The role of abdominal ultrasound in the diagnosis of typhoid fever: An observational study

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KEYWORDS
Typhoid fever; Ultrasound; Salmonellosis

Summary
Objectives: To study the usefulness of abdominal ultrasound in the diagnosis of typhoid fever and to determine the common ultrasound findings early in the course of the disease.
Methods: Abdominal ultrasound examination was performed within the first week of initiation of symptoms in 350 cases with clinical diagnosis of typhoid fever. Subsequent ultrasound follow-up examination was done 15 days later (beginning of the third week). All the patients proved to have positive Widal test and Salmonella culture. The study was performed in Erbil-Iraq from the period January 1993 to October 2010.
Results: The following ultrasound findings were reported: hepatomegaly (31.4%), prominent intrahepatic bile ducts (64.85%), splenomegaly (100%), mesenteric lymphadenopathy (42.85%), bowel wall thickening (35.71%), acalculous cholecystitis (16.28%), perforations (1.14%), and ascites in (3.4%).
Conclusion: The current study showed that the findings are typical enough to justify initiation of treatment for typhoid fever when serology is equivocal and culture is negative, and is fairly safe to say that normal ultrasound examination early in the course of febrile illness rules out typhoid fever.

Introduction
Typhoid fever is a special form of salmonellosis that is confined to humans and characterized by prominent systemic symptoms [1]. The pathology of typhoid fever as a feco oral disease has been described as far back as 1870 by William Jenner [2]. Typhoid has been estimated to cause 33 million infections per year. Community-based studies of typhoid transmission in areas of high endemicity have shown annual incidences reaching 1200 per 100,000 of the population [3]. Although the course of the illness is typical enough in majority of cases to reach a presumptive clinical
diagnosis, variations from classical pattern are not uncommon. Furthermore, the clinical picture may change with inadequate treatment and atypical clinical findings make an early diagnosis difficult. Definitive diagnosis of typhoid fever is made by blood culture and serological tests, namely Widal test, both requiring from some days to over a week to show positive results. Improper and inadequate use of antibiotics leads to sterile cultures adding to the difficulty in diagnosis [4]. Despite modern effective treatment of typhoid fever, the complications of the disease continue to be potentially dangerous. Therefore every effort should be made for early diagnosis. (Figs. 1–3)

The aims of this study were to highlight the usefulness of abdominal ultrasound examination in early diagnosis of typhoid fever and to demonstrate ultrasonographic changes associated with typhoid fever. (Table 1)

Materials and methods

Prospective study carried out at Erbil & Rizgari Teaching Hospitals between January 1993 and October 2010. The study population consisted of 350 consecutive patients (M-227, F-123; age ranged between 7 years and 70 years with mean age of 28 years), with a proven diagnosis of typhoid fever based on positive Widal and blood culture for *Salmonella typhi*. Abdominal ultrasound examination carried out within one week of initiation of symptoms and a follow-up examination fifteen days later (after commencement of treatment). A convex transducer with frequency of 3.5–5 MHz and a linear transducer with a frequency of 7–10 MHz ultrasound probes (Siemens G60, Toshiba SAL 32B, and Shimadzu) were used.

All ultrasound examinations included the examination of the liver wherein the size and echo texture and bile ducts were noted. The gall bladder was next examined concentrating on its size, luminal contents, mucosal surface, wall thickness, pericholecystic fluid collection. The spleen was examined concentrating on the size and echotexture. Spleen was considered enlarged when its longitudinal diameter exceeded 13 cm. After examining the upper abdomen, the lower abdomen was examined according to the graded compression method described by Puylaert [5]. Multiple transverse & longitudinal scans of the abdomen and pelvis were then performed for the study of the small bowel to identify any areas of wall thickening.

Measurement of the thickness of the bowel wall was performed. The thickness was considered abnormal when it measured more than 3 mm.

Using a similar technique, enlarged mesenteric lymph nodes were visualized. Follow-up ultrasound examination of the abdomen was repeated in all patients after two weeks.

Results

All 350 patients were studied by ultrasound on the first week of initiation of symptoms and a follow-up examination was done on day 15 after initiating therapy.

Liver was enlarged but with no focal hepatic lesion in 110 cases. Prominent intrahepatic bile ducts but normal extra hepatic bile ducts were seen in 227 cases.

Spleen was enlarged in 350 cases with maximum longitudinal diameter ranged between 17 cm and 31 cm with a mean of 21.8 cm. No focal spleen lesion noticed.

The gallbladder was distended in (40) cases with longitudinal dimension of more than (12 cm). The gallbladder wall measured more than 4 mm with increased vascularity in (35) cases. Pericholecystic edema noticed in (25) cases with one case of gallbladder perforation.

Increased bowel wall thickness ranging from 4 to 9 mm was noticed in (125) cases. The wall thickening was clearly
noticed in the ileocecal region. There were three cases of ileal perforation with para colic abscess formation. Multiple [5–10] enlarged, well defined, oval/round nodes with diameter ranging from 8 to 30 mm (mean 18 mm) and all were hypo echoic were seen in 150 cases. Free fluid in peritoneal cavity was noticed in 12 cases. Follow-up examination fifteen days later reveled reduction in the size of spleen and mesenteric lymph nodes but they were still large. The liver and intrahepatic bile ducts returned to normal. There were complete resolution of bowel wall thickening and surgical treatment for the one case of gallbladder perforation and three cases of bowel perforation with pelvic abscess performed. The cases of acalculous cholecystitis were resolving and they were arranged for elective cholecystectomy.

