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Ultrasonography of the pelvic organs in prepubertal and postpubertal girls

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SUMMARY Reference curves for the growth of the uterus and ovaries were established for prepubertal and postpubertal girls by examining 34 healthy schoolgirls of age 7, 10, 13, and 17 years by grayscale ultrasound. Uterine volume increased from mean 0·9 cm^3 at 7 years to 53 cm^3 at 17 years. The ovaries could not be detected by ultrasound in girls of 7 years, but ovarian volume increased from mean 0·7 cm^3 at 10 years to 5·8 cm^3 at 17 years. There was good correlation between the Tanner score and uterine and ovarian volumes ($r = 0·91$ and 0·82 respectively). To test the reference curve, the uterine volume was assessed in 10 girls with abnormal sexual development. Five girls with precocious puberty had values >mean + 2 SD and 5 girls with primary amenorrhoea had values <mean − 2 SD. Good reference values for ovarian and uterine size are necessary before ultrasound can be used to evaluate these organs in children with abnormal development of the reproductive system.

In disorders of sexual development an accurate assessment of the size of the uterus and ovaries is often necessary. Diagnostic ultrasound is a simple, quick, reliable, and harmless method, which reduces the need for pelvic examination under anesthesia and invasive procedures such as laparoscopy and laparotomy. This study was undertaken to establish reference values for the size of the uterus and ovaries in prepubertal and postpubertal girls, and for comparison we report on 10 children and adolescents with known endocrine disorders of the reproductive system.

Material and methods

Thirty four healthy schoolgirls aged 7, 10, 13, and 17 years had pelvic ultrasound examinations, after both they and their parents had given informed consent. The mean and range of body length and weight of the 4 groups were congruent with the reference curves for this population. Five children with precocious puberty and 5 with delayed adolescence (3 with primary hypothalamic amenorrhoea and 2 with gonadal dysgenesis—Turner's syndrome) were also examined.

Serial transverse and longitudinal scans were obtained while the girls' bladders were full. The sagittal length and the largest anteroposterior and transverse diameters of the uterus, and the length of the cervix were measured. In most cases the isthmus region could be recognised as a small 'waist' between the cervix and the corpus uterus. The cervix often had a higher echodensity than the uterus. The ovaries were identified on transverse or oblique scans as oval, echo poor structures, lateral to the uterus and half way to the iliopsoas muscle. The ovarian vessels were used as landmarks. Two diameters (d_1 and d_2) were obtained at a 90° angle from the largest transversal sections of the ovaries and one diameter (d_3) from the parasagittal scan.

A conventional B-scanner (Philips Diagnost R50) using a 3·5 MHz unfocused 13 mm diameter transducer was used for the ultrasound examination. Sound velocity was calibrated to 1540 m/s. Volumes of the uterus and ovaries were calculated, based on a modified prolate ellipsoid formula: $d_1 \times d_2 \times d_3/2$. Reference curves were established for uterine and ovarian volumes correlated to infant age. Logarithmic transformation was done before the calculations of mean and SD for uterine and ovarian volumes. The children were weighed and measured, and their Tanner score[1] was assessed by a separate examiner.

Results

The mean total uterine length was 2·5 cm (range 2·0–3·5 cm) at 7 years, 3·5 cm (range 2·2–4·8 cm) at 10 years, 6·2 cm (range 5·2–7·2 cm) at 13 years,

and 7·0 cm (range 5·8–8·7 cm) at 17 years. The cervix decreased from 50% of the total uterine length in 7 year olds to 40% in 13 and 17 year olds. At 7 years the ovaries could not be identified, but at 10 years at least one could be seen in 8 out of 10 children. The right ovary was more often seen than the left. Figs. 1 and 2 show the mean ± 2 SD for uterine and ovarian volumes. The correlation between the Tanner score and the sizes of the uterus and ovaries was 0·91 and 0·82 respectively. In Fig. 3 the values for 10 children with pathological developments are plotted.

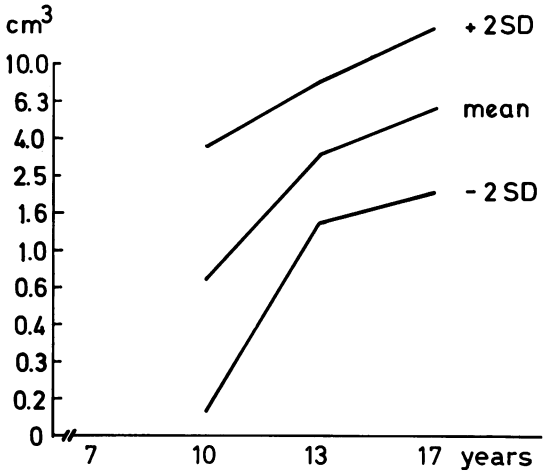

Fig. 1 *Ovarian volumes (mean ± 2 SD) calculated after logarithmic transformation.*

