PHYSIOLOGY OF REPRODUCTION

Life is a dynamic system with focused behavior, with

autoreproduction, *characterized by flow of substrates,*

energies and information.

Reproduction in mammals (humans):

1) Sexual reproduction
2) Selection of partners
3) Fertilization is internal
4) Viviparity
5) Eggs, resp. embryos – smaller, less, slow development, placenta
6) Low number of offspring, intensive parental care

In humans – high investment, low-volume reproduction strategy.

Reproduction in humans – gender comparison:

1) Both male and female are born immature (physically and sexually)

2) Sex hormones production in men also during prenatal and perinatal periods, not in women!

3) Reproduction period significantly different – puberty, climacterical

4) Character of hormonal changes significantly different – cyclic vs. non-cyclic

SEX DIFFERENTIATION

INDIFF. GONADE — week

testes-determining gene

XY — Genetic male — 6.

XX — Genetic female

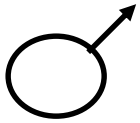
medulla — cortex

RATIO A/E

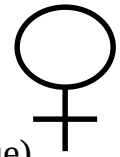
T a AMH affects inner reprod.system in unilateral way (inner gene)

AMH ←	**SERTOLI CELLS**	CELOM	**GRANULOSIS**	7.
T ←	**LEYDIG CELLS**	MESENCHYME	**THECA**	8.
	SPERMATOGONIA	GERM.EPITH.	**OOGONIA**	9.
	Wolf duct (epidydimis, vas deferens)		**AMH!!!**	
m	**W**		M w	10.

Muler duct (tuba uterina, uterus)



Shift of programme



Non-disjunction, mosaic. Examination (amniocenthesis, biopsy of chorioid.tissue).

AMH (MIH, MIF, MIS) – ANTIMULERIAN HORMONE

1940, TGF-β, receptor with internal tyrosinkinase activity

Source: Sertoli cells (5th prenatal week) or embryonal ovary (36th prenatal week)

In adult women – granulosa cells of small follicles (NO in antral – under influence of FSH - and atretic follicles)

TUMOUR MARKER

Role in men:

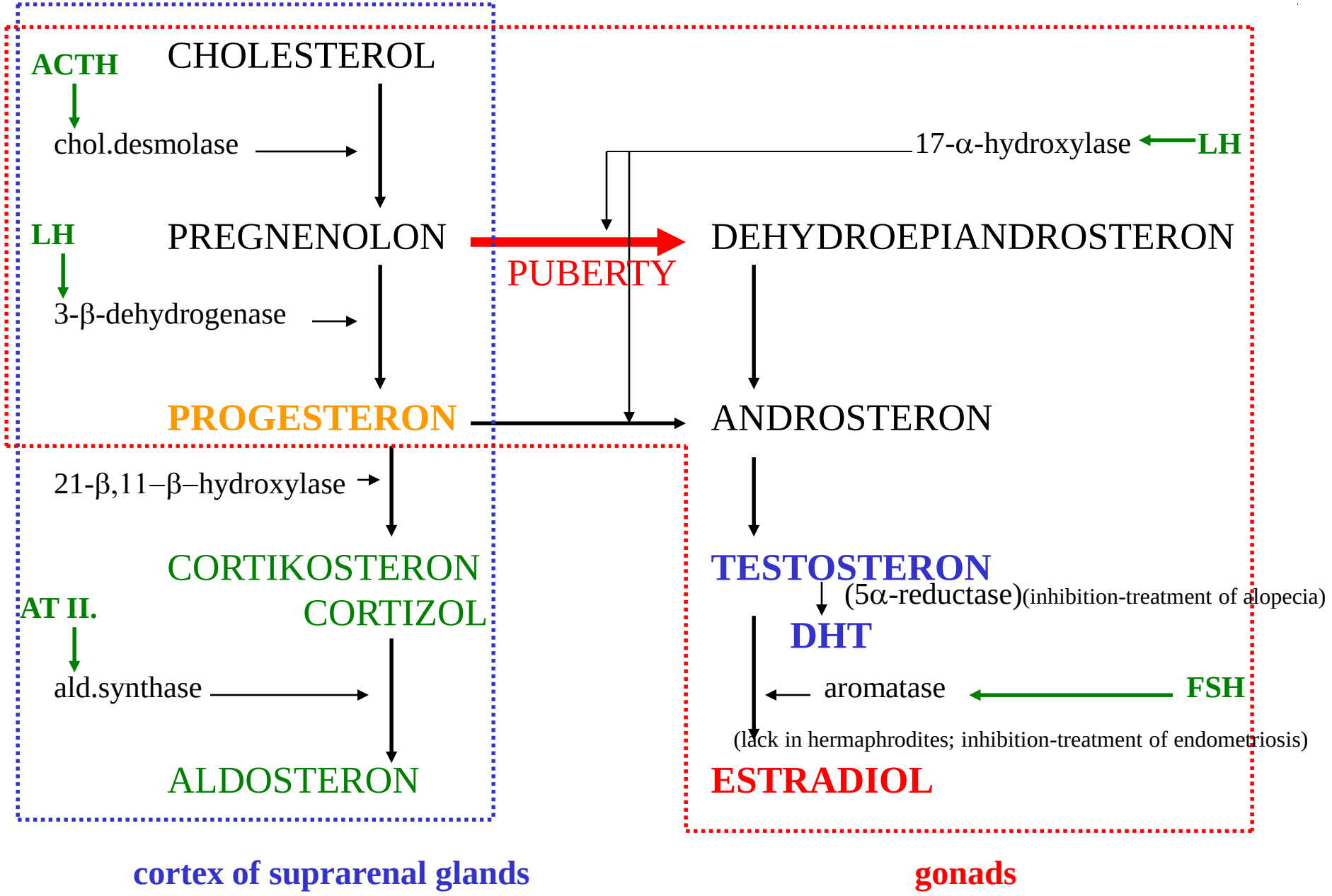
- Regression of Muller duct
- marker of central hypogonadism

