

Appendix C

FACTS OF PUBERTY

FEMALE

Background

- Oogonia arising from the primordial germ cells in the yolk sac reach a complement of 6-7 million by the sixth month of gestation; these represent the total fixed number of germ cells available. Primordial follicles consist of a primary oocyte surrounded by a single layer of spindle-shaped cells. By the time of birth, the pool of primordial follicles has already been reduced to 2-4 million by ongoing apoptosis and further attrition leaves approximately 400,000 by the time of menarche.

Puberty

- The onset of normal female puberty is characterised by the appearance of breast buds (breast stage 2, B2) at a mean age of 11.4 years, but ranging from as early as 8.4 years age to as late as 13.5 years. Any girl with breast buds before 8.4 years age has precocious puberty, whilst the absence of breast development in a girl older than 13.5 years requires endocrine assessment to ascertain the cause of the delay.
- During childhood, increased amplitude, frequency and duration of gonadotrophin pulsatility, will result in consonant pubertal progression, taking an average of two years to menarche (at B3 or B4), at mean age 12.4 (range 10-14.5) years.
- The attainment of breast stage 4 (B4) is a prerequisite for the onset of menstruation.
- For the first year after menarche, menstrual cycles are often anovulatory but ovulatory cycles, and thus the potential for fertility, can occasionally occur in girls whose sexual development is not quite complete.

Puberty and growth

- The timing of the onset of the growth spurt relative to the onset of puberty differs in a characteristic fashion between the sexes, occurring earlier in girls (breast stage 2 and 3) than in boys. The spinal component is an important part of the growth spurt.
- After the onset of menarche, only 3-5 cms of growth in height remain.
- Loss of harmony in pubertal development occurs if the relationship between height velocity and pubertal stage is lost, ie: a girl who is breast stage 2-3 should have a growth spurt (10-16 cm/yr).
- Bone age is a good guide to how much growth is past and how much is left to come. If bone age is advanced relative to chronological age, the height prediction is reduced. Bone age cannot predict the onset of puberty or the timing of the peak of the adolescent growth spurt.

MALE

Background

- The seminiferous epithelium of normal infant and child testes consists of immature Sertoli cells and spermatogonia. Primary spermatocytes, which degenerate and do not progress to spermatozoa, have been identified in some boys between the ages of 4-13 years.

Puberty

- Spermarche occurs at a median age of 13.4 (range 11.7-15.3) years at a time when median testicular size is 11.5 (range 4.7-19.6) ml.
- The prepubertal testis is approximately 2 ml in volume. The onset of puberty begins with enlargement of the testis (4 ml volume) at approximately 11.4 years. The longitudinal growth spurt starts when the testes are approximately 8 ml and is maximal at approximately 12 ml.
- The normal adult testis is 15 to 25 ml. Azoospermia is likely if the volume of each adult testis is 10 ml or less.

Puberty and growth

- The timing of the onset of the growth spurt relative to the onset of puberty differs in a characteristic fashion between the sexes, occurring earlier in girls than in boys (10-12 ml volume testes). The spinal component is an important part of the growth spurt.
- Loss of harmony in pubertal development occurs if the relationship between height velocity and pubertal stage is lost, ie: a boy with 8-10 ml volume testes should have a growth spurt (10-16 cm/yr).
- Bone age is a good guide to how much growth is past and how much is left to come. If bone age is advanced relative to chronological age, the height prediction is reduced. Bone age cannot predict the onset of puberty or the timing of the peak of the adolescent growth spurt.

REFERENCES

- Guideline** 1) <http://www.sign.ac.uk/pdf/sign76.pdf> ("Long term follow up of survivors of childhood cancer. A national clinical guideline")