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*The value of ultrasound harmonic imaging in the diagnostics
of gall bladder cholesterol polyps*

The tissue harmonic imaging (THI) is a technical modification of ultrasound imaging. THI is nowadays available in most of modern apparatus. In the harmonic imaging two different frequencies are used. Former, called fundamental frequency is generated by the transducer, while the latter, called harmonic frequency is received and used in generating images. Usually second harmonic frequency is used. The fundamental frequency is filtered out, the pure second harmonic is used to generate image (6, 10, 11).

Gall bladder cholesterol polyps are often seen in US examination. But small polyps may be difficult to visualize, especially with the presence of intensive artifacts.

The aim of the study was to assess the value of harmonic imaging in US evaluation of gall bladder cholesterol polyps.

MATERIAL AND METHODS

Material comprises 40 patients with pathology of gall bladder diagnosed in US examination. 10 patients from this group with gall bladder cholesterol polyps diagnosed in US were included into the study. In each patient supplementary US examination in the harmonic mode was performed. The examination was performed with the ultrasound apparatus Sonoline G50 by Siemens, equipped with C5-2 Curved Array Transducer and proper software enabling examination with the harmonic mode. The frequency of standard mode was 3.5 MHz. In harmonic imaging the fundamental frequency was 2.2 MHz and the second harmonic frequency was 4.4 MHz. The quality of gall bladder images was assessed, as well as the visibility of the pathology. The presence of the reverberation and artifacts inside the gall bladder and in surrounding structures were assessed on standard and harmonic images.

RESULTS

The quality of images in the harmonic mode was better. The walls of the gall bladder were more distinct. The polyps were more evident on harmonic images (Fig. 1). THI enable more precise measurements of the polyps. In three cases in the standard mode the inspissated bile was found in gall bladder, and in those patients polyps were difficult to assess. Examination of those patients in the harmonic mode excluded the presence of the bile sludge, and facilitated the assessment of the polyps (Fig. 2). In four patients on harmonic images more polyps were found than in the standard mode (Fig. 3).



Fig. 1. Cholesterol polyps in the gallbladder (A – standard mode; B – harmonic mode)

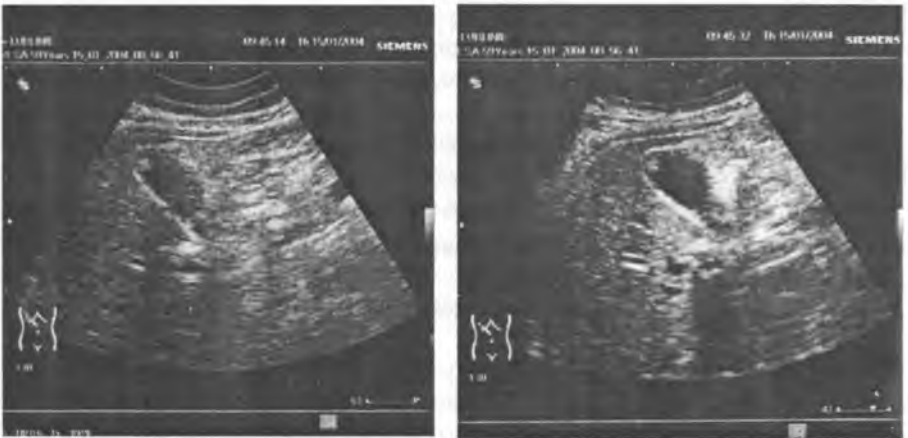


Fig. 2. Suggestion of inspissated bile in the gallbladder in standard mode in a patient with gall bladder polyps (A – standard mode; B – THI)

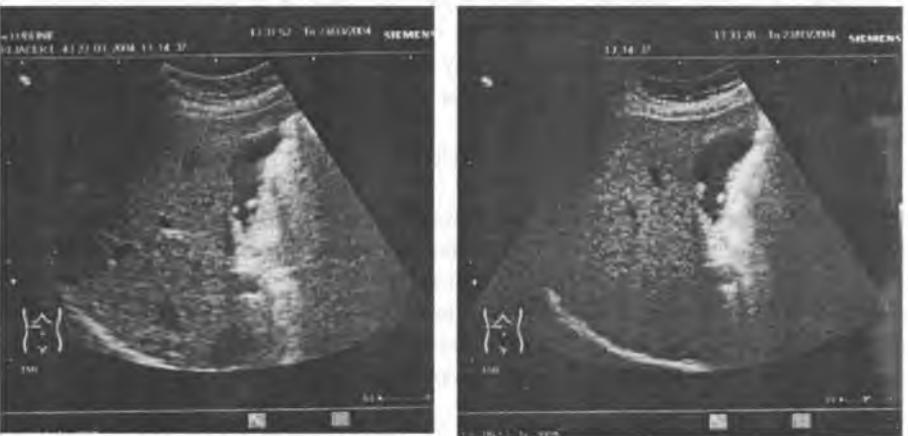


Fig. 3. Cholesterol polyps in the gallbladder. The number of polyps revealed in the harmonic mode is larger than in standard mode (A – standard mode; B – harmonic mode)

DISCUSSION

In harmonic imaging the ultrasound beam cross-section of harmonic frequency is narrower than that of the fundamental frequency transmitted by the transducer. This can lead to improved lateral resolution (6). The second harmonic has also reduced side-lobes levels resulting in reduction of image noise (1, 2, 6, 10). Increased lateral resolution and reduced level of image noise generating by side-lobes result in increased quality of images (8, 9).