Role in women:

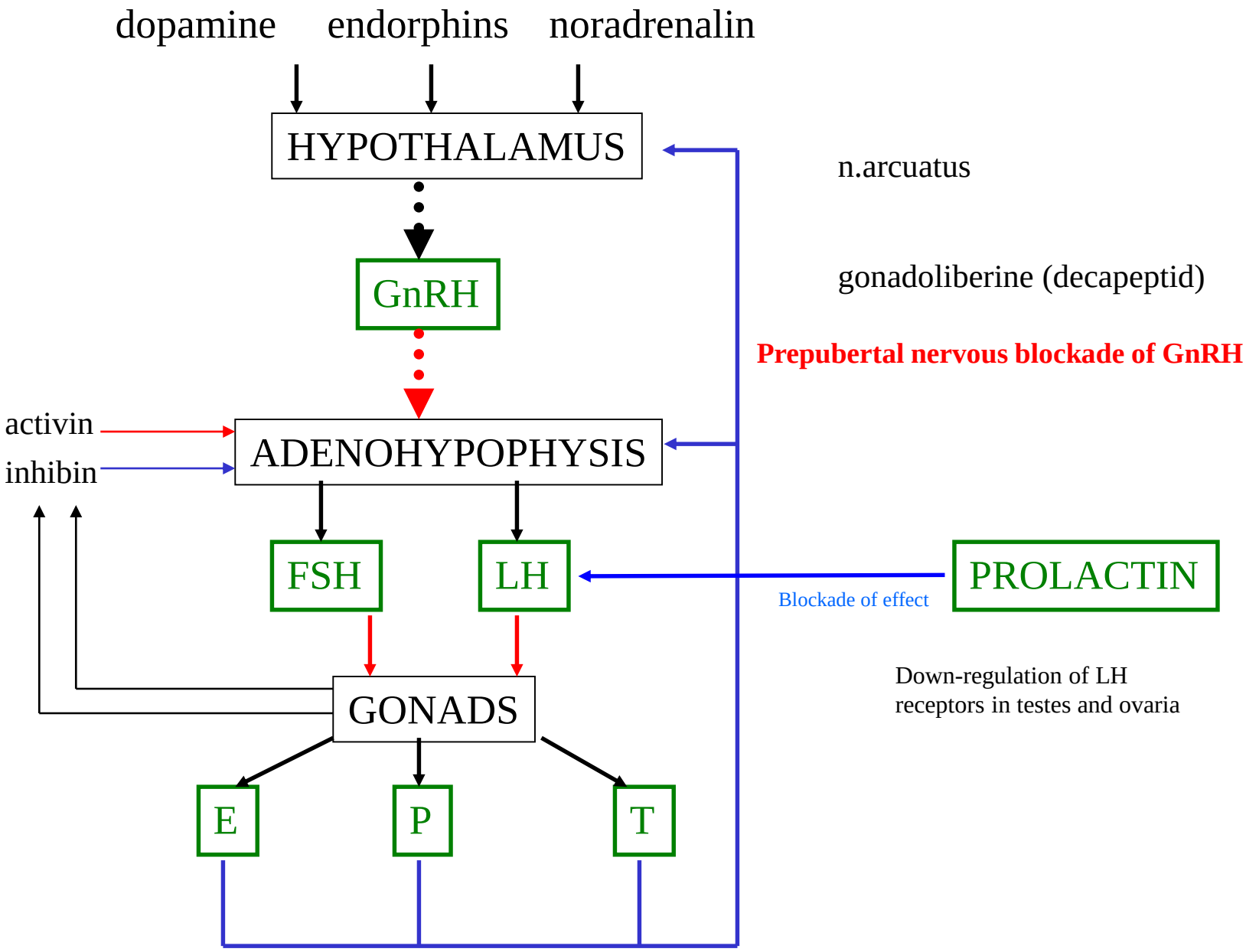
- Lower plasmatic levels (by one order), till climacterical
- Estimation of ovarian reserve (AMH level corresponds to pool of preantral follicles)
- marker of ovarian functions loss (premature climacterical)
- Diagnosing of polycystic ovaria syndrom

BIOSYNTHESIS OF STEROID HORMONES

Impact of androgens on CNS.



CONTROL OF SEX HORMONES SECRETION



PROLACTIN

Co-hormone

- Protein, 199 AA, Mr = 22 500
- Lactotrophic cells of adenohypophysis
- Glycosylation = regulation of activity
- Mostly inhibitory effect of hypothalamus on PRL synthesis
- Stimulatory effect of thyreoliberin and VIP peptide, but also estrogens
- During gravidity - PRL levels increase by 20-times, during lactation its release is stimulated from mammal mechanoreceptors
- In men: approx. half levels as compared to women (5 $ng.ml^{-1}$ vs. 8 $ng.ml^{-1}$)
- Released during sleep (continually), during stress, exercise
- Laktotrophic effect:
  - Stimulation of mamma differentiation in puberty
  - Growth of mamma during pregnancy (together with estrogens and progesterone)
  - Stimulation of casein and lactalbumin synthesis
- In men: effect on testosterone metabolism and androgen receptors synthesis
- Released during orgasms, caused temporary decrease of libido
- Minor effects on immune functions
- High PRP levels = amenorrhea, anovulation with galactorrhea (in women), in men – decrease of libido, impotence, oligospermia, decreased testosterone production

LEPTIN A REPRODUCTIVE FUNCTIONS

Activation of reproductive system does not depend on age, but on nutritional state of organism.

