



Hormone Interactions:

Synergism and Antagonism:

- multiple synergistic stimuli are more than additive
- insulin opposes glucagon

Is insulin a competitive inhibitor of glucagon?

Permissiveness:

- need 2nd hormone to get full expression
- e.g. reproductive development

Time (hours)	Glucagon + Epinephrine + Cortisol	Glucagon + Epinephrine	Epinephrine	Glucagon	Cortisol
0	100	100	100	100	100
1	150	130	110	100	100
2	180	150	120	100	100
3	210	140	120	100	100
4	230	140	110	100	100
5	250	140	110	100	100

Interaction of Hormones at Target Cells

Three types of hormone interaction

- 1) Permissiveness –
one hormone cannot exert its effects without another hormone being present

- 2) Synergism –
more than one hormone produces the same effects on a target cell

- 3) Antagonism –
one or more hormones opposes the action of another hormone

Adrenal Androgens

source: zona reticularis

physiological role??

very low titers compared to gonadal production

females: contribute to

pubertal changes:

adrenarche

presence of pubic hair <8 years of age

development of axillary hair & adult axillary odor

premature production ↑ dehydroepiandrosterone (DHEA)

↑ growth : advancing bone age & clitoral enlargement

↑ incidence in African American females

benign condition that requires no treatment except:

abnormal growth acceleration

development secondary traits

pregnancy: abnormal production (tumor or steroidogenesis)

morphogenetic consequences:

mammary carcinomas

cigarette smoking

↑ dehydroepiandrosterone (DHEA)

↑ antiestrogenic effect

↑ cardiovascular disease & osteoporosis

▼ breast cancer/endometrial cancer risks

postmenopausal:

substrate for extragonadal estrogen production

males: contribute to

prepubertal:

adrenarche

pubic hair <9 years of age

penal enlargement

prostate carcinomas

Common inherited disorders of steroid hormone metabolism

▼ 21-hydroxylase enzyme needed synthesis of glucocorticoids/mineralocorticoids

▼ glucocorticoids → ACTH by anterior pituitary gland normal feedback mechanism

adrenal glands enlarge: ↑ pregnenolone synthesis

↑ progesterone

↑ 17<-hydroxyprogesterone

↑ androgens



Figure 18.3 Pathway of adrenal steroid synthesis (Stryer)

A) Effects of high levels of androgens

- 1) Development of female fetus \rightarrow
masculinization of external genitalia
- 2) Development of male fetus
 - a) sexual organs normal at birth
 - b) sexual precocity apparent several months later
 - c) accelerated growth & very early bone maturations \rightarrow short stature
- 3) 50% with 21-hydroxylase deficiency lose Na^+ in urine
- 4) \downarrow titers aldosterone (mineralocorticoid)
 \uparrow loss of salts lead to dehydration and hypotension
- 5) Therapy
 - a) administration of glucocorticoid hormone \rightarrow \downarrow ACTH secretion
 - b) mineralocorticoid for those who lose salts
 - c) symptoms reversed therapy started within the first 2 years after birth

B) Congenital adrenal hyperplasia (inherited disease)

- 1) affect enzymes required for steroidogenesis
 - 11-hydroxylase \rightarrow virilization
 - 17-hydroxylase
 - 3 β -dehydrogenase
 - 17 α -demolase
- 2) all above enzymes deficiency \rightarrow
enlargement of adrenal gland


