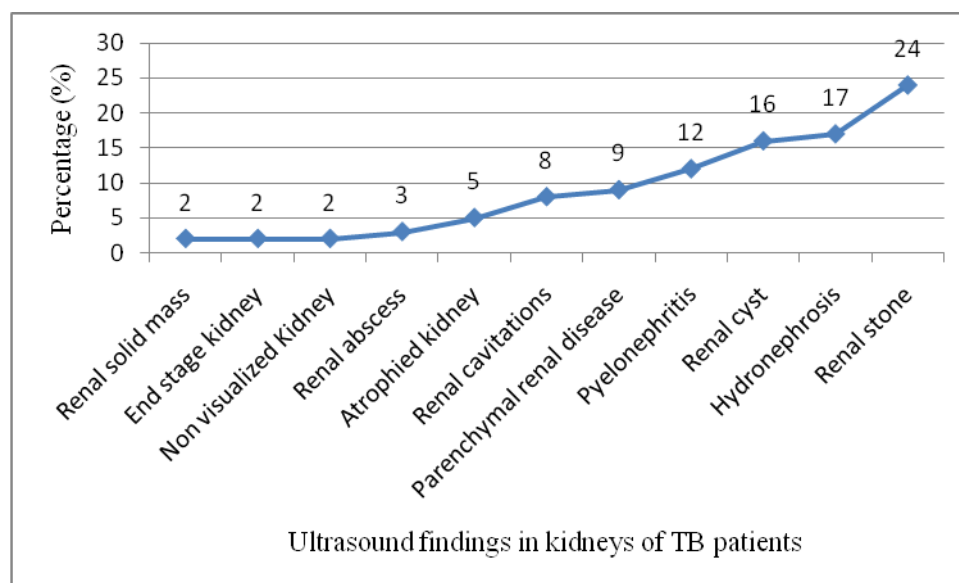


Figure 2: Ultrasound findings in kidneys of untreated TB patients

In addition, ultrasound findings in the ureters of untreated TB subjects include hydroureter in 16 (8%) cases (Table 3 and figure 3).

Table 3: Ultrasound findings in ureters of 200 untreated TB patients in the scanned samples

Ureters ultrasound findings	Frequency in patients	Percentage
Hydroureter	16	(8%)
Normal Ureter	184	(92%)
Total	200	100%

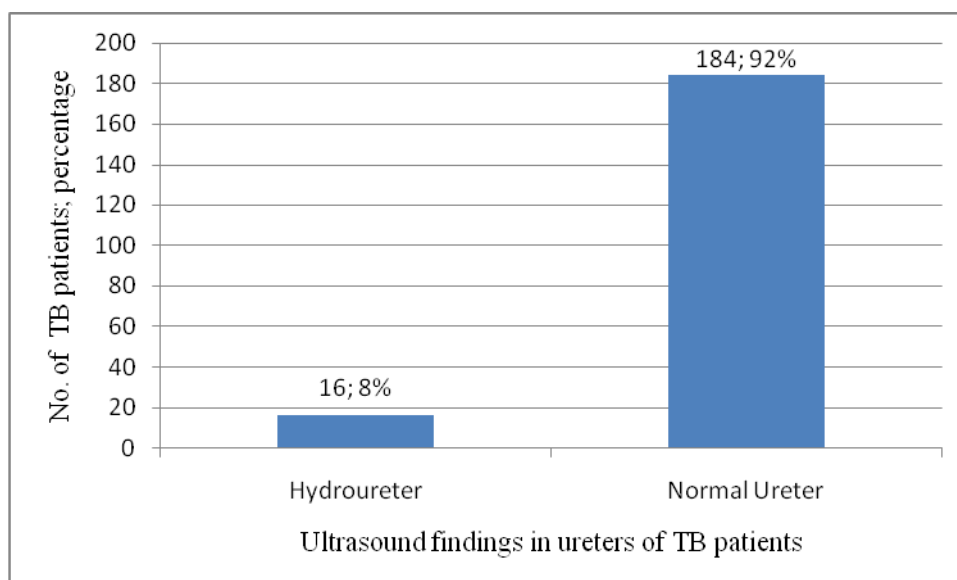


Figure 3: Ultrasound findings in ureters of untreated TB patients

In the urinary bladder (UB) of untreated TB subjects, ultrasound detected features such as UB wall thickening in 25 (12.5%), vesicle stone in 2 (1%) and UB mass in 1 (0.5%) (Table 4 and Figure 4).

