Serial 3-dimensional ultrasonographic evaluation in the 2nd and 3rd trimester of pregnancy characterises human foetal adrenal development *in utero*

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Background

The human foetal adrenal (FA) undergoes vast physiological changes as pregnancy progresses. Sonographic evaluation of human FA volume and length has led to the creation of normal FA growth centiles. These studies are limited by single time-point observations or single-plane measurements[1-6].

Objective: To characterise normal human FA growth by performing the first serial 3-dimensional ultrasonographic studies of FA volume during the 2nd and 3rd trimesters of pregnancy.

Methods

A prospective longitudinal study of 33 subjects was undertaken (Table 1). Serial 3-dimensional transabdominal ultrasound measurements (Voluson-730 and -E8 systems; 4-8MHz array transducer) of FA volume and foetal biometry were performed at gestational ages (GA): 20/40 weeks, 28/40 weeks, 34/40 weeks and 38/40 weeks. FA depth, width and length parameters were obtained. FA volume was subsequently calculated using Virtual Organ Computer-Aided Analysis software. Women were followed until the outcome of their pregnancy was known. The FA was successfully visualised and assessed in all but one case examined at the four time points.

Characteristic	Mean ± SD	Range	N
Age, years	26.8 ± 6.1	17.0 - 37.0	33
Gravidity [median]	1	1.0 - 4.0	33
Parity [median]	0	0.0 - 2.0	33
Gestational age, weeks			
Visit 1	20.35 ± 0.68	19.29 - 22.57	31
Visit 2	28.07 ± 0.75	26.29 - 29.86	32
Visit 3	34.42 ± 0.75	33.00 - 36.14	28
Visit 4	38.09 ± 0.62	36.00 - 39.71	23
Gestation at delivery, weeks	39.33 ± 2.83	26.86 - 42.14	31
Birth weight, grams	3006 ± 650	950 - 3680	31
Birthweight SDS	-0.698 ± 0.913	-3.30 - 0.840	31

Table 1: Characteristics of the participants and neonates enrolled in the study.

Statistical analysis: Data were analysed using GraphPad Prism™ Version 6. The Kolmogorov-Smirnov test was used for data normality testing. Statistical significance was determined using Wilcoxon signed rank test, where p <0.05 was considered as statistically significant. Correlation between data was determined using a Spearman rank correlation test.

Results

A positive correlation was observed between FA volume and gestational age (r = 0.629, 95% CI = 0.459-0.731; p <0.0001) (Table 2 & Fig. 1). The mean adrenal growth velocity was 0.097cm^3/week (95%CI:0.0398-0.155), 0.034cm^3/week (94%CI:0.00848-0.0637) and 0.447cm^3/week (95%CI: 0.00463-0.901) between GA 20-28/40, 28-34/40 weeks and 34-38/40 weeks, respectively (Fig. 2). FA volume did not correlate with the other foetal growth parameters (BPD, AC, FL and EFW) at the four gestational ages examined (data not shown).

Gestational age, weeks [mean ± SD]	Mean volume (cm^3)	Volume, cm^3 [mean - SD]	Volume, cm^3 [mean + SD]	Volume, cm^3 [range]	N
20.4 ± 0.68	0.207	-0.314	0.727	0.00140 - 1.32	31
28.1 ± 0.75	0.682	0.183	1.18	0.0590 - 4.94	32
34.4 ± 0.75	1.44	1.00	1.88	0.309 - 9.50	28
38.1 ±0.62	2.49	2.05	2.92	0.331 - 13.6	23

Table 2: Mean FA volume (cm^3) and ranges at the gestational ages studied.

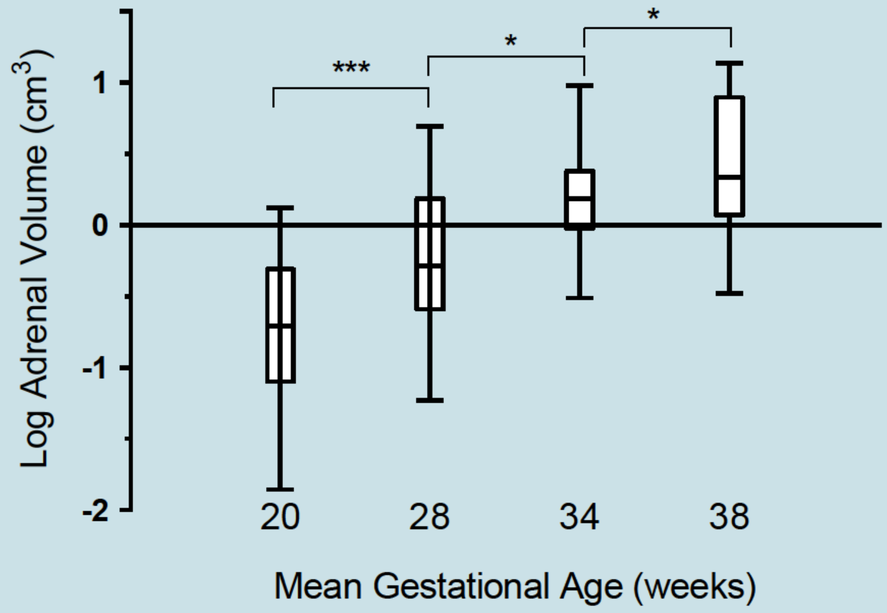

Figure 1: Box and whisker plot showing the log adrenal volume (cm^3) at the gestational ages studied. Whiskers represent ± IQR. *** = p<0.0001, * = p<0.05.

Figure 2: Mean FA growth velocity at mean GA 28/40, 34/40 and 38/40 weeks. Vertical bars represent 95% CI.

CONCLUSIONS: Serial 3-dimensional ultrasonography of HFA volumes during the 2nd-3rd trimesters of pregnancy provides detailed normative data. The observed increase in HFA growth velocity in the 3rd trimester is interesting and may suggest novel functional implications in terms of steroid production and a potential role for the HFA in the onset of parturition.

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