Puberty: Too Early, Too Late, or Just Right?

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http://taleswithgigi.com/tale/18/
Objectives

• Describe normal puberty physiology and progression

• Recognize precocious puberty and differentiate it from premature adrenarche

• Evaluate delayed puberty and amenorrhea
Outline

• Normal Puberty Physiology
• Normal Puberty Timing
• Precocious Puberty & Premature Adrenarche
• Delayed Puberty
• Amenorrhea & Special Cases
Disclosures

• Nothing to disclose
Background – Definitions

• Puberty ?
Background – Definitions

• Puberty?

Hypothalamus
  ↓
  GnRH
  ↓
  Pituitary
  ↓
  LH, FSH
  ↓
  Gonads
Background – Definitions

- Puberty ?

  Hypothalamus → GnRH → Pituitary → LH, FSH → Gonads
  Adrenal Glands
Background – Definitions

• Puberty = Gonadarche
  – Testicular enlargement, thelarche, menarche

• Adrenarche
  – Pubarche

Hypothalamus → GnRH → Pituitary → LH, FSH → Gonads
Background – Physiology

Hypothalamus → GnRH ↑→↑→↑

Pituitary → LH, FSH ↑→↑→↑

Gonads
Background - Timing

• Role of Genetics
Background - Timing

• Role of Environment
Background – Assessing Puberty

- Orchidometer
“Just Right”

• Girls
  – Puberty onset (thelarche): 10.5 yo +/- 1 year

• Boys
  – Puberty onset (testicular enlargement): 11.5 yo +/- 1 year
“Too Early”

- Girls < 8 yo
- Boys < 9 yo
“Too Early”

- Girls <8 yo
- Boys <9 yo

In this study, the first signs of puberty occurred at a younger age than had been previously reported; the mean age of onset was earlier for African American versus Caucasian girls.

“Too Early”

• Girls <8 yo

• Boys <9 yo
“Too Early” – Why does it matter?

• Pathology

• Psychosocial distress?

• Final Adult Height
“Too Early” – Height

Mid-parental height: 180.5 cm (71.1 in)
**“Too Early” – Causes**

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<thead>
<tr>
<th>Central</th>
<th>Peripheral</th>
<th>Adrenal</th>
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<tbody>
<tr>
<td>Idiopathic</td>
<td>CNS lesions</td>
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<td>• Hamartoma</td>
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<td>• Astrocytoma</td>
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### “Too Early” – Causes

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<td>Testicular tumors</td>
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<td>Exposure</td>
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- Hamartoma
- Astrocytoma
- Pinealomas
- Optic/Hypothal glioma
- Cysts, Hydrocephalus
"Too Early" – Causes

Central
Idiopathic
CNS lesions
- Hamartoma
- Astrocytoma
- Pinealomas
- Optic/ Hypothal glioma
- Cysts, Hydrocephalus
CNS irradiation

Peripheral
Girls:
- Ovarian cyst
- Ovarian tumor
Boys
- Testicular tumors

Exposure
Hypothyroid
McCune Albright

Adrenal
Disorders of adrenal steroid metabolism
- Nonclassic CAH (21 OH)
- 11-beta OH
- 3-beta HSD
Idiopathic
“Too Early” – Evaluate

Central
Idiopathic
CNS lesions
• Hamartoma
• Astrocytoma
• Pinealomas
• Optic/ Hypothal glioma
• Cysts, Hydrocephalus
CNS irradiation

Peripheral
Girls:
• Ovarian cyst
• Ovarian tumor
Boys
• Testicular tumors
Exposure
Hypothyroid
McCune Albright