Table 4: Ultrasound findings in UB of 200 untreated TB patients in the scanned samples

UB ultrasound findings	Frequency in patients	Percentage
UB wall thickening	25	(12.5%)
Vesicle stone	2	(1%)
UB mass	1	(0.5%)
Normal UB	172	(86%)
Total	200	100%

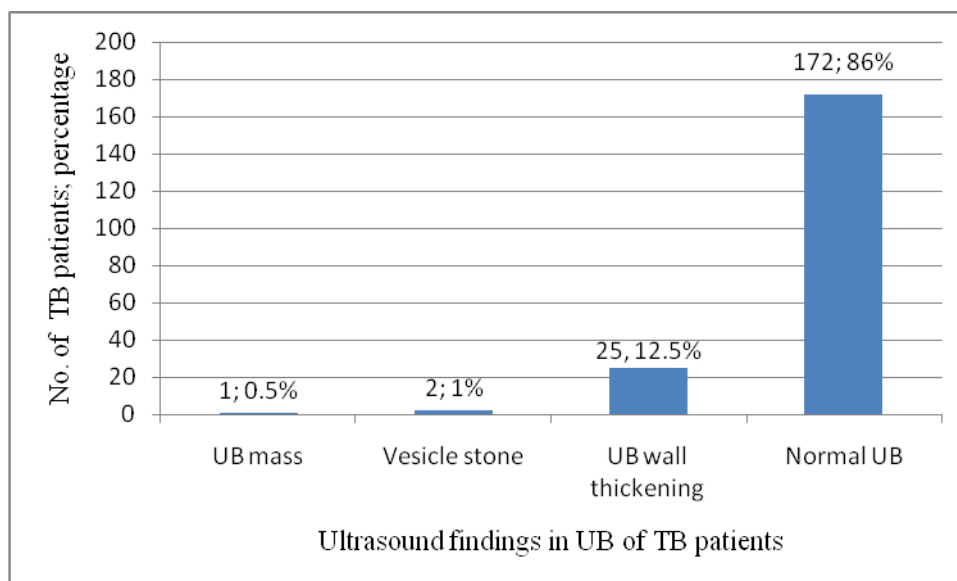


Figure 4: Ultrasound findings in UB of untreated TB patients

In this study the researchers follow up the treatment in all cases proved to have TB by ultrasound and the result of this follow up shows that there is a complete resolution in the

majority- unless renal solid masses, end stage kidney disease and atrophied kidneys- of conditions which confirm the response to treatment.

DISCUSSION

Out of 200 untreated TB cases, 118; 59% were males and 82; 41% females. Dominant of males has been reported in various other studies such as Najar et al. and O' Flgnn [7,12]. Results showed that urinary tract TB generally presents in adults (mean age is 37 ± 2.9 years) because of the time elapsed between primary infection and manifestation of the renal spread [6,7,13].

TB infection in the urinary tract could be assess clinically and microscopically but ultrasound is the cheapest, accurate and noninvasive method that give us further details about the wide spectrum of complication caused by military TB in the urinary tract, such as renal cavitations, renal abscess, atrophied kidneys, vesicle stones and others. Theses spectrum of complication cannot be answered or seen by clinical or microscopic methods alone. Microscopic exam just used to confirm the presence of TB but the study of complication was done using ultrasound.

The most frequent presenting symptoms for active urinary tuberculosis reported by Simon et al. where dysuria in 34%, hematuria in 27%, flank pain in 10% and pyuria in 5% also Najar et al. reported that 36% had dysuria and frequency, 24% hematuria, 20% loin pain, 8% ureteric colic, 11% hypertension and renal insufficiency each

and 3% presented as acute febrile illness [14,7]. While in this study, the common clinical features detected in TB patients were loin pain, hematuria, dysuria and frequency, fever, ureteric colic, hypertension and renal failure. 72 (36%) presented with loin pain because of ureteral obstruction due to stricture or the passage of blood clots or necrotic debris, 20 (10%) presented with hematuria, 24 (12%) presented with dysuria and frequency from urinary inflammation, 27 (13.5%) presented with fever, 36 (18%) presented with ureteric colic, 18 (10.5%) presented with hypertension and 3 (1.5%) had renal failure as confirmed by Narayana [15].