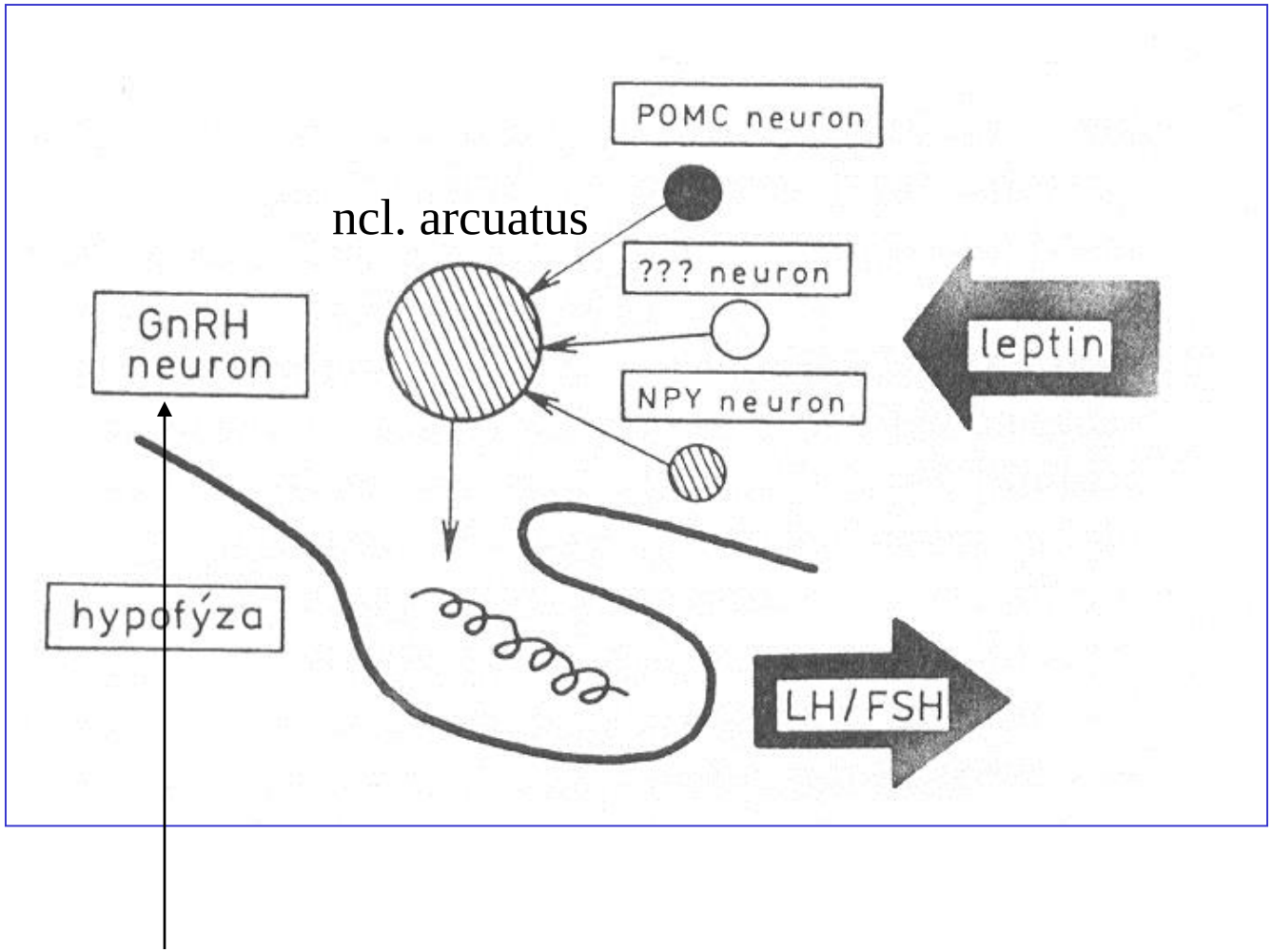
LEPTIN: ob-protein, ob-gen, 7.chromosome
„λεπτοσ“ = thin, slim
polypeptide, 176 AA

Bound in **hypothalamus**: n.paraventricularis, suprachiasmaticus, arcuatus a dorsomedialis

Produced in: adipocytes, placenta, stomach, mammal epithelium (???)
Leptin plasmatic levels are sex-dependent (less in males) and do not depend on nutritional state

Leptin receptor: gene on 4.chromosome, 5 types of receptor, A-E
Receptor B – effect in **gonads and hypophysis**

Leptin is not only a factor of body fat amount, but affects also the regulation of neuroendocrine functions including hypothalamo-hypophyseo-gonadal axis.



???Critical amount of adipose tissue – leptin – hypothalamus – LHRH - puberty

Effects of leptin on testes are not elucidated yet.

Testosterone and dihydrotestosterone suppress production of leptin in adipocytes!

REGULATION OF PUBERTY ONSET BY LEPTIN

Critical body mass.

