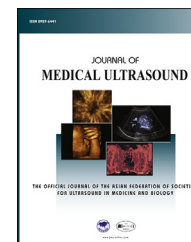


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ORIGINAL ARTICLE

Role of Abdominal Ultrasound in the Diagnosis of Typhoid Fever in Pediatric Patients

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Abstract An early diagnosis of typhoid fever caused by *Salmonella typhi* is difficult because of several spectra of clinical findings, identical to those of several other types of infections. A definitive diagnosis of typhoid fever is made by hemoculture as well as the Widal test. With pediatric patients, this life-threatening infection remains inherently long enough, demanding urgent attention. In typhoid fever, splenomegaly, enlarged mesenteric lymph nodes (MLNs), bowel wall thickening, acalculus cholecystitis, and hepatomegaly occur, which are diagnosed by the ultrasonography (USG) test. USG is a noninvasive, easily available, economical, fairly acceptable, and fairly sensitive test. The high-resolution real-time gray-scale USG method has simplified the evaluation of pathologic conditions, with remarkable clarity; consequently, an accurate assessment of the associated lesions can be done. In typhoid-endemic areas, USG findings as cited above could be used for diagnosis of typhoid fever, particularly when serology is equivocal and hemocultures are negative or not available. It was evident from USG studies that 12 of 52 patients had calculus cholecystitis; these individuals as well as eight patients without cholecystitis having hemocultures negative for *S. typhi* were excluded from the study. The rest of the cases ($n = 32$) were included in this USG-based study for evaluation of features specific for typhoid fever. The following observations were recorded: splenomegaly in 32 patients, enlarged MLNs in 30 patients, bowel wall thickening in 25 patients, acalculus cholecystitis in 20 patients, and hepatomegaly in 10 patients. It can be concluded that these USG features—hepatosplenomegaly, enlarged MLNs, bowel wall thickening, and acalculus cholecystitis—should strongly favor the diagnosis of typhoid.

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Conflicts of interest: The authors declare that they have no conflicts of interest.

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Introduction

Typhoid fever caused by *Salmonella typhi* is endemic in Third World countries, with a remarkable predominance in India. Indeed, an early diagnosis is difficult because of several spectra of clinical features of the disease. The serological Widal test and hemoculture are the confirmatory tests, which require some 7 days and 4 days, respectively [1]. However, in most situations, an improper/inadequate use of antibiotics by the patient prior to any medical consultation leads to the failure of proper diagnosis. Systemic manifestations such as enlarged mesenteric lymph nodes (MLNs) and mural thickening of the terminal ileum are seen in typhoid patients [2]—along with other findings such as splenomegaly, acute acalculus cholecystitis, and hepatomegaly, which are confirmed using the ultrasonography (USG) test. USG was recognized as the most accepted imaging modality for the evaluation of typhoid fever, being quick, noninvasive, and nonionizing; eventually, it was considered safe for children. Emphasis on the usefulness of detecting MLNs with ultrasound as a diagnostic method during the early stage of typhoid was given [3]. MLNs are vital barriers against the systemic dissemination of *S. typhi* in a mouse model [2]. Obviously, typhoid cases are difficult to diagnose early, which remains an important goal in this field. USG examination of the abdomen is helpful in the diagnosis of typhoid fever during the 1st week of onset of fever. The bowel wall thickening of the ileocecal region with MLNs is not specific for any one causative organism for bacterial enteritis, but a proper diagnosis of typhoid fever could be possible along with the typical USG features described above.

The present study was aimed at elucidating the usefulness of USG over the routine Widal test and hemoculture, in the diagnosis of typhoid fever. The high-resolution real-time gray-scale USG method has simplified the evaluation of pathologic conditions, with remarkable clarity; consequently, an accurate assessment of the associated abdominal lesions in suspected cases of typhoid fever can be done. In this study, hemoculture results confirmed typhoid fever cases; additionally, the relationship between USG findings and manifestation of typhoid pathogenesis is explained. Thus, USG findings might be helpful toward the early diagnosis of typhoid fever.

Methods

This 1-year study (which lasted up to February 2016) was conducted with 52 pediatric patients aged 4 years to 14 years, who were clinically suspected of having enteric fever in the past 2–5 days with consistent abdominal pain, and who presented to the pediatric outpatient department of the hospital. On the same day, along with USG procedures, blood samples of patients were used for culture in xylose deoxycholate agar. Subsequently, these patients underwent routine Widal test after 7 days of fever. A convex transducer with a frequency of 4 MHz and a linear transducer with a frequency of 12 MHz on the ultrasound machine (Voluson S6, GE Healthcare, New York) were used for a thorough evaluation of the abdomen with emphasis on liver, spleen, and gall bladder (GB), as well as the small and

large intestines. USG Murphy's sign along with pericholecystic edema and fluid collection were evaluated according to the graded compression method [2] in suspected cases of acalculus cholecystitis. A GB wall thickness of 3 mm was considered normal. After the initial USG procedure on Day 1, repeated scans were done with selected patients on 5-day intervals up to 15 days of presentation. The average duration of the USG examination was 20 minutes, and no patient required analgesia to achieve the adequate bowel compression.

Microbial analysis

To determine the presence of the causative bacterium, a 1-mL blood sample taken from each patient was serially diluted to 1:10 in 0.1% peptone water, and an aliquot of 0.5 mL was plated on xylose deoxycholate agar; one or two drop(s) of Tween 80 was/were added to the first of each dilution with each blood sample. Plates were incubated at 37°C for 24 hours. In each trial, a few presumptive colonies were picked and were confirmed as *S. typhi* [4]. At the end of 4 days, the growth of *S. typhi* was confirmed (Figure 1).

Results

It was evident from USG studies that 12 of 52 patients had calculus cholecystitis; these patients as well as eight patients without cholecystitis and whose hemocultures tested negative for *S. typhi* were excluded from the study. The rest of the cases ($n = 32$) were included in the USG-based study for the evaluation of specific features of typhoid such as splenomegaly, enlarged MLNs, bowel wall thickening, acalculus cholecystitis, and hepatomegaly. Splenomegaly was found in 32 patients; 30 patients had enlarged MLNs; 25 patients had bowel wall thickening; 20 patients had acalculus cholecystitis; and 10 patients had hepatomegaly (Table 1).

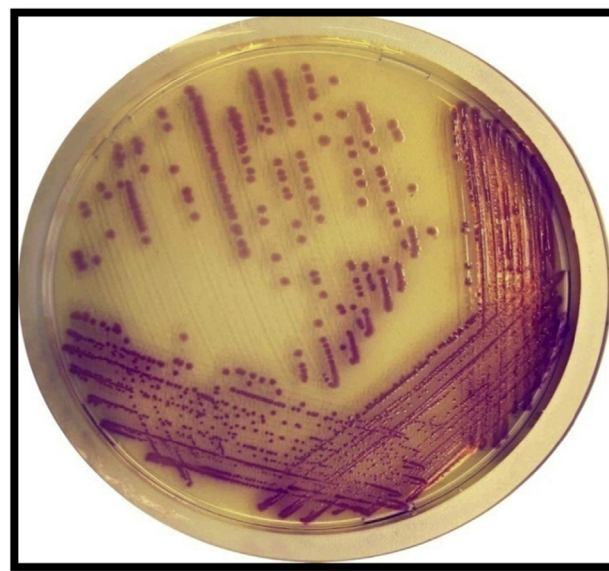


Figure 1 *Salmonella typhi* in xylose lysine deoxycholate (XLD) agar.

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