**Discussion**

This study demonstrated abdominal ultrasonographic changes associated with typhoid fever. These changes are present early in disease. Our earliest examination was performed within the first few days of fever and all had positive findings. This study also showed that short period of adequate treatment may but not necessarily revert the abnormal sonographic findings almost normal. The examination is of particular value in those patients who received inadequate treatment, thereby greatly reducing the chance of obtaining positive blood culture. The serological test, Widal, is the only diagnostic test widely available. Widal test is usually positive only in the second week and rising widal titers are required to make a definitive diagnosis.

**Table 1** Summarizes the ultrasound findings.

<table>
<thead>
<tr>
<th></th>
<th>Hepatomegaly</th>
<th>Prominent bile ducts (intrahepatic)</th>
<th>Splenomegaly</th>
<th>Mesenteric lymphadenopathy</th>
<th>Bowel wall thickening</th>
<th>Acalculous cholecystitis</th>
<th>Perforation</th>
<th>Ascites</th>
</tr>
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<tbody>
<tr>
<td>1st week</td>
<td>n: 110/350 (31.4%)</td>
<td>n: 227/350 (64.85%)</td>
<td>n: 350/350 (100%)</td>
<td>n: 150/350 (42.85%)</td>
<td>n: 125/350 (35.71%)</td>
<td>n: 57/350 (16.28%)</td>
<td>n: 4/350 (1.14%)</td>
<td>3 ileal &amp; 1 gallbladder +ve Surgical treatment</td>
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<td></td>
<td>+ve</td>
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<td>3rd week</td>
<td>–ve</td>
<td>–ve</td>
<td>+ve (reduced size)</td>
<td>–ve (reduced size and number)</td>
<td>–ve</td>
<td>–ve</td>
<td></td>
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</table>

Figure 3  Ultrasound shows mucosal thickening of the terminal ileum in transverse and longitudinal scans with enlarged mesenteric lymph nodes and normal appendix.
Therefore, clinically atypical cases are difficult to diagnose early. The ultrasound examination will be the only method of confirming the diagnosis when the clinical features are suggestive but the blood culture is negative [6]. The common ultrasound findings noticed were hepatosplenomegaly, thickening of the walls of the terminal ileum, cecum and ascending colon, mesenteric lymphadenopathy and acute acalculous cholecystitis, and this in accord with studies done by Mateen et al. [7].

Before the advent of ultrasound, typhoid fever was considered to be complicated by cholecystitis in 2.8% patients [8]. A recent study from Bangalore, in which ultrasound criteria were used for the diagnosis, found a high prevalence of 24% [9]. Our findings suggest that ultrasound examination contributes to frequent detection of acalculous cholecystitis (16.8%) in typhoid fever, a complication considered to be rare previously.

Gall bladder perforation is an uncommon but dreaded complication of acute calculous cholecystitis. However, perforation of the gall bladder in absence of stone is rare, more so following infection with Salmonella typhi [10]. Ultrasonography is useful in 70% of cases in diagnosing gall bladder perforation and detecting the defect in gall bladder wall and hence it can be used as first line imaging modality for evaluating such a case [11].

Several studies have reported ultrasonographic findings in typhoid fever. Puylaert et al. reported ultrasound findings in three patients from the United States with typhoid fever, revealing enlarged mesenteric lymph nodes mesenteric and mural thickening of the terminal ileum. These observations led to the conclusion the findings in typhoid fever are similar to those of non-typhoidal Salmonella, Campylobacter jejuni, and Yersinia enterocolitica cases [12]. Following this study, Tarantino et al. evaluated the clinical application of the signs of bowel wall thickening and/or enlarged mesenteric lymph nodes to diagnose typhoid fever by assessing the sensitivity (68%) and specificity (81%) of these findings in febrile patients. In these patients, mural thickening (4–9 mm) was observed in only 36.8% of patients with typhoid fever [13]. Nakachi et al. reported the clinical findings in the early diagnosis of typhoid fever, emphasizing the usefulness of detecting mesenteric lymphadenopathy with ultrasound as a diagnostic method [4]. Mateen et al. demonstrated finding splenomegaly, hepatomegaly and a thick-walled gallbladder are also useful for diagnosing typhoid fever; in all cases of typhoid fever were the bowel wall thickening and enlarged mesenteric lymph nodes noticed the five-layered intestinal wall structure was preserved, suggesting minimal destruction, and this distinguishes typhoid enteritis from tuberculosis enteritis, where the five layered structure of the bowel wall is lost and narrowing of the bowel lumen and strictures are common [7,14].

Perforation of ileum is a critical complication of typhoid. The very first sign of the perforation is usually occurs in the 3rd week of disease course. The frequencies of perforation vary in different geographical areas, 15–33% in West Africa and 1–3% in Egypt and Iran. At the present time, the mortality rate while declining, it still remains very high ranging from 1 to 39% with significant morbidity in spite of curative advancement [15]. The current study showed lower incidence of intestinal perforation (1.14%) this could be due to that all patients were examined in their first week of illness where perforation is rare.

Although the sonographic features are not specific for typhoid fever and the differential diagnosis include tuberculosis, Crohn’s disease, lymphoma, and many of non-typhoidal salmonella but the clinical findings of these conditions usually do not mimic those of typhoid fever moreover in endemic areas combination of sonographic findings are typical enough to justify initiation of treatment and is fairly safe to say that normal ultrasound examination early in the course of febrile illness rules out typhoid fever [16].

Conflict of interest

None.

References