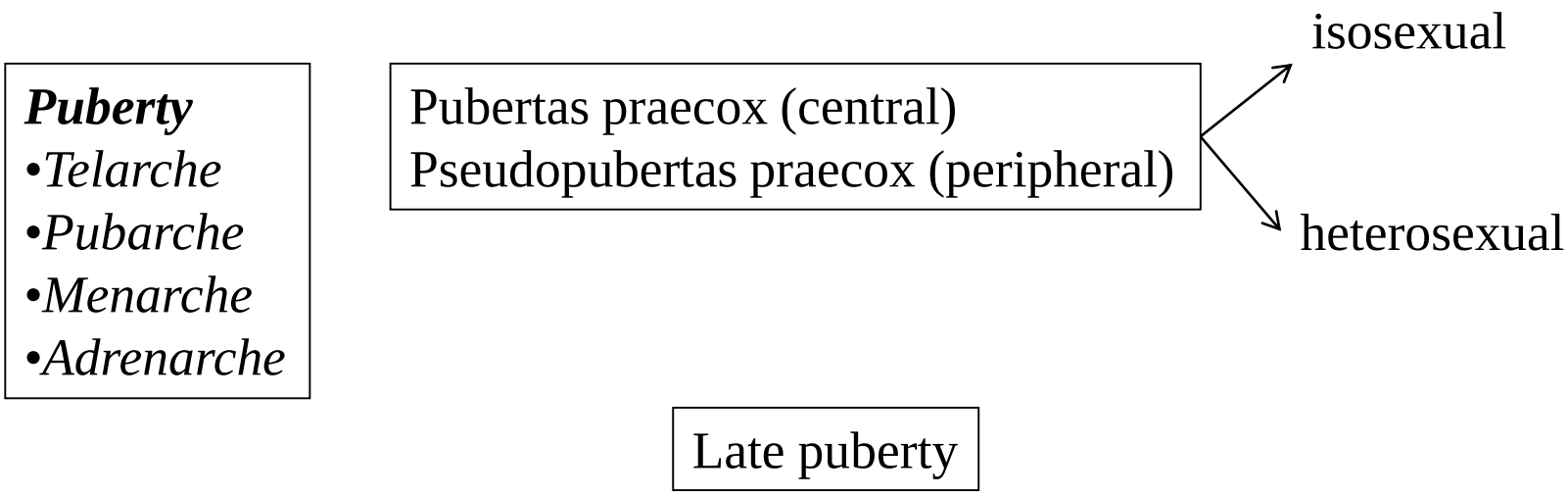
Leptin plasmatic levels in pre-pubertal children are sex-independent.

Pre-pubertal „leptin resistance“ (relative).

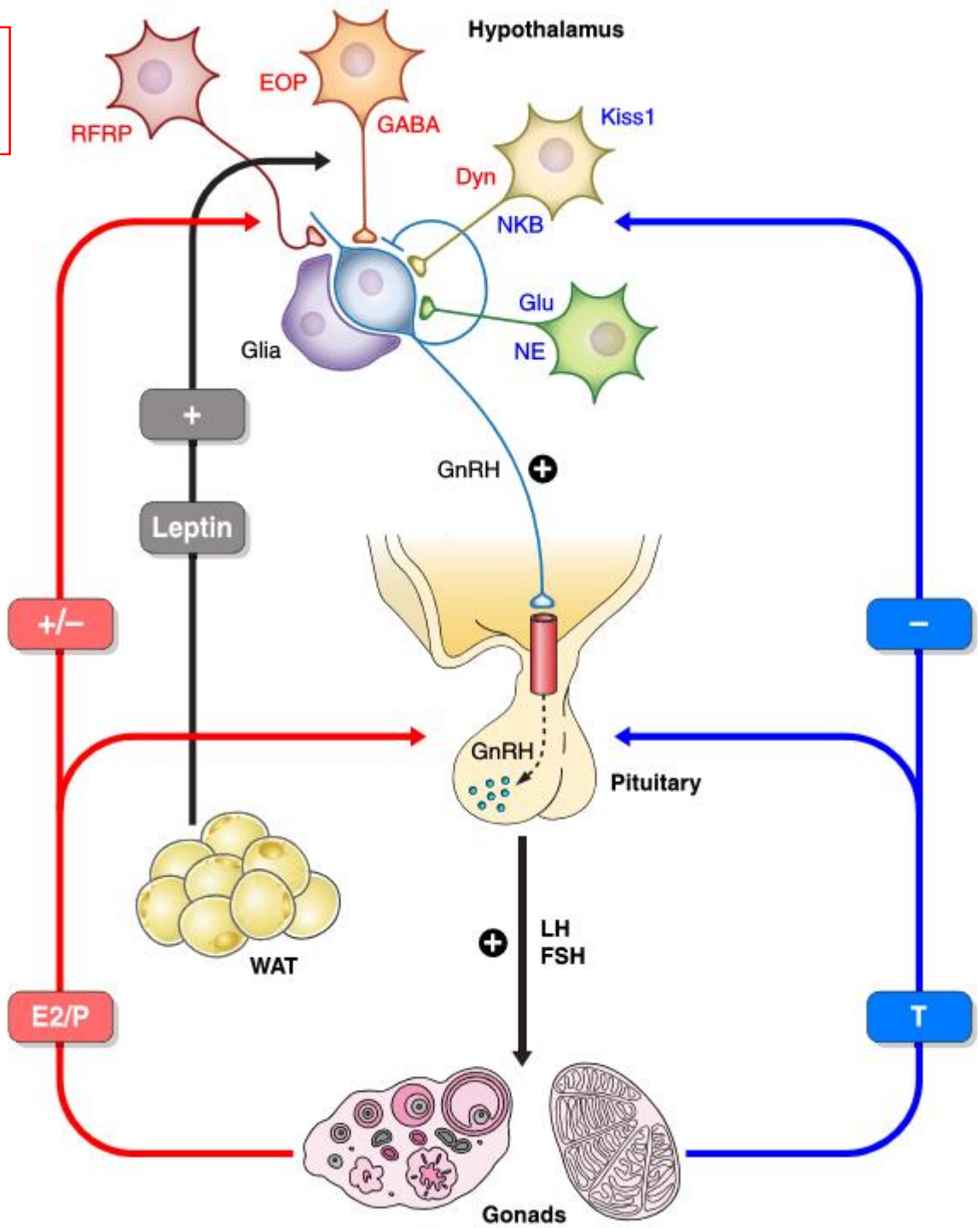
In puberty, girls produce 2x more leptin per 1kg of adipose tissue than boys.

