GE Healthcare

The impact of ultrasound Speckle Reduction Imaging (SRI) for duodenal mass study

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Introduction

For years, ultrasound has been used to image the abdomen primarily for the evaluation of solid organs such as the liver, pancreas, kidneys and spleen. Although, advancements in technology have improved the detection rate of abnormalities in these organs to a great degree, the gastrointestinal tract (GI) remains challenging when it comes to ultrasound evaluation. Therefore, the use of ultrasound has mainly been confined to the study of specific regions for example, the appendix and occasionally the stomach for specific disease entities. This limitation is due to the sonographic artifacts associated with the bowel.

In children, ultrasound of the appendix has met acceptance among all observers.[1] However, in adults computed tomography (CT) remains the imaging modality of choice.[2] When an abnormality is seen in the intestine by ultrasound, the radiologist remains reluctant, in most cases, to call a specific diagnosis or even comment on the exact origin of the abnormality. Routinely, CT follows ultrasound studies for diagnostic confirmation.

The case presented in this paper demonstrates how ultrasound using Speckle Reduction Imaging (SRI) was as definitive as CT in characterizing and localizing a mass arising from the duodenum.

Case history

A 41-year-old, female patient presented to the clinic complaining of vomiting and abdominal pain weeks prior to the examination. The initial impression upon physical examination pointed to an abnormality related to the gallbladder. For this reason, an ultrasound of the upper abdomen was ordered. The initial ultrasound was performed on a LOGIQ® 9 ultrasound system using fundamental B-Mode imaging combined with Coded Harmonic Imaging (CHI) and SRI (GE Healthcare, Milwaukee, WI). During the initial ultrasound examination, a sludge filled gallbladder was identified without evidence of gallbladder distention or stones. Medial to the gallbladder and inferior to the antrum of the stomach was a solid hyperechoic soft tissue mass that appeared inseparable from the adjacent gallbladder on fundamental imaging.

Imaging of the mass without SRI identified the abnormality and was not missed (Fig. 1). However, when SRI was applied the borders of the mass appeared sharper. The improved contrast and resolution provided additional information about the origin of the mass. The mass appeared to arise from the duodenum, and that it had no relation to the gallbladder (Fig. 2). Also, fluid retention above the mass, due to obstruction, created a clear mass/fluid interface that enhanced the appreciation of the polypoid nature of the borders of the mass and made it clear that there was significant compromise to the lumen of the duodenum. In addition, the exophytic component to the mass was better delineated.

The highest level of SRI achieved the best results. The diagnosis of a duodenal mass was made.

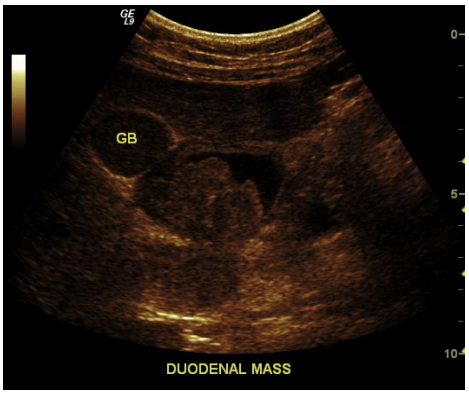

Figure 1

B-Mode image of the duodenal mass without SRI identifed the mass in the region of the duodenum but does not appear to sharpen the outline of the mass and give a distinct separation from the nearby gallbladder.

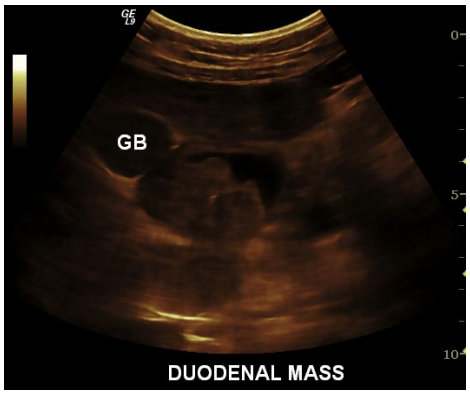

Figure 2

SRI imaging combined with harmonic imaging. Notice the near complete elimination of the speckle (noise) in the image. This gave higher contrast and improved resolution that resulted in better appreciation of the borders of the mass and its separation from the gallbladder. Notice the sharp demarcation line between the solid mass and the retained fluid above the obstruction.