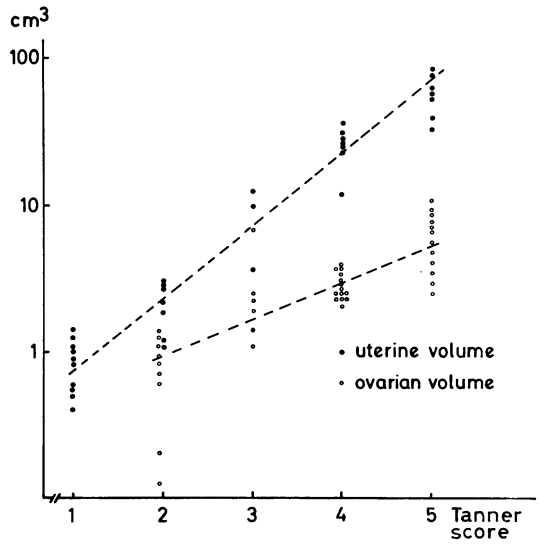

Fig. 2 *Uterine and ovarian volumes correlated to the Tanner score.*

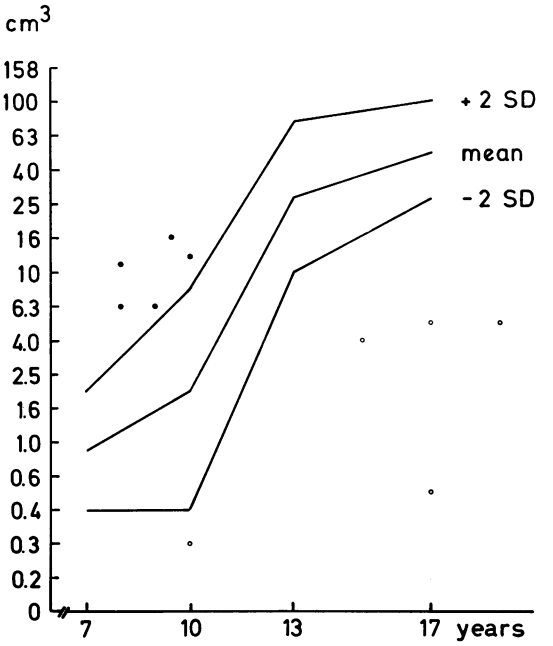

Fig. 3 *Uterine volume (mean ± 2 SD) obtained after logarithmic transformation. The closed circles represent the uterine volumes of 5 girls with idiopathic precocious puberty. The open circles represent 3 adolescent girls with idiopathic amenorrhoea (higher values) and 2 girls with Turner's syndrome (lower values).*

Discussion

It is known from anatomical studies[2] that after the postnatal regression of the uterus, which is thought to be caused by withdrawal of hormones from the mother, there is no change in uterine size until early puberty. During this period the uterus is small, with an average length of 2·5 cm and a width of 1 cm. The ultrasonographic measurements in the group aged 7 years agree with these data. From late childhood until menarche uterine growth surpasses that of any other part of the female genitalia. This is also obvious from our measurements, which show a steep rise in the curve representing the uterine volume from 10 to 13 years (Fig. 1). The correlation between uterine volume and the Tanner score was high. The normal uterine dimensions reported by Sample *et al.*[3] in their sonographic studies in postpubertal girls aged 13–20 years correspond with our findings.

According to the anatomical study by Simkins,[4] the shape of the ovaries of the newborn and the infant often depart from the normal symmetrical ovoid appearance seen in puberty and maturity. The ovaries appear lobulated and this persists until late childhood. The growth of the ovary progresses in relation to the child's age. Recalculation of Simkins's data, using the simplified prolate ellipsoid formula, gives an average ovarian volume of 0·41 cm^3 for children aged 6 months to 2 years and 0·74 cm^3 for 7 to 9 year old girls. Although normal premenarcheal ovaries are within the range of resolution of the ultrasonographic technique used, the ovaries of our 7 year old girls could not be identified. This was also the experience of Haller *et al.*[5] Sample *et al.*, however, reported that the ovaries could be identified in all girls of 2 to 12 years.[3]

In the immediate premenarcheal period the ovary enlarges rapidly and according to Krantz and Atkinson,[2] attains by menarche a mean volume of 3·3 cm^3, which is nearly that in the adult. This agrees with our findings in girls at 13 years. There was, furthermore, a correlation between ovarian volume and the stage of puberty, as assessed by the Tanner score ($r=0·82$). In a study of postmenopausal women, Campbell *et al.*[6] found an average ovarian volume of 4·5 cm^3 (range 1·5–10·4 cm^3). As expected, their values are lower than those of our 17 year olds.

For comparison we studied uterine size in 10 girls with endocrine disorders. We found that all the girls with idiopathic precocious puberty had a uterine volume $>+2$ SD for their age, whereas girls with hypothalamic amenorrhoea and untreated Turner's syndrome all had a small uterus (Fig. 1).

Pelvic ultrasonography is a valuable diagnostic method in the child or adolescent with endocrine disorders such as precocious puberty, amenorrhoea, or hirsutism.[3] Reference values for the growth of the uterus and the ovaries from prepuberty to postpuberty are necessary to distinguish normal development from pathological conditions.

References

1. Tanner J M. *Growth at adolescence*, second edition. Oxford: Blackwell, 1962.
2. Krantz K E, Atkinson J P. Gross anatomy. *Ann NY Acad Sci* 1967; **142**: 551–75.
3. Sample W F, Lippe B M, Gyepes M T. Gray-scale ultrasonography of the normal female pelvis. *Radiology* 1977; **125**: 477–83.
4. Simkins C S. Development of the human ovary from birth to sexual maturity. *Am J Anat* 1932; **51**: 465–505.
5. Haller J O, Schneider M, Kassner E G, *et al.* Ultrasonography in pediatric gynecology and obstetrics. *AJR* 1977; **128**: 423–39.
6. Campbell S, Goessens L, Goswamy R, Whitehead M. Realtime ultrasonography for determination of ovarian morphology and volume. *Lancet* 1982; **i**: 425–6.

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