CRITICAL DEVELOPMENTAL PERIODS

1) Birth
2) Weaning
3) Puberty (adolescence)
4) Climacterical (menopause)

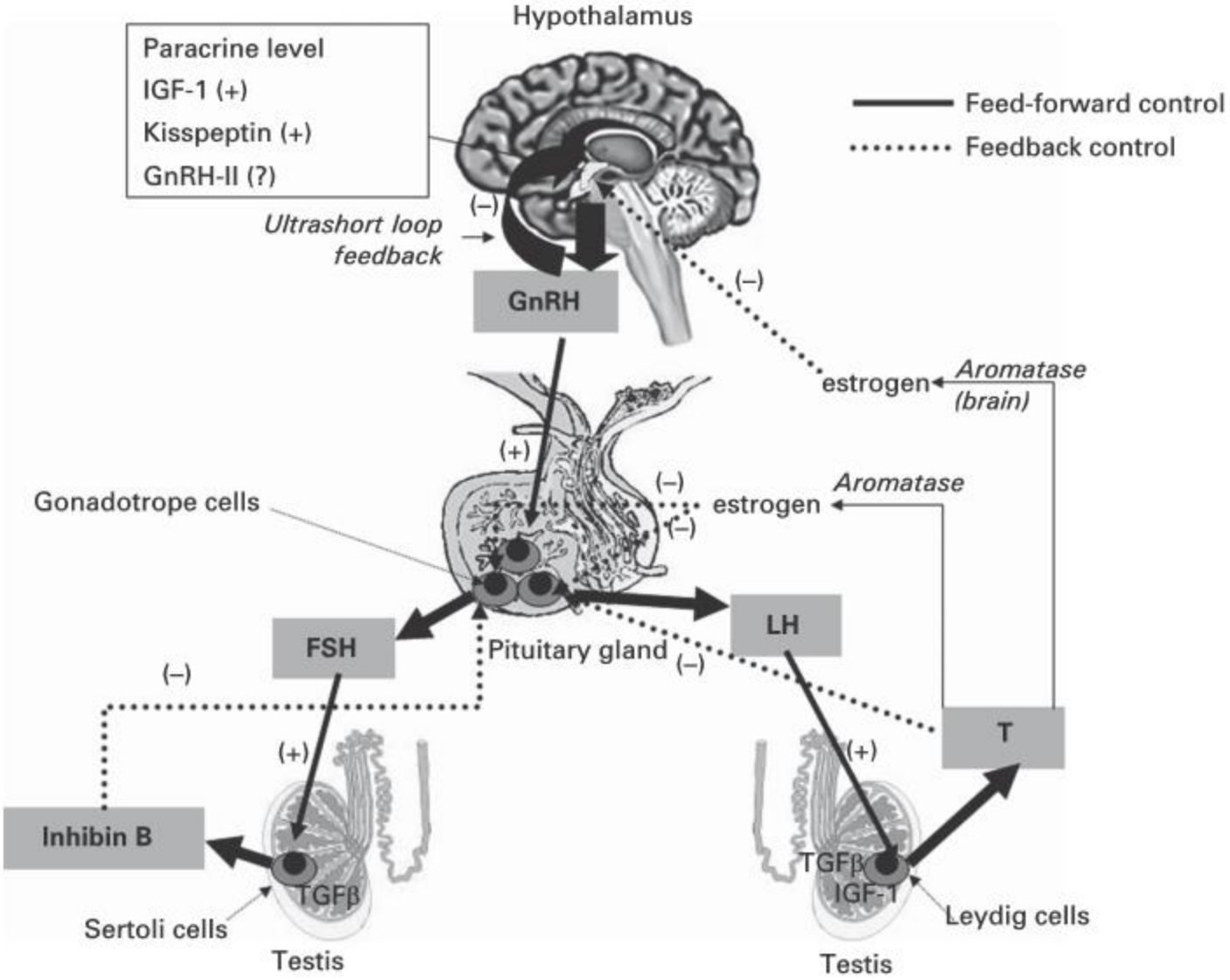


CONTROL OF SEX HORMONES SECRETION



Pinilla et al., Phys Rev 92: 1235- 1316, 2012

