

Abdominal Sonography: Evaluation of Image Quality in Patients with Varying BMI Using Tissue Harmonic Imaging and Standard Sonography.

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ABSTRACT

Background: The study was conducted at the Department of Radiodiagnosis and Imaging, Army Base Hospital Delhi Cantt on 200 patients (114 females, 86 males) with varying age and BMI (Body Mass Index) from year 2005 to 2009. **Methods:** Abdominal sonography was done using standard B mode using HDI 5000 (Philips/ATL) system. This equipment awarded a U.S. patent for Tissue Harmonic Imaging (THI). The study was done using broadband curvilinear 2 to 5 MHz (C 5-2) transducer. This transducer can be used for both standard conventional B-mode (CUSS) and tissue harmonic imaging (THI). **Results:** Correlation was done for BMI of the study population and was found that greater percentage of lesions were seen better THI in patients having BMI >25. The p value was < 0.05 (significant). **Conclusion:** Out of the 258 positive findings assessed for total image quality in THI in comparison to CUSS the p value was < 0.001 (significant).

Keywords: BMI, Tissue harmonic imaging, B mode ultrasound, Total Image Quality, Artifacts.

INTRODUCTION

Medical called sonography is a mode of medical imaging using ultrasound waves that has a wide array of clinical applications. The basis of its operation is the transmission of high frequency sound both a primary modality and contributes for better evaluation long with other diagnostic procedures into the body followed by the reception, processing, and parametric display of echoes returning from structures and tissues within the body. Ultrasound is primarily a tomographic is a both a primary modality and contributes for better evaluation long with other diagnostic procedures. It is also a soft-tissue modality and does not provide informative images through bone or gases containing organs, such as lung and bowel.

Tissue harmonic imaging (THI) is a newer ultrasonographic technique which allows improved image quality, particularly in patients that are difficult to examine, consisting mainly of patients with increased BMI called 'technically difficult patients'.^[2,3] The images obtained in these patients show large amounts of acoustic noise, which

obscures the delineation of anatomical structures. Approximately 20-30% of the adult patient population belongs to this difficult to scan category.^[2] The main cause of the noise and clutter in these patients is due to ultrasound beam distortions that occur predominantly in the body wall and subcutaneous tissues.^[2-4] Majority of these technically difficult patients are obese with large body habitus but some slim and small patients also may be difficult to image.^[2]

Because the harmonic beam is formed in the body [Figure 3], it suffers less from reverberation artifacts generated in overlying fat and muscle [Figure 4].

In this prospective study is to evaluate of Image Quality in patients with varying BMI using Tissue Harmonic Imaging and Standard Sonography.

Aims and Objectives

To evaluate of Image Quality in patients with varying BMI using Tissue Harmonic Imaging and Standard Sonography.

MATERIALS & METHODS

The various image quality parameters used for objective assessment are Spatial, Axial and Lateral resolution. Common artifacts that are encountered reverberation, cystic clearing, refraction, enhancement and shadowing degrade the total picture quality.

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The patients were 6 hours fasting prior to all examinations. These were performed by the same operator in order to obtain standardized results. Before the study was started standardization of the image quality was done with at least 10 normal subjects.

The study was conducted at the Department of Radiodiagnosis and Imaging, Army Hospital (Research & Referral), Delhi Cantt on 200 patients (114 females, 86 males) with varying age and BMI (Body Mass Index) from year 2005 to 2009.

Abdominal and pelvic sonography was done on grey scale using HDI 5000 (Philips/ATL) system. This equipment awarded a time bound U.S. patent for Tissue Harmonic Imaging (THI).

The study was done using broadband curvilinear 2 to 5 MHz (C 5-2) transducer. This transducer can be used for both conventional B-mode and tissue harmonic imaging.

To obtain the best quality and most informative image in both the modalities 'I-Scan' switch was used. This 'I-scan' switch functions by way of optimizing the transmitted pulse and the received signals for images. The TGC gains and brightness were not manually manipulated.

In all the patients, paired images of positive findings in conventional and harmonic modes were obtained at the same scan plane.

The images obtained were evaluated and subjectively compared according to the said parameters to assess their total image quality in both Conventional Ultrasound (CUSS) and Tissue harmonic Imaging (THI) by the same observer.

These positive findings were placed in three categories depending on their image qualities in Conventional Ultrasound and Tissue harmonic imaging as follows: Category I -THI Better than CUSS, Category II - THI similar to CUSS, Category III - CUSS better than THI.

Harmonic and conventional ultrasound image qualities of the positive findings in abdominal and pelvic ultrasonography were also compared to assess their associations with age, sex and body habitus/BMI of the patients.

In our study Harmonic and conventional ultrasound images were compared on the basis of lesion visibility and lesion characteristics in values of the scores awarded to each patient were plotted. Appropriate univariate /multivariate statistical analysis of the data was done in respect with total image qualities in CUSS and THI

RESULTS & DISCUSSION

The study was conducted on 200 consecutive patients who were referred for abdominal and pelvic ultrasound examinations with various indications, to the Department of Radiodiagnosis, Army Hospital (Research & Referral), Delhi Cantt., a Super-speciality referral hospital between July 2005 to April 2009.

