Hormonal Control of Reproduction in Male

Hormonal control of reproduction in males was varied among species. The mechanism is known that initiation of spermatogenesis occurs at puberty due to the interaction of the hypothalamus, pituitary gland, and Leydig cells.

1. FSH stimulates both the production of androgen binding protein (ABP) by Sertoli cells and the formation of the blood-testis barrier. ABP is essential to concentrating testosterone in levels high enough to initiate and maintain spermatogenesis. Intra-testicular testosterone levels are 20–100 or 50–200 times higher than the concentration found in the blood stream.
2. Increasing the levels of FSH will increase the production of spermatozoa by preventing the apoptosis of type A spermatogonium.
3. Inhibin acts to decrease the levels of FSH. The Sertoli cells themselves mediate parts of spermatogenesis through hormone production. They are capable of producing the hormones estradiol and inhibin. The Leydig cells are also capable of producing estradiol in addition to their main product testosterone.

Endocrine Regulation of Testicular Function

1. The Hypothalamus:

- GnRH is released from the hypothalamus into the portal system in separate pulses whereby it reaches the anterior pituitary and causes the pulsatile discharge of LH and the discharge of FSH.
- LH secretion is immediate after GnRH stimulation, the discharge of FSH is slow and gradual.

- This fact, together with a slower clearance of FSH from blood, results in attenuation of changes in blood concentration of FSH.
- The LH and FSH from the anterior pituitary are essential for the normal function of Leydig cells and Sertoli cells, respectively.

2. The Hypothalamus-Pituetary -Gonadal Axis

- The hypothalamic-pituitary-gonadal axis is a self-regulating system.
- LH secretion is controlled by a complex interaction of the sex steroids and GnRH.
- In the mature male, a release of LH usually is followed by a rise in serum testosterone.
- Regulation of LH secretion by feedback inhibition also can be induced by other androgens and estrogens.
- The feedback regulator of FSH secretion may be inhibin and probably originates from the Sertoli cells.
- Secretion of testosterone by the Leydig cells provides a high concentration of testosterone around the seminiferous tubules which are essential for spermatogenesis.
- The tissue concentration of testosterone probably approaches that in testicular vein blood which is 20 to 100 times higher than in peripheral blood.

Regulation of Puberty:

Puberty is when a male first produces sufficient sperm to impregnate a female. For practical reasons, puberty in bulls has been defined as the age when ejaculation is obtained containing 50 x 10^6 sperm of which >10% are motile.

Puberty is not synonymous with sexual maturity or adult status which occurs months or years later.

The hypothalamus is believed to play a key role in initiating puberty because the pituitary gland, gonads, and steroid-dependent target tissues each are competent and ready to respond to their respective tropic hormones before puberty.

The early change is an increase in the frequency of pulsatile discharge of LH. This is followed by altered testicular steroidogenesis, increased circulating levels of testosterone, differentiation of Sertoli cells, and the onset of spermatogenesis.

Puberty occurs when an animal becomes desensitized to the feedback inhibition imposed on the hypothalamic-pituitary complex by gonadal steroids. Presumably, this allows an increase in GnRH discharge and a greater response by the pituitary gland to GnRH. The repeatedly observed increased frequency and amplitude of LH discharges could reflect such a shift. This hypothesis also is supported by the observation that testicular growth, testosterone secretion, and spermatogenesis were delayed in pubertal-age bull calves administered low doses of estradiol.

Numerous environmental factors (both internal and external) influence the central nervous system to modulate the endocrine system and, thereby, alter the chronological age at which a given animal reaches puberty. Energy intake, breed, and season of birth are major factors affecting age at puberty. Old Age With few exceptions, the testes of a mature male continue to secrete testosterone and produce spermatozoa at a rate adequate to meet the breeding requirements of the species.

