Effect of transducer frequency on the measurement of myometrial thickness

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Objective

Several papers and meta-analyses confirmed a strong association between the thinning of the low uterine segment (LUS) and residual myometrial thickness (RMT) in the third trimester and the risk of uterine scar rupture/dehiscence at delivery. But no precise cut-off value could be recommended. Our objective was to evaluate the effect of transducer frequency on the measurement of myometrial thickness.

Methods

Myometrium thickness was measured transabdominally with urinary bladder partially filled using both a conventional low-frequency (LF) transducer (2-5 MHz) and a high-frequency (HF) linear transducer (5-12 MHz). Measurements were performed on two sites: the thinnest RMT area (n = 84) and additionally just beneath the bladder fold reflection in the midline, as reference site (n = 50). For each site the paired results obtained with HF and LF were compared (Wilcoxon signed-rank test).

Results

For both sites myometrial thickness was significantly thinner with conventional LF than with HF transducer (p < 0. 01). The mean (±SD) of these intermethod differences (LF-HF) was -0. 48mm (± 0. 43) for the thinnest site and -0. 23mm (± 0. 46) for the reference site (median: -0. 5mm and –0. 4mm respectively).

Conclusion

There is a fundamental inaccuracy in the measurement of anatomical structures with ultrasound, due to the limited axial resolution, which for modern transducers corresponds to the wavelength λ, e. g. 0. 3mm for 5MHz or 0. 15mm for 10MHz. Image overlapping of higher echogenic layers (here: bladder wall and amnio-chorionic membrane), over poor echogenic layers (here: myometrium) occures and yields an underestimation of myometrium in the range of 2λ. This is in line with the mean differences of -0. 48mm and –0. 23mm found in this study for LF as compared to HF and may result clinically relevant for the thinnest site.

Effect of transducer frequency: high vs. low frequency (HF vs. LF)
Gonser, 15th World Congress in Fetal Medicine, FMF 2016, Mallorca
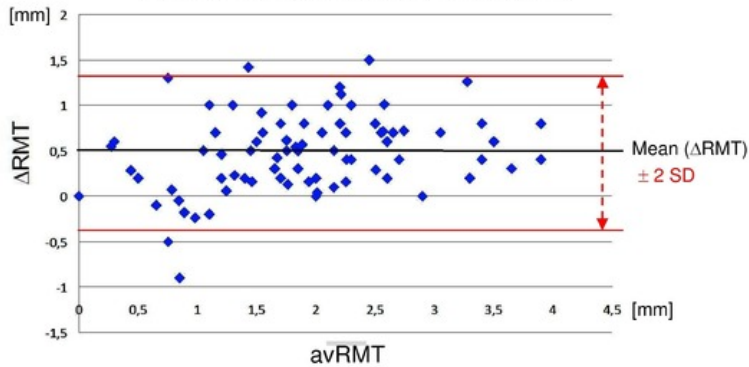
Bland-Altman Plot: comparison of measurements obtained at the thinnest RMT area:
For each pair of measurements RMT(HF) and RMT(LF),
- the intermethod differences: ΔRMT = RMT(HF) - RMT(LF) are plotted against
- the intermethod averages: avRMT = [RMT(HF) + RMT(LF)]/2.

Limits of agreement (LoA): vertical range on the plot including 95% of the measurements:
LoA (ΔRMT) = mean ± 2 SD   (Bland & Altman 1986, 1999)