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Title

Does 3D ultrasound measurement improve the assessment of ovarian volume?

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Introduction

Measurement of ovarian volume has been used to screen women before in vitro fertilisation (IVF) treatment as an indirect indicator of ovarian reserve. Currently, access to 2D ultrasound scanning is more widely available and the majority of studies relating ovarian volume measurements to IVF outcome have been performed using 2D scanning.

The aim of this study is to compare validity, reliability and precision of ovarian volume measurements by 2D and 3D transvaginal ultrasound scan. We have used the data to construct precision

charts which give well-defined limits for the true volume when an estimated volume has been obtained by either method.

Material & methods -

Forty-nine women were recruited from patients attending a teaching hospital for investigation/ treatment of sub-fertility between March and May 2006. A single operator performed all scans using a Voluson 730 PRO ultrasound machine. For each available ovary, 2D and 3D images were sequentially acquired and stored for later analysis. Calculation of ovarian volume was performed by a single observer using both the standard prolate ellipsoid formula and Virtual organ computer-aided analysis (VOCAL) using rotation steps of 30 degrees (3D-30) and 9 degrees (3D-9). Intra-observer reliability and precision statistics were obtained for all measurements. The 3D-9 measurements were taken as the gold standard for this study.

Results -

The median (range) age of subjects was 34 (21-43) years. Data was obtained for 92 ovaries; for six subjects only one ovary was visualised.

Validity: Good correlation with 3D-9 measurements were obtained for both 2D ($r = 0.97$) and 3D-30 ($r = 0.98$) and both have low standardised errors of estimate (for 2D: 0.26 [0.23,0.31] 95% CI, for 3D-30: 0.19 [0.17,0.22] 95% CI). However, the 95% limits of agreement (Bland-Altman) for 2D (5.26) and 3D-30(3.46), suggest that 3D-30 is the better predictor of the gold standard measure.

Reliability: Both methods are reliable, with 2D having a lower correlation coefficient (0.98 vs. 0.99) and a higher typical error of measurement expressed as a percent (coefficient of variation) (for 2D: 10.7% [9.2,12.6] 95% CI, for 3D-30: 9.1% [7.9,10.7] 95% CI). Both techniques become less reliable (2D: 11.6% [9.6,14.8] 95% CI, for 3D-30: 10.7% [8.9,13.5] 95% CI) using data from ovaries with volume below 10ml ($n = 50$).

Precision: From the data, precision charts for each method have been constructed using 50%, 67%, 80%, 90% and 95% confidence intervals for the true volume, given a clinically obtained approximation. For example, the 95% confidence interval about a 2D measurement of 4ml is [3.3ml, 4.9ml]. For a 4ml 3D-30 measurement the range is [3.4ml, 4.8ml].

Conclusions-

Our results confirm that 2D and 3D ultrasound measurements of ovarian volume are both valid and reliable. However, as confidence intervals are wide, particularly for smaller ovaries, the methods suffer from a lack of precision. Clinical decisions may be made on the basis of individual assessments. Our findings show that 3D assessment of ovarian volume increases the precision of the measurement, but this is unlikely to be clinically significant in the assessment of the individual patient.

Key words

Ovarian volume, IVF, 3D Ultrasound