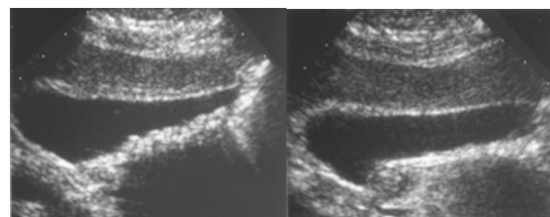
1. Body Mass Index (BMI) Distribution

Body mass index (BMI) is a measure of body fat based on height and weight that applies to both men and women.

$$\text{Body mass Index (BMI)} = \frac{\text{Weight (in Kilograms)}}{\text{Height}^2 \text{ (in metres)}}$$

The patients were divided in the following categories based on BMI.

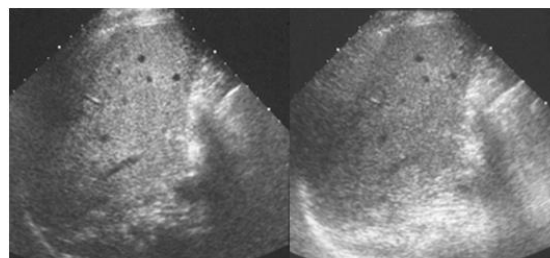
- Underweight = less than 18.5
- Normal weight = 18.5 - 24.9
- Overweight = 25.0 - 29.9
- Obese = 30 or greater



1a)

1b)

Figure: 1a) obtained used THI reveals better image quality and confident demonstration and diagnosis of calculi present at the dependent part of gall bladder.



2a)

2b)

Figure: 2b) obtained used THI reveals better image quality and confident demonstration and diagnosis of calculi present at the dependent part of gall bladder.

Table 1: BMI categorization of the study population

S.No	BMI	No. of patients (%)
1.	<18.5	12 (06)
2.	18.5 - 24.9	90 (45)
3.	25-29.9	76 (38)
4.	30 or greater	22 (11)
	Total	200 (100)

(Numbers in parentheses are percentages).

4. Organwise distribution of lesions:

In the 200 consecutive patients that were referred in various stages of investigation, treatment and follow up that were subjected to abdominal and pelvic ultrasound examinations a total of 258 abnormal findings were detected during the examinations.

Categorisation of the lesions was done on the basis of organ distribution and lesion characteristics. Paired images obtained by the conventional and Tissue harmonic techniques were evaluated and compared as per format given in Appendix A. Associations between the various image evaluation parameters and artifacts with BMI, organ of involvement and characteristics of the lesions was done.

Table 2: Distribution of lesions according to the BMI of the patients.

S.No.	Organ involved	Total Positive cases	< 18.5	18.5-24.9	25.0-29.9	>30.0
1	Liver	84 (32.5)	4	27	36	18
2	Pancreas	14 (5.42)	-	5	5	4
3	Biliary System	42 (16.2)	1	22	13	5
4	Spleen	10 (3.87)	2	3	3	2
5	Renal	43 (16.7)	5	10	17	11
6	Adrenal	4 (1.55)	-	2	2	-
7	Retroperitoneum	13 (5.0)	1	2	5	6
8	Uterine	13 (5.0)	-	2	5	6
9	Ovarian	12 (4.9)	-	3	3	6
10	Prostate	13 (5.0)	1	4	4	4
11	Urinary bladder	10 (3.8)	-	3	4	3
Total		258 (100)	14	83	97	64

Table 3: Total Image Quality on the basis of BMI

S. No	BMI	No. of Findings	THI better than Conventional USS	THI similar to Conventional USS	Conventional USS better than THI
1.	< 24.9	97	54 (59.67)	36 (37.11)	7 (7.21)
2.	> 25.0	161	118 (73.29)	34 (21.11)	8 (4.96)

The maximum number of lesions, i.e. 159 (61.6 %), were detected in patients with BMI range of greater than 25. the comparative categorization of the 258 lesions on the basis of contrast and spatial (detail) resolution in both conventional and harmonic modes. It is evident that the overall resolution is better in a total of 199 (77.14%) lesions, 48 (18.6 %) lesions exhibit similar resolution and in 11(4.26 %) of the lesions CUSS exhibits better resolution than THI. As evident from the data table above, that out of the 258 lesions detected and evaluated, 170 (65.9%) lesions show better Total image quality on THI than on CUSS.

Harmonic imaging provided better total image quality than in THI in 54 (59.67%) findings in patients with BMI less than 24.9 and in 118 (73.29%) lesions in patients with BMI > 25.0. The median BMI for patients with lesions that rated higher degree of confidence with harmonic imaging was.

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CONCLUSION

- Correlation was done for BMI of the study population and was found that grater percentage of lesions were seen better THI in patients having BMI >25. Significant p value of < 0.05 was obtained.
- Our study establishes that THI is significantly better than CUSS by and producing a better picture quality and eliminating the various image artifacts, hence THI is recommended for abdominal sonography in patients of both sexes with varying BMI.

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