Bone Age
LH
FSH
Estradiol / Testosterone
TSH, fT4
“Too Early” – Evaluate

Central

▷ Bone age
▷ LH, FSH
▷ Estradiol / testosterone

Peripheral

▷ Bone age
◁ LH, FSH
▷ Estradiol / testosterone

Bone Age
LH
FSH
 Estradiol / Testosterone
TSH, fT4
“Too Early” – Evaluate

Central

↑ Bone age
↑ LH, FSH
↑ Estradiol / testosterone

MRI: Brain & Pituitary

Peripheral

↑ Bone age
↓ LH, FSH
↑ Estradiol / testosterone
“Too Early” – Evaluate

Central

↑ Bone age
↑ LH, FSH
↑ Estradiol / testosterone

Peripheral

↑ Bone age
↓ LH, FSH
↑ Estradiol / testosterone

Pelvic / testicular Ultrasound, etc
“Too Early” – Evaluate

Bone Age
DHEA-S
17OHP

Adrenal Disorders of adrenal steroid metabolism
• Nonclassic CAH (21 OH)
• 11-beta OH
• 3-beta HSD
Idiopathic
“Too Early” – Treat

- Central – GnRH agonist
“Too Late”

• Girls
  – Lack of thelarche by 13 yo

• Boys
  – Lack of testicular enlargement by 14 yo
“Too Late” – Why does it matter?

- Psychosocial
- Pathology/Fertility Implications
- Bone Health
“Too Late” - Causes

- CDGP
- Hypogonadotropin Hypogonadism
- Hypergonadotropin hypogonadism
“Too Late” - Causes

- CDGP
- Hypogonadotrophic Hypogonadism
- Hypergonadotrophic hypogonadism
“Too Late” - Causes

- CDGP
- Hypogonadotropin Hypogonadism
- Hypergonadotropin hypogonadism
“Too Late” - Evaluate

• Growth
• Bone age
• Early AM: LH, FSH, estradiol/testosterone
• Karyotype
• *Stalled puberty - prolactin
“Too Late” - Treat

- CDGP

- Boys: observation vs. low dose testosterone
“Too Late” - Treat

• Hypogonadism

  – Girls: Estradiol starting ~ 12 yo

  – Boys: Testosterone starting ~ 13 yo
“Too Late” – Special Cases

• Boys: Klinefelter’s Syndrome
  – 47, XXY
  – Eunuchoid body habitus
  – Gynecomastia

[Diagram showing the hypothalamus, pituitary, and gonads with arrows for GnRH, LH, and FSH]
“Too Late” – Special Cases

- Girls: Turner Syndrome
  - 45, XO
  - Short stature
Amenorrhea

• Primary
  – No menses by 15 yo (or within 3 years of thelarche)
Amenorrhea

• Primary
  – No menses by 15 yo (or within 3 years of thelarche)
  – Labs: LH, FSH, estradiol, TFTs, β-HCG
  – Imaging
  – Karyotype
Amenorrhea

- Secondary
  - No menses for 90 days or more after menstruating

β-HCG
PCOS

- Irregular menses
- Clinical / lab evidence of hyperandrogenism
PCOS
- Irregular menses
- Clinical / lab evidence of hyperandrogenism

Labs:
- Testosterone
- Free Testosterone
- DHEA-S, 17-OHP
- HbA1c
- Lipids
PCOS - Treat

- Combined Oral Contraceptives
- Metformin if prediabetes
Secondary Amenorrhea – Other Causes

- Thyroid
- Prolactinoma
Functional Hypothalamic Amenorrhea

Hypothalamus

\[ \text{GnRH} \]

Pituitary

\[ \text{LH, FSH} \]

Gonads
Functional Hypothalamic Amenorrhea

- Labs: LH, FSH, estradiol, TFTs, cortisol
Functional Hypothalamic Amenorrhea

• Why Treat?
  – Bone Health

• Restore energy balance
  – OCP *not* recommended
Gynecomastia
Gynecomastia

• Red Flags
  – Prepubertal
  – Testicular mass / small, atrophic testes
  – Galactorrhea
  – Mass not under areola
Gynecomastia

- Lavender / tea tree oil
Gynecomastia

• Treat?
Take Home Points

• Puberty: thelarche, testicular enlargement

• Adrenarche: pubic & axillary hair, apocrine body odor, acne

• Precocious puberty
  – Girls < 8 ?, Boys <9

• Delayed Puberty
  – Girls > 13, Boys > 14
References


7. Rosenfield RL, Cooke DW, Radovick S: CHAPTER 15 - Puberty and its disorders in the female A2 - Sperling, Mark A. In *Pediatric Endocrinology (FOURTH EDITION)*, Content Repository Only!, 2014, p. 569-663.e561

Questions?