The uterine artery pulsatility index as an accurate index for the assessment of puberty

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Background

The onset of physiological puberty in females is characterized by physical, hormonal, and genital changes. However, a single specific parameter to early identify these modifications does not exist; its identification could be extremely useful in the evaluation of pubertal development disorders.
The uterine artery pulsatility index (PI), defined as systolic peak - diastolic peak / average speed of maximum flow, is an expression of vascular compliance in the uterine artery. Circulating estrogen reduce vascular resistance and, consequently, the PI values.

Objective and Hypotheses

The end-point was to assess the accuracy of the uterine artery PI in the evaluation of the pubertal status and to set a cut-off value to classify prepubertal vs pubertal girls.

Methods

495 girls (mean age 8.6 ± 2.17 years) referring to our hospital from September 2005 to March 2013 for the evaluation of pubertal disorders were enrolled. Exclusion criteria were GnRH-indipendent puberty, Turner syndrome, Prader-Willi syndrome, and patients under GnRH-analogs treatment. Tanner score, LH peak measurement after GnRH stimulation, ultrasound uterine and ovarian diameters, and PI values were assessed. T-test, ANOVA and ROC analysis were performed.

Results

PI values in the prepubertal (n=207), pubertal (n=288) groups were respectively: 6.3±1.4 and 3.7±1.3 (P<0.0001). The best PI cut-off value to distinguish pubertal from prepubertal girls was 4.6 (sensibility 83%, specificity 94%, PPV 95%, NPV 80%, accuracy 87%). ROC area for LH peak and for combined PI-longitudinal uterine diameter were 0.9439% and 0.9272% (P = 0.7931), respectively.

	Pre-Puberty	Puberty
N	207	288
Age (years)	7.6 ± 2.0*	8.7 ± 2.1
B median (range)	2 (1-4)	3 (1-5)
LH peak (mU/ml)	2.7 ± 2.2*	19.4 ± 15.6
Longitudinal uterine diameter (mm)	31.9 ± 4.1*	46.8 ± 9.8
Transverse uterine diameter (mm)	10.3 ± 2.1*	18.8 ± 6.0
Antero-posterior uterine diameter (mm)	9.1 ± 2.0*	16.8 ± 5.9
Uterine volume (mm^3)	1634.5 ± 851.9*	9333.6 ± 7940.7
Right ovary Diameter 1 (mm)	19.0 ± 3.7*	23.7 ± 5.0
Right ovary Diameter 2 (mm)	9.9 ± 1.9*	12.9 ± 3.4
Left ovary Diameter 1 (mm)	19.0 ± 3.8*	23.5 ± 4.8
Left ovary Diameter 2 (mm)	10.0 ± 2.1*	12.9 ± 3.0
Right ovary volume (mm^3)	1056.6 ± 583.0*	2362.4 ± 2304.1
Left ovary volume (mm^3)	1066.5 ± 584.1*	2231.8 ± 1448.2
Mean ovarian volume (mm^3)	1061.6 ± 569.4*	2297.1 ± 1703.2
PI*	6.3 ± 1.4*	3.7 ± 1.3

All data are expressed as mean ± standard deviation

* Significantly different from puberty: P < 0.001

	Threshold	Sensitivity (%)	Specificity (%)	Negative predictive value (%)	Positive predictive value (%)	Accuracy (%)
B	2	96	71	92	82	85
LH peak (mU/ml)	4.6	92	92	89	94	92
Longitudinal uterine diameter (mm)	35	88	87	83	91	87
PI	4.6	83	94	80	95	87
PI + longitudinal uterine diameter (mm)	4.6/35	93	83	90	88	89

Conclusions

The ultrasound uterine artery PI can be considered an accurate and non-invasive parameter for the diagnosis of pubertal activation. Ultrasound with combined assessment of PI and longitudinal uterine diameter allows to exclude pubertal activation with high accuracy and could be proposed as the first diagnostic approach to study pubertal development problems.

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