The role of imaging studies in urinary tuberculosis has been to assess the extent of involvement, to monitor the effect of treatment, and to discover complications. Early findings are best detected on IVU or retrograde pyelography. Late or chronic changes are optimally evaluated with computed tomography and sonography. Recently, however, sonography has been performed more often because it is more easily available and is economical [9,17,18,19]. In this study ultrasound detected a wide spectrum of abnormalities in kidneys (**Figures 5 A, B, C and D**), ureters and UB (**Figure 6 A and B**) of TB infected subjects.

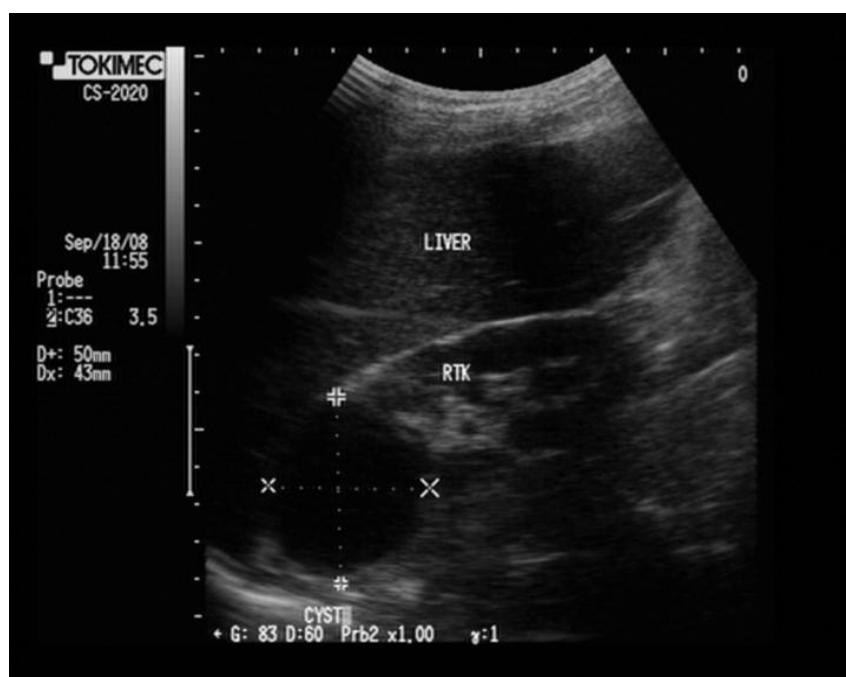


Figure 5A: Longitudinal renal sonogram in TB patients; upper polar simple renal cyst

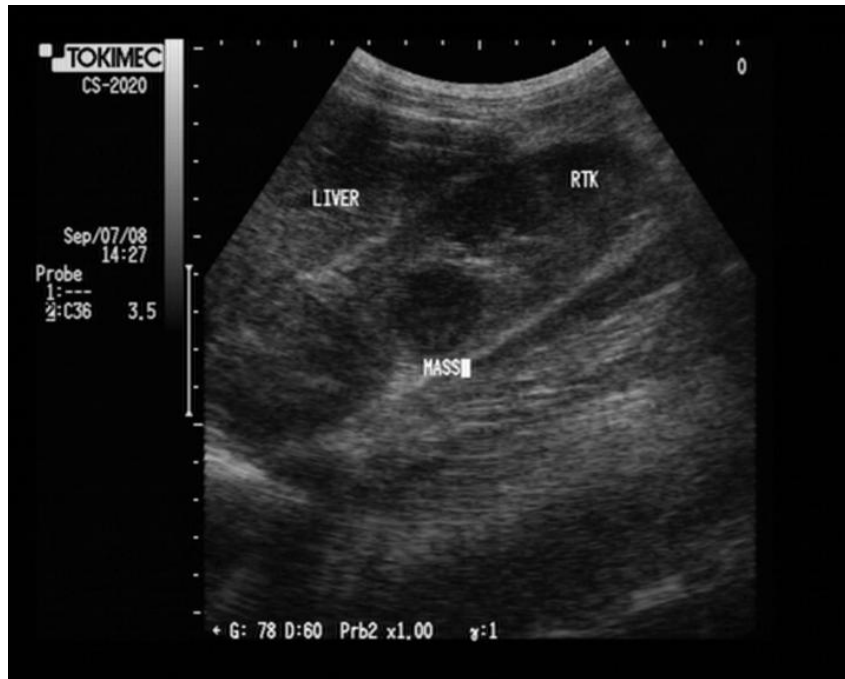


Figure 5B: Longitudinal renal sonogram in TB patients; mid polar solid renal mass

