Transient periportal hyperechogenicity in feverish patients: a novel ultrasonographic finding

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Abstract

Purpose Periportal hyperechogenicity has been recorded in many inflammatory and infectious diseases, including viral hepatitis, inflammatory bowel diseases, toxic shock syndrome of staphylococcus infection, typhoid fever, and schistosomiasis. We aimed to evaluate the echogenicity of the portal tracts of the liver by abdominal ultrasound imaging in patients with fever irrespective of the cause.

Methods Abdominal ultrasound examination was performed in 277 consecutive patients presented with fever at their first visit and repeated 2 weeks later after their recovery.

Results Transient periportal hyperechogenicity was present in 39% (108 patients) of the feverish patients studied irrespective of the cause of the fever.

Conclusion Transient periportal hyperechogenicity is a frequent ultrasonographic finding in feverish patients irrespective of the cause of fever, and hence should not be misdiagnosed as liver disease or chronic periportal fibrosis unless the hyperechogenicity persists after recovery from the febrile or inflammatory condition.

Keywords Portal tracts · Fever · Periportal · Ultrasound · Hyperechogenicity

Introduction

The portal tracts of the liver are anatomical regions containing a portal vein branch, a hepatic artery branch, and a bile duct branch together with nerve fibers, lymphatic vessels, and a potential space [1, 2]. Any disease affecting any of these structures may lead to a widening of the portal tract regions, which then appear as hypo- or hyperechoic during an abdominal ultrasound examination. Other names of periportal hyperechogenicity include echo-rich periportal cuffing, stars and sky, stars and stripes, prominence of portal tracts, and star heaven phenomenon [1, 3].

There are no standard criteria for the diagnosis of periportal hyperechogenicity [3]. However, it appears as small thick echogenic rings in a transverse section and as thick echogenic small caliber tubal structures in a vertical section (the

so-called stars and stripes). This hyperechogenicity could be diffuse or localized according to the affecting pathology [2]. We accidentally noticed the prominence of portal tracts in many feverish patients. Therefore, we decided to assess periportal echogenicity in patients with fever by abdominal ultrasound.

Patients and methods

A total of 277 consecutive patients presented with fever were enrolled in this study. A thorough history taking and clinical examination were carried out, with a focus on the localizing symptoms and signs. An abdominal ultrasound examination, with an emphasis on the liver and periportal regions, was performed using a convex probe with a frequency of 3.5 MHz on an ultrasound machine (Mindray DP-2200, China) for all patients at their first visits and repeated 2 weeks later (after recovery). The ultrasound examination was done by two separate operators, one of them being blind for the clinical state of the patient. The study was approved by the ethical committee of the Al-Azhar Assiut Faculty of Medicine. Informed consent was obtained from each patient

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Table 1 U.S. findings according to grade of fever

	LGF No = 172	HGF No = 105	<i>p</i> value
PpH: No (100%)	58 (33.72%)	50 (47.62%)	0.021

LGF low grade fever, *HGF* high grade fever, *PpH* periportal hyperechogenicity

Table 2 Comparison between patients according to systemic manifestations

	Mild No = 157	Severe No = 120	<i>p</i> value
PpH: No (100%)	46 (29.3%)	62 (51.67%)	0.000
Chills or shivering	Absent	Present	0.000
Activity	Not impaired	Impaired	0.000

PpH periportal hyperechogenicity

according to the world medical association declaration of Helsinki as revised in 2000, Edinburgh, UK.

Statistical analysis

The data were registered as number and percentage. Statistical analysis was done using SPSS version 22 (IBM SPSS Inc., Chicago, US). A Chi squared test was used to compare qualitative data between groups.

Inclusion criteria

Any patient with fever is included in this study irrespective of the cause of the fever or the age of the patient.

Exclusion criteria

The absence of fever, obscured portal tracts regions (as in a massive fatty liver and shrunken liver cirrhosis), and the refusal of the patient to participate.