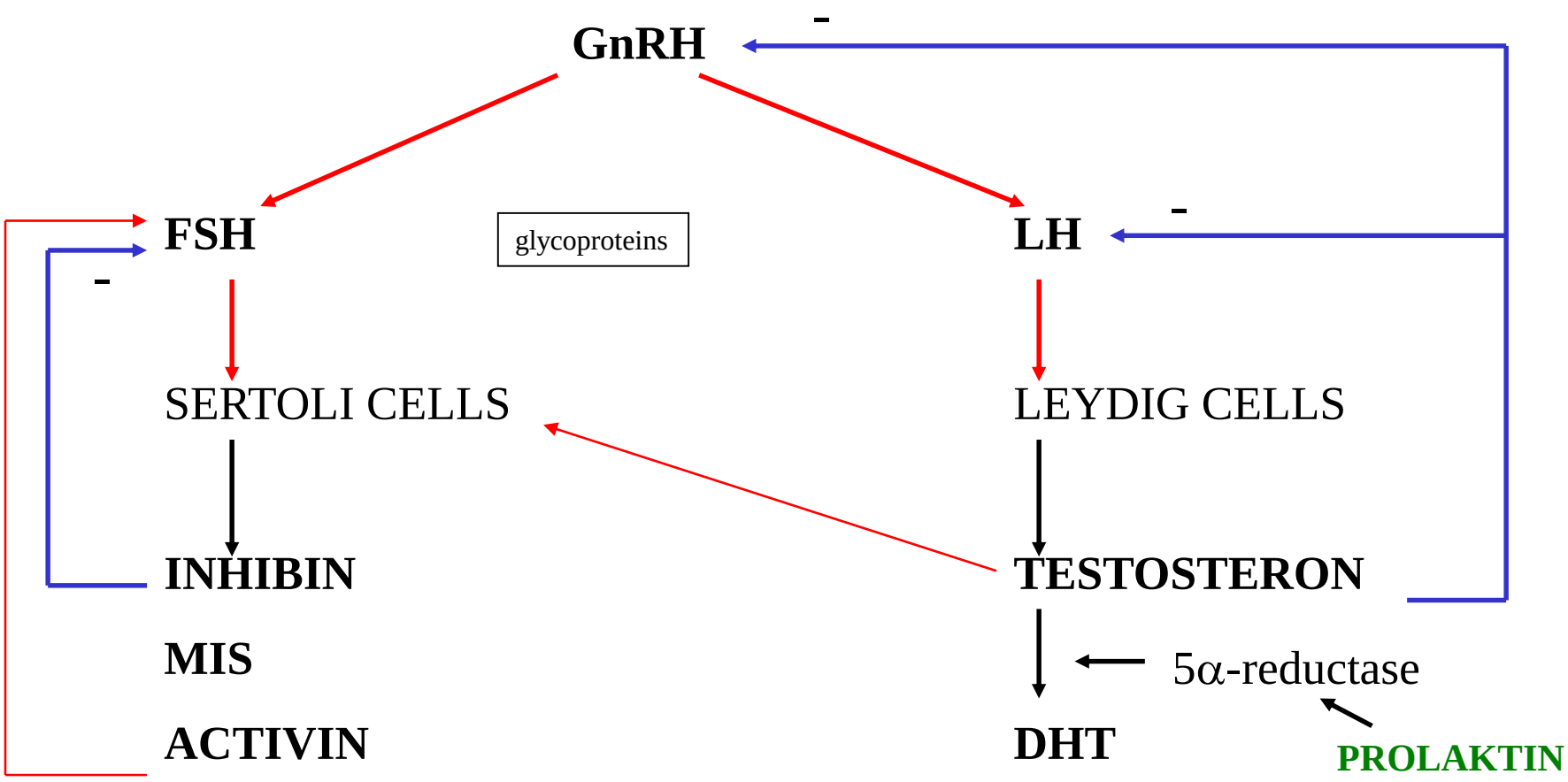
MALE REPRODUCTION SYSTEM



An Introduction to Male Reproductive Medicine

Edited by Craig Niederberger

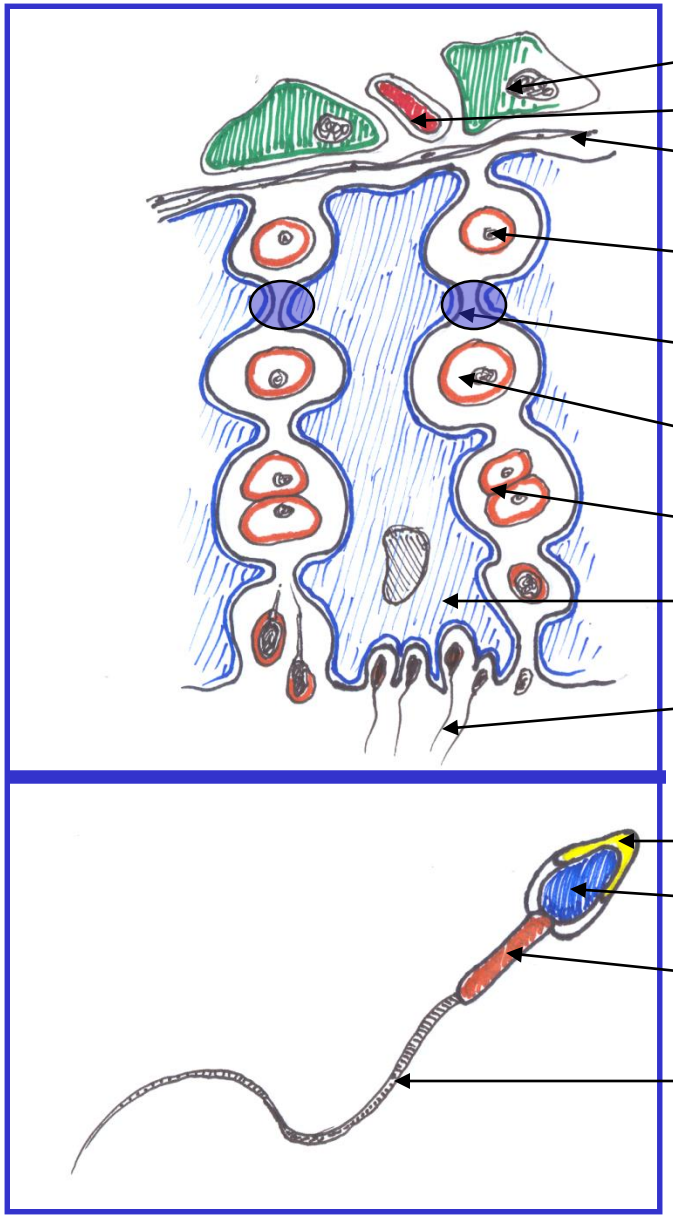
HUMOURAL CONTROL OF REPRODUCTIVE FUNCTIONS IN MAN