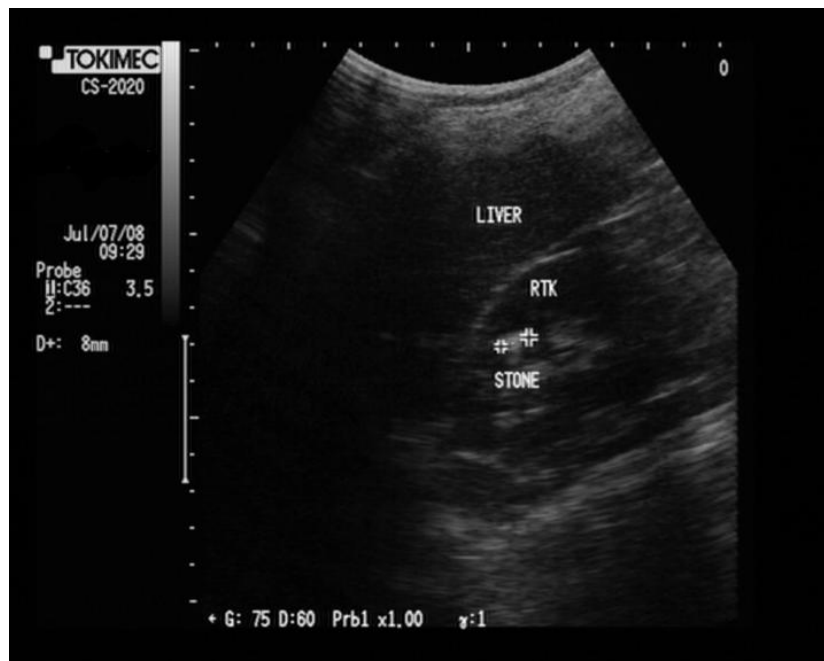


Figure 5C: Longitudinal renal sonogram in TB patients; pelvicalyceal calculi

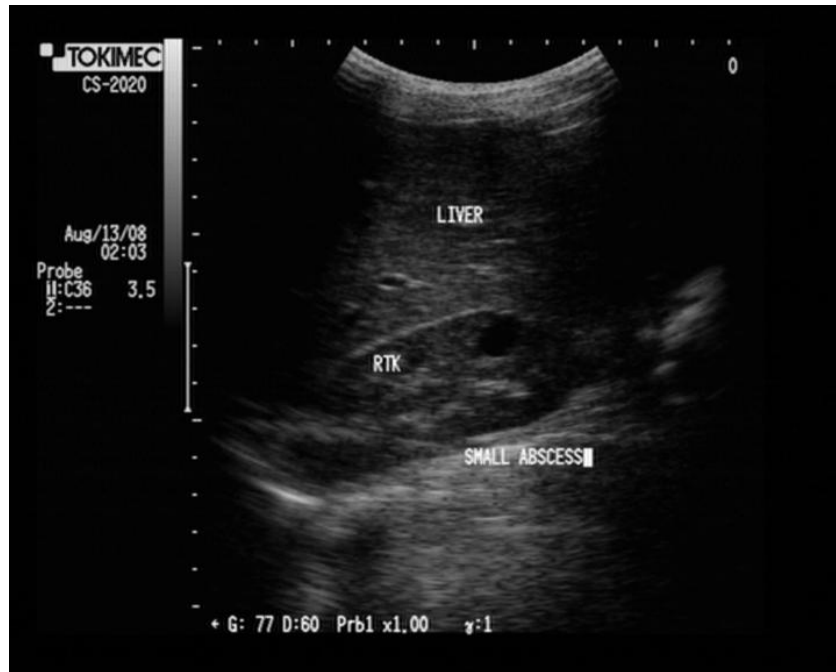


Figure 5D: Longitudinal renal sonogram in TB patients; renal abscess



Figure 6A: Short axis renal sonogram in TB patients; hydronephrosis with hydroureter

