

Fetal echocardiography: a comparison of different techniques

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Summary

There is great availability on the market of echocardiographic instruments that have innovative technological systems which use second harmonic imaging. The true usefulness and applicability of these instruments in fetal echocardiography have yet to be verified.

The objective of the present study was to verify the impact of this echographic technology in the diagnostic evaluation of the fetal cardiovascular system. Thus, an Acuson Sequoia echograph which uses native tissue harmonic imaging (NTHI) was used to examine 30 pregnant women between the 28th and 32nd week of gestation. The b-mode and m-mode images were acquired and recorded by the conventional method and by the second harmonic imaging method without contrast medium. Two experts in the field analyzed and compared the images recorded by the two methods and made diagnostic and qualitative judgements. The 30 cases examined were unanimously determined to have no visible echo pathologies. The morpho-biometric evaluation obtained by the two methods did not show any significant differences and the quality of the images obtained by the traditional method was found on average to be higher.

In conclusion we believe that the use of second harmonic imaging for studies of the fetal heart does not seem to offer any advantages with respect to the conventional method.

Key words: Fetal echocardiography; Second harmonic imaging.

Introduction

The refinement of echocardiographic methods has allowed detailed studies of the fetal heart for a few decades. Recently echographic instruments which use harmonic imaging, generated by tissue when ultrasound passes through, have become commercialized.

The use of second harmonic imaging is based on a system for the acquisition and processing of ultrasound which uses the return ultrasound with a double frequency with respect to the fundamental frequency. Due to this technique images are more detailed and, with the improvement of the signal/noise ratio, the adulterations and background noises are more easily eliminated thus allowing images with better quality to be obtained in adults.

Moreover, with this method it is possible to optimally use the echographic contrast medium based on microbubbles [1, 2].

The objective of this study was to evaluate the real usefulness of native tissue harmonic imaging (NTHI) in fetal echocardiography while also considering the notable cost of the instrumentation in comparison to traditional instrumentation. The use of emission energy (Mechanic Index) which is slightly higher than that used in conventional exams [3] is also considered.

Materials and Methods

Thirty pregnant women between the 28th and 32nd week of gestation were examined for echo visible pregnancy and fetal

pathologies. Acuson Sequoia echography employing second harmonic imaging was used for the study with electronic sectional sound at a frequency varying from 2 to 3.5 MHz. The images were digitally stored on a hard disc of the echocardiograph and analyzed frame by frame.

Fetal position together with the right and left part of the body were established at the beginning of the exam with regard to four reference points: head, spine, liver and stomach. A cardiac scanning plan along the long and short axis was used to view the anatomic structure, intracavitary fluxes and to measure the thickness of the parietal cavity [4]. The acquisition of the images was achieved once the optimal scanning plane was set for each sequence with the traditional method and immediately after, using the same positioning, with second harmonic imaging. Two experts analyzed the recorded images individually. They evaluated the visual quality on a scale from 1 to 4 of the images obtained from the conventional method and with NTHI. The thickness of the parietal wall and the dimensions of the cardiac cavities were also considered.

Results

The use of second harmonic imaging showed slightly poorer results in the visual quality of the images with respect to the traditional method with a mean subjective score of 3.2-3.4 obtained separately in close agreement by the two experts. The thickness of the telesystolic and telediastolic intraventricular space was higher, but not significantly, with second harmonic imaging with respect to the traditional method. This increase can likely be attributed to lower axial resolution with second harmonic imaging. The telesystolic and telediastolic cavity dimensions of the right and left ventricles were practically the same (Table 1, Figures 1-4).