Results

Periportal hyperechogenicity was detected in 108 patients (39%) of the population studied (Tables 1 and 2, and Figs. 1, 2, 3, 4, 5, 6). All 108 cases were diagnosed by the two ultrasound operators. However, there were 5 cases diagnosed by one operator only, 3 cases by operator 1, and 2 cases by operator 2. All these 5 cases were considered not to have periportal hyperechogenicity.

Periportal hyperechogenicity was more common in patients with high-grade fever and severe systemic manifestations (chills or shivering, impaired daily activity, headache, malaise, and anorexia) than in patients with low-grade fever and few systemic manifestations (Tables 1, 2). The age of the patients ranged from 2–86 years. Reexamination 2 weeks later after the initiation of therapy and improvement of the body temperature showed a normal appearance of the portal tracts and liver in 106 patients and

Fig. 1 **a** A 6-year-old male child with fever, colic, diarrhea and vomiting. Ultrasound imaging through left lobe of the liver, vertical view showing highly echogenic portal tracts appearing as multiple short

echogenic tubes and rings (stars and stripes). **b** The same patient after recovery. Notice the disappearance of the echogenic portal tracts

Fig. 2 **a** A 46-year old male with acute bronchitis and fever. Ultrasound imaging through the right lobe of the liver, subcostal view with inverted transducer showing multiple echogenic dots and short tubes

(portal tracts) and elongated gall bladder. **b** The same patient after recovery. Notice the disappearance of the echogenic portal tracts

Fig. 3 **a** A 16-year old female with typhoid fever. Ultrasound imaging, subcostal view through the right lobe of the liver with inverted transducer showing highly echogenic portal tracts appearing as multiple short echogenic tubes and rings. **b** The same patient after recovery.

Ultrasound imaging through right lobe of the liver vertical view showing normal liver with disappearance of the highly echogenic portal tracts

persistence of periportal hyperechogenicity in 2 patients with compensated cirrhosis. However, in both these cirrhotic patients, the number and prominence of the portal tracts markedly decreased after the disappearance of fever (Tables 3, 4).

Discussion

Periportal hyperechogenicity has been reported in many disorders, including acute and chronic hepatitis,

Fig. 4 A 53-year-old female presented with fever, diarrhea and prolapsed piles. Ultrasound imaging, vertical intercostal view through the right lobe of the liver showing innumerable small highly echogenic rings (portal tracts) and gallbladder

Fig. 5 A 32-year-old male with acute urinary tract infection and fever. Ultrasound imaging of the right lobe, vertical view showing multiple echogenic rings (portal tracts), part of the right kidney and gallbladder

cholangitis, acute pancreatitis, inflammatory bowel disease [1], schistosomiasis [4, 5], toxic shock syndrome [6], during fasting [7], thalassemia, vasculitis, hypereosinophilic

Fig. 6 A 6-year-old female child with acute tonsillitis. Ultrasound imaging of the liver in the midline transverse view from below upwards showing right lobe and part of the left lobe with highly echogenic portal tracts

Table 3 Causes of fever in the studied population

Cause	Patients with PpH (no.)	Total number of patients	Percent
Infectious diarrhea	43	91	47.25
URTI	27	97	27.83
Typhoid	15	23	65.21
UTI	5	12	41.66
Cholangitis	5	8	62.5
LRTI	4	16	25
FMF	3	5	60
Brucellosis	2	13	15.38
SLE	2	5	40
Appendicular abscess	1	3	33.3
PID	1	2	50
Total	108	277	39

PpH Periportal hyperechogenicity, *URTI* upper respiratory tract infection, *UTI* urinary tract infection, *LRTI* lower respiratory tract infection, *FMF* familial Mediterranean fever, *SLE* systemic lupus erythematosus, *PID* pelvic inflammatory disease

Table 4 Gender and age group of the studied population

	No.	Percent
Males	158	57.03
Females	119	42.96
Children	37	13.35
Adults	240	86.64

syndrome [3], leukemia, lymphoma, hepatocellular carcinoma, and right-sided heart failure [3, 8]. Our study revealed changes in ultrasound imaging in the portal tract regions of patients with fever early in the course of their illness and later after their improvement. Transient periportal hyperechogenicity was observed in 108 out of 277 patients (39%). This hyperechogenicity was more common for intra-abdominal causes of fever (infectious diarrhea, typhoid and urinary tract infection) than for extra-abdominal causes. This may be related to the inflammatory mediator-rich portal blood that is trapped in the portal tracts.