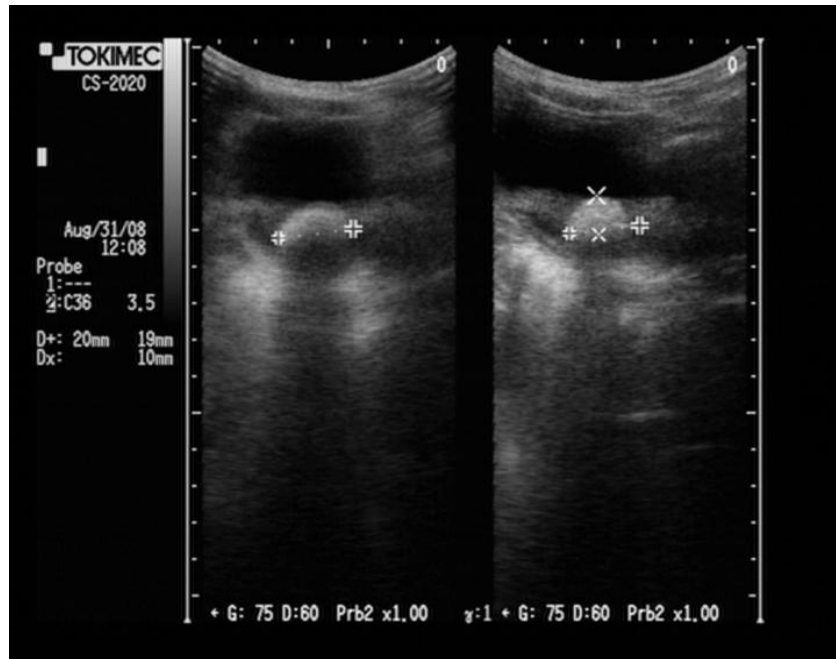


Figure 6B: Short axis UB sonogram in TB patients; Vesicle stone with UB cystitis

In kidneys, tuberculosis effects were renal stones in 48 (24 %), hydronephrosis in 34 (17%), renal cavitations in 16 (8%), renal cyst in 32 (16%) Pyelonephritis in 24 (12%), parenchymal renal disease in 18 (9%), renal abscess in 6 (3%), atrophied kidney in 10 (5%), renal solid mass, end stage kidney disease and non visualized kidneys in 4 (2%). In ureters, ultrasound was able to detect hydroureter in 16 (8%). UB wall thickening in 25 (12.5%), vesicle stone in 2 (1%) and UB mass in 1 (0.5%) were found in UB as complication of TB infection. Conditions of *Schistosoma haematobium* or *Schistosoma mansoni* especially in the ureter and urinary bladder were not detected among cases, because this study was done in west of Sudan which is an area geographically away from the classical causes of *Schistosoma*.

Such findings were supported in a study that evaluate high resolution sonographic features of urinary tuberculosis, where Vijayaraghavan et al. found that sonographic features included parenchymal masses, cavities, mucosal thickening of the collecting system and urinary bladder, stenosis of the collecting system, a contracted urinary bladder, vesicoureteric reflux, and calcifications. Their proof of tuberculosis was by urinalysis, culture, and biopsy. Which confirm that high resolution sonography in appropriate clinical situations is useful in diagnosis of urinary tuberculosis. The various high-resolution sonographic findings in urinary

tuberculosis are illustrated. The distinguishing features are visualization of involvement of multiple sites and multiple stages of disease in the same patient [16].

CONCLUSION

It could be concluded that ultrasonography is a quick and non invasive method of evaluating the urinary tract in miliary TB conditions. Therefore, after proven TB infection either by urine culture or histological confirmation, ultrasound can used widely to determine its effects in urinary tract and to monitor the therapeutic efficacy in a clinical situation.

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Conflicts of interest: The authors declare that there is no conflict of interest.

Ethical approval: The protocol of the study was approved by the ethical committee of Al-Nihood Teaching Hospital. Informed consents were obtained from all patients. Where the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1964.

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