Moreover, in harmonic imaging very close to the transducer very little harmonic is generated, thus influence of reverberations in the superficial tissue layers are suppressed (1, 5, 6, 10, 11). In THI the use of lower frequencies for transmission, facilitates the visualization of deep structures (11). All features of harmonic imaging mentioned above, reduced width of harmonic beam, reduced level of side-lobes, and no artifacts generating by superficial layers result in better visualization of abdominal structures (8, 9). Harmonic images are cleaner with higher contrast (5). The minimum noise and clutter in the harmonic mode reduce artifacts in liquid cavities, which appear much cleaner and darker on images. The tissue harmonic imaging is especially useful in the assessment of urinary bladder, gall bladder, large vessels and their pathologies. The assessment of liquid lesions, such as cysts, hydronephrosis, and ascites is easier in the harmonic mode (8, 9). The assessment of cysts and differentiation of true cysts and cystic tumors may be improved by the harmonic mode. In the evaluation of urinary bladder most of the artifacts degrading bladder images are walls reduced, and its walls are much better outlined in the harmonic mode (3, 8, 9).

Images of the lumen of vessels appear also with less reverberations artifacts and with a darker lumen on harmonic images. So vessel can often be easier to identify and cleaner (1, 8, 9, 11). The increase in contrast resolution can lead to more confidential assessment of abdominal and pelvic masses, particularly in obese patients, differentiating hyporeflexive solid masses and cystic lesion (11). The harmonic imaging can lead to a better analysis of tissue parenchyma and a better detection of lesion. The assessment of prominent renal columns may be easier in the harmonic mode, so THI may be helpful in differentiation with tumors. The pancreatic area is sometimes difficult to assess, with a poor contrast between fat and gland and, within gland, between healthy parenchyma and tumors. Some recent study showed that, for pancreas, harmonic imaging was significantly better than conventional sonography. Visualization of the pancreatic duct and the common bile duct was also improved (8, 9, 11). The detection of focal liver lesion is often better in harmonic mode, which can increase the liver-lesion contrast, leading to improved detection of hepatic lesions, particularly in patients with viral liver cirrhosis (7, 8, 9, 10, 11, 12). The reduced artifacts result in clearer images of gall bladder lumen, which is usually filled with liquid. On standard mode in some cases the inspissated bile is diagnosed, while examination in the harmonic mode exclude this diagnosis. The false positive diagnosis of inspissated bile usually results from the presence of artifacts (8, 9, 11). The images of gall bladder polyps are more distinct so measurements of them are much more precise. That is very important in control examination, and evaluation of polyps growth (8, 9).

CONCLUSION

In the harmonic mode the level of artifacts generated by the body wall is reduced and contrast resolution is increased due to reduction in the noise level. The visualization of gall bladder is improved in the harmonic mode. The assessment of gall bladder polyps in harmonic mode is easier. The polyps are easily seen, assessment of their margins and size is facilitated by harmonic imaging. The number of polyps revealed in US examination is larger in the harmonic mode.

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SUMMARY

The aim of the study was to assess the value of harmonic imaging in US evaluation of gall bladder cholesterol polyps. Material comprises 40 patients with pathology of gall bladder diagnosed in US examination. 10 patients from this group with gall bladder cholesterol polyps diagnosed in US were included into the study. In each patient supplementary US examination in the harmonic mode was performed. The quality of images in the harmonic mode was better. The walls of the gall bladder were more distinct. The polyps were more evident on harmonic images. THI enable more precise measurements of the polyps. In three cases in the standard mode the inspissated bile was found in gall bladder, and in those patients polyps were difficult to assess. Examination of those patients in the harmonic mode excluded the presence of the bile sludge, and facilitates the assessment of the polyps. In four patients on harmonic images more polyps were found than in the standard mode. In the harmonic mode the level of artifacts generated by the body wall is reduced and contrast resolution is increased due to reduction in noise level. The visualization of gallbladder is improved in the harmonic mode. The assessment of gallbladder polyps in the harmonic mode is easier. The polyps are easily seen, assessment of their margins and size is facilitated by harmonic imaging. The number of polyps revealed in US examination is larger in the harmonic mode.

Wartość harmonicznego obrazowania tkanek w diagnostyce ultrasonograficznej polipów cholesterolowych pęcherzyka żółciowego

Celem pracy była ocena wartości THI w ocenie polipów cholesterolowych w pęcherzyku żółciowym. Materiał stanowiła grupa 40 pacjentów z rozpoznaną patologią pęcherzyka żółciowego w USG. 10 pacjentów z tej grupy z rozpoznanymi polipami cholesterolowymi w pęcherzyku żółciowym włączono do badania. U każdego z nich wykonano uzupełniające badanie USG w trybie harmonicznym. Uzyskane w tym trybie obrazy miały większą wartość diagnostyczną. Zarysy ścian pęcherzyka żółciowego były wyraźniejsze w THI. Polipy były wyraźniej widoczne w trybie harmonicznym. THI umożliwiło precyzyjne pomiary wielkości polipów. W trzech przypadkach w trybie standardowym stwierdzono zagęszczoną żółć w pęcherzyku żółciowym, co utrudniało identyfikację polipów. Badanie tych pacjentów w trybie harmonicznym wykluczyło obecność zagęszczonej żółci i ułatwiło rozpoznanie polipów. U czterech pacjentów liczba polipów stwierdzonych w trybie harmonicznym była wyższa niż w trybie standardowym. W trybie harmonicznym poziom artefaktów generowanych przez ścianę jamy brzusznej jest obniżony, a rozdzielczość kontrastowa poprawiona dzięki obniżonemu poziomowi zakłóceń. Uwidocznienie pęcherzyka żółciowego jest lepsze w trybie harmonicznym. Łatwiejsze jest rozpoznanie polipów pęcherzyka żółciowego, jak również ocena zarysów polipów i ich rozmiarów. Liczba stwierdzonych w THI polipów jest większa niż w standardowym badaniu USG.