The main pathogenic mechanism of periportal hyperechogenicity is unknown but may be related to one or more of the following: lymphatic stasis, obstruction by edema, or compression from inflammatory or malignant infiltration of the portal tracts [9]; periportal infiltration by inflammatory or malignant cells [5, 9]; edema of hepatocytes, causing the liver to appear as hypoechoic in relation to the portal tracts [10]; and depletion of hepatic glycogen and/or fat stores, which may occur in the fasting liver and in depleting diseases [7].

Many studies have recorded transient periportal hyperechogenicity in various individualized acute inflammatory and infectious diseases. For example, Younis [11] examined 350 patients with typhoid fever and observed periportal hyperechogenicity (expressed as prominent bile ducts) in 64.85% of patients. In comparison, we observed periportal hyperechogenicity in 15 patients with typhoid fever out of 23 patients (65.21%). Neesse et al. [9] noticed periportal hyperechogenicity in 4 patients with inflammatory bowel diseases, which disappeared after a few weeks (after remission) and reappeared several weeks later. The authors explained this hyperechogenicity as a possible result of trafficking of the intestinal lymphocytes via the enterohepatic circulation to the portal tracts. Chateil et al. [12] studied 6 children with acute hemophagocytic lymphohistiocytosis, who presented with acute onset of fever, weakness, and anorexia, and found transient periportal hyperechogenicity and thickening in 4 patients (66.6%), which disappeared after recovery from the acute stage in 5–15 days. Chau et al. [5] observed prominent periportal echogenicity at the hilum of the liver in patients with acute recurrent pyogenic cholangitis, but they did not find this prominent echogenicity in patients with longstanding pyogenic cholangitis. They explained this prominence of echogenicity by the possibility of an inflammatory reaction around the bile ducts rather than the formation of fibrous tissue. Fitzgerald and MacClain [13] studied 21 pediatric patients with hemophagocytic lymphohistiocytosis aged 5 days–16.5 years and noticed increased echogenicity at the porta hepatis region, which disappeared after initiation of chemotherapy and improvement of the general state. In their study, Chau et al. [14] found periportal hyperechogenicity in 15 patients (30%) who presented with recurrent pyogenic

cholangitis. Finally, hyperechogenicity was also recorded in patients with dengue fever [15], chikungunya virus-induced acute arthritis [16], leptospirosis [17], and febrile attacks of sarcoidosis [18].

Although all the previously mentioned studies confirm the prevalence of transient periportal hyperechogenicity in many febrile diseases with either infectious or noninfectious causes, our study is the first one to discuss the association between periportal hyperechogenicity and fever in general, irrespective of the cause of the fever.

However, our study has some limitations: lack of correlation with laboratory markers, such as liver function tests, complete blood count, C-reactive protein, and erythrocyte sedimentation rate.

In conclusion, periportal hyperechogenicity is a frequent finding in patients with fever. However, it is a very unspecific sign, and further studies aimed at understanding the mechanisms underlying this alteration in ultrasound aspect are needed. Hyperechogenicity is not specific nor pathognomonic for liver diseases but can also be present in extrahepatic diseases. So, the clinician should exclude the possibility of acute febrile diseases with abdominal or extra-abdominal causes before rushing to the diagnosis of periportal fibrosis and/or liver diseases only on the basis of ultrasound imaging of the liver. It would be better to examine those patients again after recovery.

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Compliance with ethical standards

Conflict of interest The authors declared no potential conflicts of interest.

Ethical approval Approval was obtained from the ethical committee of Al-Azhar-University-Faculty of Medicine, Assiut, Egypt.

Informed consent Informed consent was obtained from all participants in this study.

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