

Title:

Reproducibility of IETA color score for assigning the amount of flow within the endometrium using stored 3D volumes

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## Abstract

**Objective:** To estimate intra- and inter-observer reproducibility for assigning IETA color score for endometrial vascularization by color Doppler.

**Methods:** 68 endometrial 3D volumes from endometrium color Doppler assessment from women with different endometrial pathologies were evaluated by eight different examiners (4 skilled examiners and 4 OB/GYN trainees). One skilled examiner that not participated in the assessment selected the 68 volumes from the database in order to select a balanced number of each IETA score. Each examiner evaluated the 68 endometrial volumes to assign IETA color score (1: absence of vascularization, 2: vascularization low, 3: moderate vascularization, 4: abundant vascularization) using TUI imaging. The analysis repeated 4 weeks later to assess. Inter- and intra-observer reproducibility was analyzed by calculating weighted kappa index. The second of the measurements made by each observer was used to estimate inter-observer reproducibility.

**Results:** The intra-observer reproducibility was very good for all examiners with a weighted kappa index ranging from 0.84 to 0.91. The inter-observer reproducibility was good or very good for all estimated comparisons with a weighted kappa index ranging from 0.77 - 0.96, regardless of experience level.

**Conclusions:** The reproducibility for assigning IETA color score for assessing endometrial vascularization using three-dimensional volume is good or very good regardless of the experience of the examiner.

**Keywords:** Doppler, Endometrium, reproducibility

## INTRODUCTION

Ultrasound has become an important tool for the assessment of endometrial pathology (1). Endometrial thickness measurement is an easy and reproducible method for ruling out the presence of endometrial lesions (2,3). However, a thickened endometrium is a non-specific finding (4). For this reason, the use of color or power Doppler mapping has been advocated for increasing specificity and “specific lesions” of color mapping, such as endometrial polyps, hyperplasia or cancer, have been proposed (5-7). However, these patterns have shown just moderate reproducibility, even in experienced hands (8,9). In 2010, the International Endometrial Analysis Group (IETA) proposed a simpler approach for assessing the amount of flow within the endometrium, the so-called IETA color score (10). This score is based on the subjective impression of the examiner regarding the amount of endometrial color signals and it is graded as score 1 (no flow), score 2 (minimal flow), score 3 (moderate flow) and score 4 (abundant flow)

This score is appealing because of its apparent simplicity. However, to the best of our knowledge, no study has been reported analyzing the reproducibility of this score. The aim of the present study was to assess the reproducibility of IETA color score among different examiners with different level of expertise images from stored 3D volumes from the endometrium.

## MATERIALS AND METHODS

Ten examiners with different levels of experience on gynecological ultrasound (4 skilled examiners and 6 OB/GYN trainees) were provided with a set of 68 anonymized

3D volumes of the uterus including the whole endometrium from a non-consecutive series of corresponding 68 women who attending a tertiary care hospital with the clinical suspicion of endometrial pathology (abnormal uterine bleeding). Due to retrospective design and anonymization institutional review board was waived.

All volumes were acquired by a single expert examiner (MAP). All women were examined using a Voluson E8 (GE Healthcare, Milwaukee, IL, USA) using a 5-9 MHz endovaginal probe. In all cases, the same Doppler settings were used (window angle, 70°; pulse repetition frequency, 0.6 kHz; gain, 0.2; frequency, mid; quality, normal; wall motion filter, low 1; smooth, 3/5; ensemble, 10; flow resolution, mid 2)

The series was non-consecutive since the examiner selected all 68 cases with a balanced number of IETA color score (17 cases for each IETA color score) according to her subjective impression. This examiner did not participate in the assessment of reproducibility.

Since the aim of the study was not to assess diagnostic performance of IETA color score, histologic diagnosis of every case included was not retrieved.

As stated above, all 3D volumes were analyzed by eight examiners. Four examiners were gynecologists (JLA, SG, SA, BG) with more than 15 years' experience on gynecological ultrasound and special interest on endometrial pathology. Four examiners were OB/GYN (CL, VH, AP, PF) trainees with less than 2 years' experience on gynecological ultrasound. Before starting this study, all examiners read the original paper from IETA (10) and all trainees had very short theoretical course about IETA color score with sample cases by one of the expert examiners.

Each examiner had to assess all uterine 3D volumes using a dedicated software (4DView, GE Healthcare, Zipf, Austria). Examiners were instructed to use the tomographic ultrasound imaging (TUI) from the coronal plane to assess the amount of flow and assigning IETA color score in each case (Figures 1-4)

The examiners were unaware of how many cases of each IETA color score were within the set of 68 cases. All examiners performed the evaluation blinded each other.

In order to analyze intra-observer agreement all examiners evaluated the set of volumes twice, four weeks apart. To assess inter-observer agreement, the second assessment of each examiner was used. Reproducibility was assessed using weighted kappa index with its corresponding 95% confidence interval and percentage of agreement (11).

## RESULTS

As stated above, among 68 3D volumes there were 17 cases of each IETA color score according to the examiner who performed the selection.

Intra-observer agreement was very good for all examiners (weighted kappa index ranged from 0.84 to 0.91) (Table 1).

