PRECOCIOUS PUBERTY

Evelien Gevers

Consultant Paediatric Endocrinologist, Royal London Children's Hospital,

Barts Health NHS Trust, London

Reader, William Harvey Research Institute, Queen Mary University London

Definitions relating to puberty

- **Adrenarche: onset of androgen dependent changes e.g. pubic and axillary hair, body odour, acne**
- **Thelarche: onset of female breast development**
- **Puberty: development of secondary sexual characteristics. Attaining reproductive capacity**
- **Menarche: onset of menstruation**

Normal puberty

Girls	Boys
Breast development > 8 years	Testicular/penile growth > 9 years
Pubic hair > 8 years	Pubic hair > 8 years
Average onset breast dvp 10.5 years	Average onset puberty 11.5 years
Early growth spurt (B2). Menarche occurs approx. 2 years after breast dvp.	Growth spurt at later stage of puberty (testes 10-12 ml)

Hormonal regulation of puberty

- Hair development – adrenal androgen production
- Breast development – ovarian estrogen production
- Penile enlargement – testicular testosterone production

Tanner stages of pubertal development

- Females: Breast (B) development (B1-5)
- Males: Genital (G) development (G1-5)
  Testicular volume (1ml-20ml)
- Both: Pubic hair (P) development (P1-5)
  Axillary (A) hair development (A1-3)

Stage 1 = prepubertal, Stage 5 (3 for ax hair) = mature

Abnormal puberty

- Pubic/axillary hair development before the age of 8 years (boys and girls).

OR

- Breast development before the age of 8.

OR

- Testicular/penile enlargement before the age of 9.

Premature pubic / axillary hair development

- Pubic or axillary hair development before age 8

- Important to assess the cause:
  - Benign premature adrenarche – does not need treatment
  - Adrenal pathology – needs treatment
    - Congenital adrenal hyperplasia
    - Virilizing tumour
  - Exogenous androgens – needs intervention
  - Part of full precocious puberty – needs treatment most of the time

Assessment premature hair dvp

- **History**: when started, how fast progressing, growth spurt, acne, body odour, other signs of puberty ?

- **Examination**: height, weight, height velocity, blood pressure, pubertal staging

- **Investigations:**
  - Adrenal androgens: Androstenedione, DHEAS, 17OHP, testosterone cortisol (ACTH if possible), (LH/FSH if other signs of puberty)
  - U&Es
  - Bone age

Interpretation

- Benign premature adrenarche:
  - **Mildly advanced** bone age (1-2 years). Mildly or no increased height velocity
  - **Mildly increased** androstenedione, DHEAS (and FSH). **Normal 17OHP and ACTH**
- Congenital adrenal hyperplasia
  - **More severe virilization** (may have increase in penile/clitoral size), may have high BP.
  - Increased height velocity, **more advanced bone age**
  - **Increased** 17OHP, androstenedione, Testosterone and ACTH.
- Adrenal virilizing tumour
  - **More severe and progressing virilization**
  - **Increased** DHEAS, or androstenedione, **low ACTH**
- Precocious puberty
  - Other signs of pubertal dvp on examination. Increased HV in girls. **Advanced bone age.**
  - LH, FSH, testosterone may be detectable. Mildly raised androst, DHEAS. Normal ACTH.

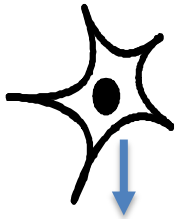
Follow up

- **Benign premature adrenarche**:
  - after 4 months to assess progression/growth and ensure no other underlying pathology. If in doubt of pathology, do urine steroid profile.
  - Then 6-12 monthly to follow progression, growth, bone age.
  - Discharge after age 8.
- **Congenital adrenal hyperplasia suspicion**
  - Urine steroid profile
  - Refer to paediatric endocrinology
- **Adrenal virilizing tumour**
  - Urine steroid profile
  - Refer to paediatric endocrinology

Physiology of normal puberty

Central Nervous system

Hypothalamus



GnRH (Gonadotropin releasing hormone)

Pituitary

LH **FSH**

Breast /uterus growth

Ovaries: estrogen production

Testicles: testosterone production

Penile growth

Body hair growth

Ovaries: follicle maturation

Testicles: Sertoli cell number increase

Testes size increase

Precocious puberty

- Breast development < 8, testis/penile growth < 9

Differentiate between:

- Premature thelarche (girls)
- True precocious puberty (Central Precocious Puberty): early activation of the hypothalamic-pituitary-gonadal axis (common in girls, rare in boys)
- Pseudo-precocious puberty (peripheral precocious puberty): sex steroids secreted without activation of the hypothalamic-pituitary-gonadal axis (rare in either sex)

Assessment early puberty

History

- When start of breast development ? Hair development? Increased growth? Vaginal bleeds ? (cyclical abdominal pain not useful to predict onset of menarche)
- Headaches, vomiting, abnormal vision (blurred, double vision, loss of visual field) ?
- Café au lait spots ?
- Family history of puberty and parental heights.

Examination

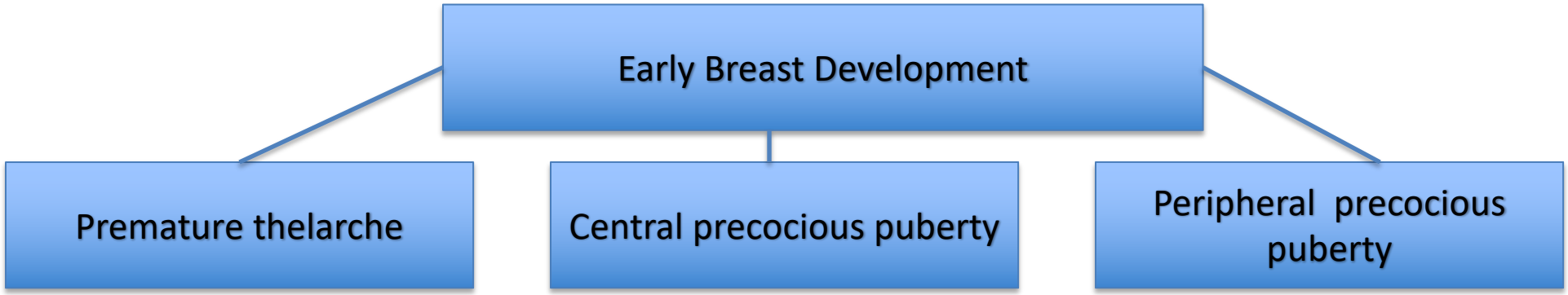
- Plot height and weight with previous growth assessments and parental adjusted heights
- Tanner staging and testicular volume in boys
- Café au lait marks
- Neurological examination
- Visual fields, fundoscopy

Investigations

- LH, FSH
- Testosterone (boys), estrogen (girls)
- Androstenedione, DHEAS, 17OHP, ACTH (cortisol) if small testes (< 3ml) (and thus peripheral Precocious Puberty)

- Bone age
- Pelvic Ultrasound (girls) – assessment uterus (shape and size), and ovaries (dominant follicle? Tumour?) (note: multiple follicles normal in pre- and peri-pubertal girls and is no indication of PCOS)

Interpretation (girls)



Increased/normal height velocity
Advanced/normal bone age.
Variable estrogen
Variable LH and FSH

LHRH test: LH<5 or LH<FSH
PUS: no or little uterine growth or endo thickening. No dominant follicle

FOLLOW UP until age > 8

Increased height velocity
Advanced bone age.
Detectable estrogen*
Detectable LH and FSH*

LHRH test: LH>5 and LH>FSH
PUS: may show uterine growth, endometrial thickening and ovarian dominant follicle

MRI BRAIN AND TREATMENT

increased height velocity
Advanced bone age.
High estrogen
Undetectable LH and FSH

LHRH test: no response
PUS: may show uterine growth, endometrial thickening and ovarian dominant follicle.

REFER

Interpretation (boys)

Pubic hair and penile enlargement

Central precocious puberty

Increased height velocity
Advanced bone age.
Detectable testosterone*
Detectable LH and FSH*

LHRH test: LH>5 and LH>FSH

MRI BRAIN AND REFER FOR TREATMENT

Peripheral precocious puberty

increased height velocity
Advanced bone age.
High testosterone
Undetectable LH and FSH

LHRH test: no response

REFER FOR INVESTIGATION AND TREATMENT

- QUESTIONS ?