Following the ultrasound examination the patient underwent a CT scan of the abdomen with contrast. The CT showed evidence of stomach distention and a mass that was within the vicinity of the duodenum or pylorus without clear margins (Fig. 3 a, b). The CT failed to characterize the mass borders as precisely as was observed with ultrasound SRI.

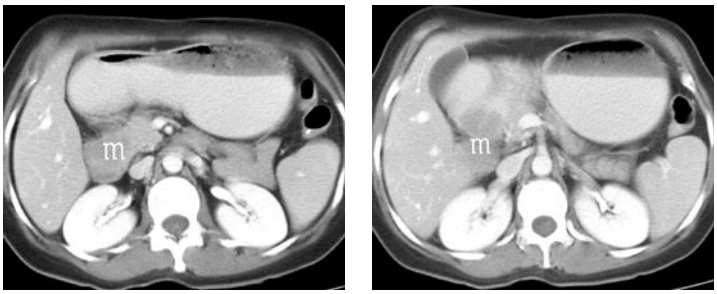

Figure 3 (a,b)

CT scan of the abdomen with contrast at two different levels. These CT images show evidence of a mass lesion associated with some degree of stomach dilatation. The mass was expected to be arising in the region of the duodenum or pylorus. No distinct demarcation line could be appreciated. The mass (m) outline and relationship to nearby organs is not well delineated, an observation that was better appreciated with SRI.

Subsequent to the CT, the patient underwent an upper GI barium study to evaluate the degree of obstruction. The study demonstrated an intramural mass lesion with an exophytic component arising from the second part of the duodenum, resulting in a significant degree of compromise to the lumen of the duodenum. Still, a minimal amount of barium was seen beyond the mass (Fig. 4).

Immediately following the diagnostic workup, the patient underwent surgical exploration and resection of the mass that resulted in Whipple's procedure. The pathologic analysis proved to be malignant adenocarcinoma of the duodenum. The patient tolerated the surgery well.

Discussion

Duodenal carcinoma is a rare malignancy[3] that is usually diagnosed with endoscopy. The case presented describes the role of ultrasound in identifying such masses. Combined with Coded Harmonic Imaging, SRI proved to be superior to CHI fundamental grayscale imaging alone for the characterization of the mass lesion, its borders, and relationship to adjacent anatomical landmarks.

In this case, using SRI proved superior to CT in lesion margin definition. SRI improves contrast resolution and is compatible with new imaging technologies like CHI, compounding and others. This layering of technology further improves resolution and contrast and subsequently results in optimizing diagnostic confidence. There is no doubt that SRI is changing the way we look at ultrasound images at our institution. SRI images closely reflect the real tissue structure. Although CT is currently the imaging modality of choice in evaluating and staging intra-abdominal masses including duodenal carcinoma,[4] the introduction of new technologies like SRI show the potential to reproduce sensitivity close to that of CT.

The case presented herein demonstrates the important role of SRI in improving diagnostic confidence by exactly localizing lesions to specific organs by eliminating noise and improving spatial resolution. SRI has the potential to identify subtle lesions that cannot be appreciated using fundamental gray-scale imaging alone. Gray-scale imaging suffers from significant levels of noise and degraded resolution. Further research on a larger scale is required to validate our assumptions and is currently underway. Due to the promise of SRI, advancements continue to be made to the algorithm. Using the original image from this case, a newer version of SRI, SRI-HD, was applied to the original raw data. The highest level of SRI-HD was used (Fig. 5).

Figure 4

Lateral/oblique view of the stomach from an upper GI barium study. Notice the large filling defect in the second part of the duodenum with significant narrowing of the barium column through the site of obstruction. Although this image shows significant narrowing of the duodenum, residual lumen allowed barium to pass beyond the mass into the distal parts of the small intestine indicating incomplete obstruction.

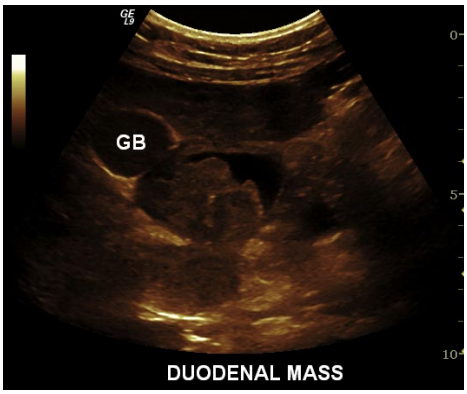

Figure 5

Image of the duodenal mass with harmonic imaging and SRI-HD applied.

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