Inter-observer agreement was good or very good for all pair comparisons, regardless the level of experience (weighted kappa index ranged from 0.77 to 0.96) (Table 2)

## DISCUSSION

In the present study, we have evaluated the reproducibility of IETA color score for the assessment of endometrial vascularization with color Doppler using 3D uterine volumes. We have found that, both intra- and inter-observer agreement among different examiners was good or very good, regardless the experience of the examiner.

The main strength of our study is that, to the best of our knowledge, we provide for the first time data regarding the reproducibility of IETA color score. A second strength is the number of cases assessed (with a balanced number of each IETA score) and the number of examiners involved.

Our study has also limitations. The main limitation is that we used stores 3D volumes and not real time ultrasound. This is a significant limitation since it means that the examiner could not modify machine color settings to assess color Doppler signals. It is well known that machine color settings, such as gain and pulse repetition frequency, affect significantly the color map displayed over the region of interest (12).

Furthermore, using 3D volumes selected by an expert examiner using adequate machine settings could explain the unsuspected high agreement observed among observers. Probably, in real time ultrasound, where the examiner has to manage machine settings, the reproducibility would be poorer, especially for non-expert examiners.

One single study has evaluated prospectively the power Doppler criteria proposed by IETA for assessing endometrial vascularization in women with suspected endometrial pathology (13). Kabil Kucur et al evaluated 97 women with clinical suspicion of endometrial lesions. Histologically, out of the 97 women, 39 had endometrial polyps, 9 had endometrial hyperplasia, 10 had submucous myoma, 7 had endometrial cancer

and 32 had “other non-specific pathologies”. They did not find statistically significant differences on color score among different pathologies. Interestingly, only 57% of women with endometrial cancer had a color score 3 or 4 and up to 79.5% of women with endometrial polyps and 80% of women with submucous myoma had color score 3 or 4. One single examiner performed all examinations, but intra-observer reproducibility was not assessed.

In summary, our findings suggest that the reproducibility for assigning IETA color score for assessing endometrial vascularization using three-dimensional volumes is high regardless of the experience of the examiner. However, we are aware that our results might be overestimated for study’s design.

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Table 1. Intra-observer agreement for all examiners for assigning IETA color score

Examiner	Weighted kappa index	95% CI	Percentage of agreement
Expert A	0.85	0.78-0.93	82.3%
Expert B	0.85	0.76-0.93	82.3%
Expert C	0.91	0.87-0.98	89.7%
Expert D	0.84	0.76-0.93	82.3%
Trainee A	0.90	0.84-0.97	89.7%
Trainee B	0.89	0.82-0.96	88.2%
Trainee C	0.91	0.85-0.97	89.7%
Trainee D	0.91	0.85-0.98	91.2%

Table 2. Inter-observer agreement among different observers for assigning IETA color score expressed as weighted kappa index

	Expert B	Expert C	Expert D	Trainee A	Trainee B	Trainee C	Trainee D
Expert A	0.84 (0.75-0.92) [80.9%]	0.85 (0.76-0.93) [82.3%]	0.77 (0.68-0.87) [73.5%]	0.83 (0.75-0.92) [80.9%]	0.84 (0.75-0.92) [80.9%]	0.88 (0.80-0.95) [85.3%]	0.80 (0.71-0.90) [79.4%]
Expert B	-	0.88 (0.80-0.96) [86.8%]	0.88 (0.81-0.96) [86.8%]	0.86 (0.78-0.94) [85.3%]	0.87 (0.79-0.95) [85.3%]	0.91 (0.84-0.97) [89.7%]	0.86 (0.77-0.95) [86.8%]
Expert C	-	-	0.84 (0.76-0.92) [82.3%]	0.90 (0.83-0.97) [89.7%]	0.96 (0.91-1.0) [95.6%]	0.87 (0.79-0.95) [85.3%]	0.84 (0.75-0.94) [85.3%]
Expert D	-	-	-	0.85 (0.77-0.93) [83.8%]	0.83 (0.74-0.91) [80.9%]	0.85 (0.76-0.93) [82.3%]	0.85 (0.76-0.94) [85.3%]
Trainee A	-	-	-	-	0.93 (0.87-0.99) [92.6%]	0.77 (0.68-0.87) [73.5%]	0.86 (0.77-0.95) [86.8%]
Trainee B	-	-	-	-	-	0.86 (0.78-0.94) [86.8%]	0.84 (0.74-0.93) [83.8%]
Trainee C	-	-	-	-	-	-	0.85 (0.76-0.94) [85.3%]

95% confidence intervals in parentheses. Percentage of agreement in brackets

### Figures' legends

Figure 1. Tomographic ultrasound imaging (TUI) displayed in coronal plane of a uterus.

IETA color score 1.

Figure 2. Tomographic ultrasound imaging (TUI) displayed in coronal plane of a uterus.

IETA color score 2.

Figure 3. Tomographic ultrasound imaging (TUI) displayed in coronal plane of a uterus.

IETA color score 3.

Figure 4. Tomographic ultrasound imaging (TUI) displayed in coronal plane of a uterus.

IETA color score 4.