TESTOSTERON PRODUCTION:

- Embryonic – sex differentiation, development of generative organs
- Perinatal – descensus testis (?)
- Fertile period – LH pulsation
- After 50.year – decrease of sensitivity to LH

SPERMATOGENESIS



Leydig cell
Capillary
Basal membrane
Spermatogonium
Tight junction
Spermatocyte
Spermatide (haploid)
Sertoli cell (contraction)
Spermia

70 days

1-64 (6 divisions)

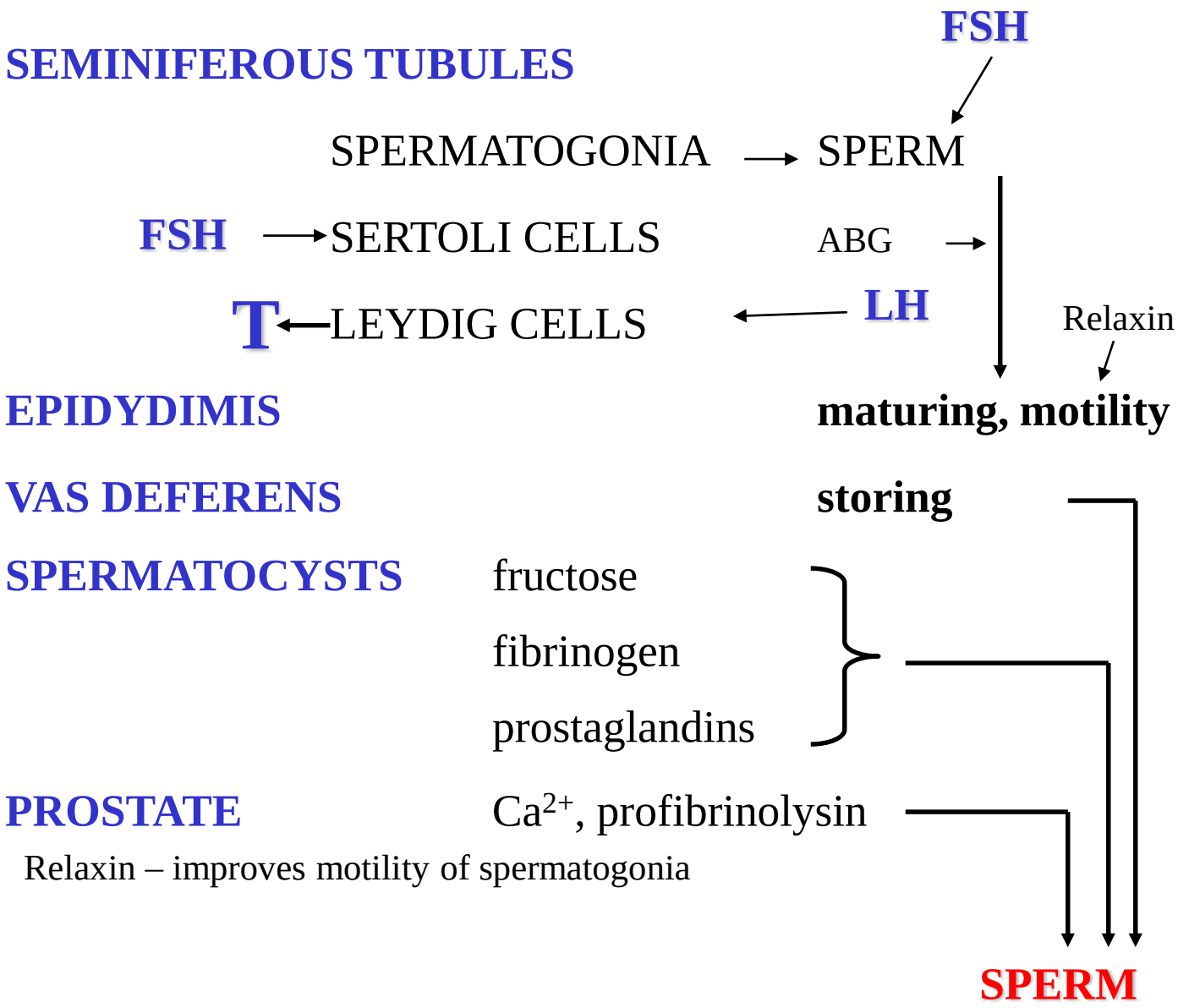
Temperature<35°C

Acrosom (enzymes)
Head (nucleus, DNA)
Body (mitochondria)
Flagella (microtubules, 9+2)

Lumen:

androg., estrog.
K^+
glutamate, aspartate
inositol

PRODUCTION OF SPERM



Relaxin – improves motility of spermatogonia

2 months

temperature

radiation

14-21 days

months

Ejaculation:

3-4 ml

10^8 sp / ml (season)

pH = 7.5

motility (3mm/min)

Volume	1,5 - 2,0
pH	7,2 - 8,0
Concentration of sperm	20 mil/ml
Total number of sperm	40 mil and more
Motility	50% and more in category A+B, above 25% in A
Morphology	30% and more of normal forms
Vitality	75% and more of living sperm
Leukocytes	up to l mil/ml
Autoaglutination	< 2 (scale 0 - 3)

Vyšetření plodnosti muže

Jméno:
Datum vyšetření :
Sexuální abstinence:
Anamnéza:
Klinické vyšetření: varlata, tuhá, pružná nebol,
podélná osa pravého varlete mm:
podélná osa levého varlete mm:

Makroskopické vyšetření:

Vzhled:
Zkapalnění:
Viskozita:

Objem ejakulátu (2,0 - 5 ml)
pH vzorku (7,2 – 7,8)

Mikroskopické vyšetření:

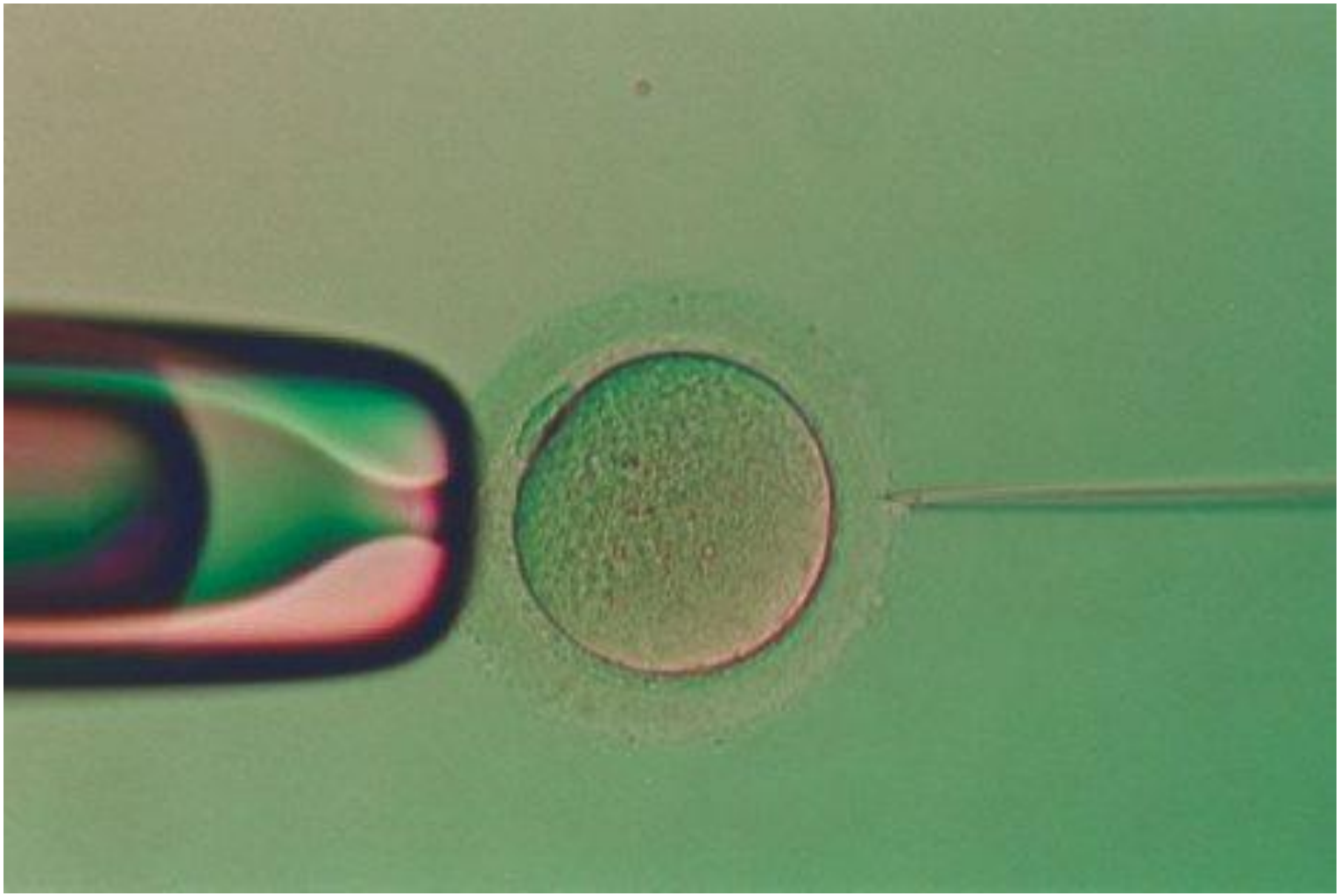
(spermiogram proveden v Makler counting chamber®, v závorkách normální referenční hodnoty)

Koncentrace spermií(nad 2O mil./ml):
Celkový počet spermií v ejakulátu(nad 4O mil./ml):
Pohyblivost spermií(minimálně 5O% kategorie A+B, 25% a více kategorie A):

A+B	C	D	
			mil/ml
			%

Vitalita (75% a více živých spermií):
Morfologie (30% a více normálních forem):
Leukocyty (do 1 mil/ml):
Přídatné buňky (do 5 mil/ml):
Aglutinace (< 2, stupnice 0 – 3):

Závěr:
Doporučení:
Vyšetřil:



SEXUAL REFLEXES