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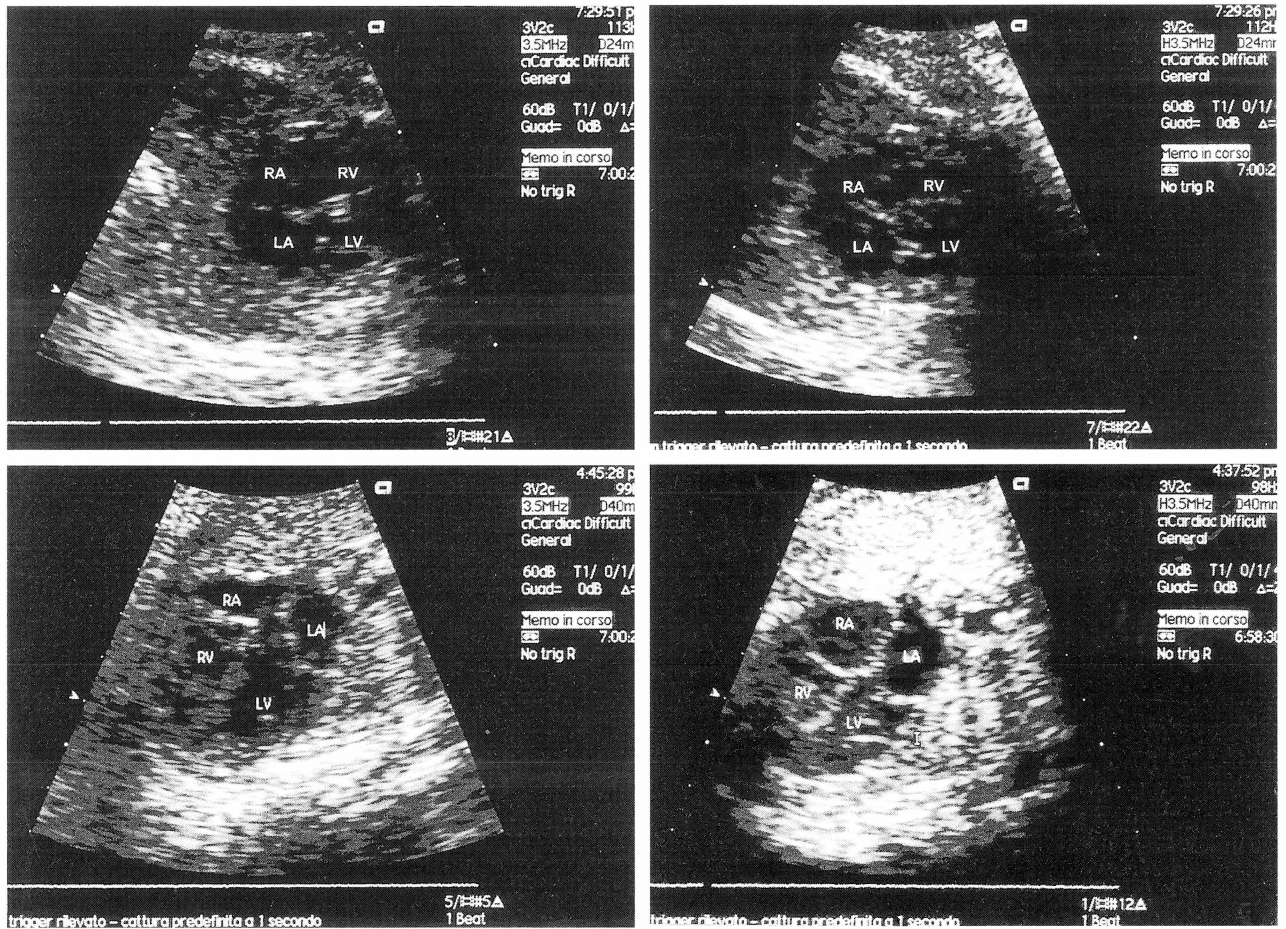


Figure 1. — Four-chamber projections on the horizontal-long axis obtained by fundamental frequency at the 32nd gestational week.
 Figure 2. — Same image as in Figure 1 obtained by NTHI.
 Figure 3. — Four-chamber projections on the horizontal-long axis obtained by fundamental frequency at the 30th gestational week.
 Figure 4. — Same image as in Figure 3 obtained by NTHI.

Table 1. — Dimensional parameters in 2D obtained by a conventional exam and by NTHI in relation to a mean diameter of BPD* of 7.6 cm.

	3.5 MHz	H3.5 MHz (NTHI)
RVTDD	12.1 mm	12.0 mm
RVTSD	8.1 mm	8.0 mm
LVTDD	12.4 mm	12.3 mm
LVTSD	8.0 mm	7.9 mm
TDITIS	2.3 mm	2.5 mm
TSTIS	3.2 mm	3.4 mm

RVTDD = Right ventricular telediastolic diameter; RVTSD = Right ventricular telesystolic diameter; LVTDD = Left ventricular telediastolic diameter; LVTSD = Left ventricular telesystolic diameter; TDITIS = Telediastolic thickness of intraventricular septum; TSTIS = Telesystolic thickness of intraventricular septum; *BPD = Biparietal diameter.

Conclusions

The results did not show any advantages in quality of the two-dimensional images obtained using second harmonic imaging with respect to the traditional method, and moreover morphofunctional detection was the same [5]. Therefore, considering also the complexity and cost

of the echographic equipment with second harmonic imaging, the use in studies of the fetal heart does not presently seem justified.

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