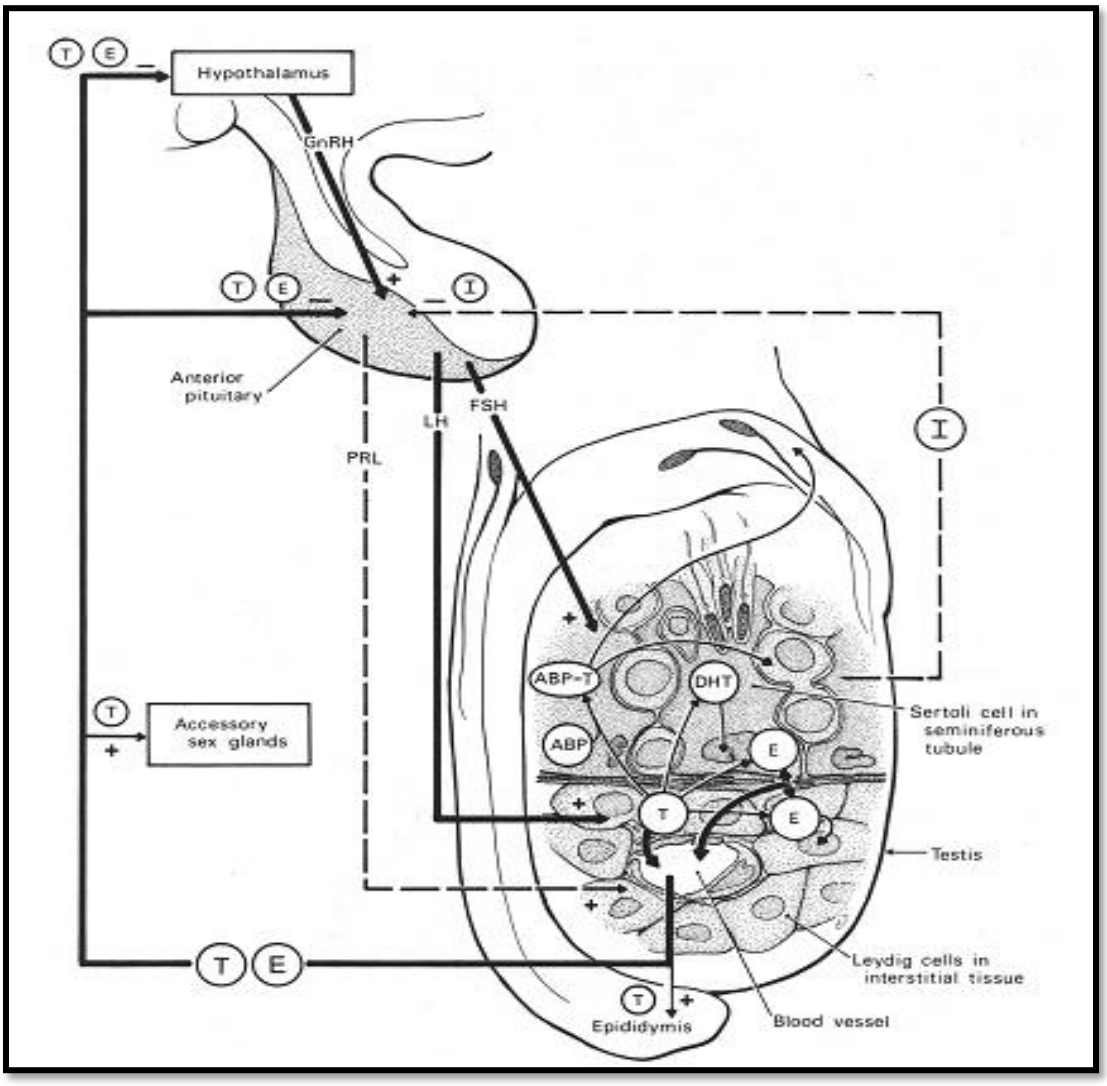

Figure 3. Diagram showing inter-relationships among hormone production in the Leydig cells and seminiferous tubules and the feedback control of gonadal hormones on the hypothalamus and anterior lobe of the pituitary gland. An increased level of testosterone (T) in peripheral blood, either as a result of increased production by the testes or following injection of the exogenous hormone, provides negative feedback on the hypothalamus to suppress pulsatile discharge of GnRH and thus suppress discharge of luteinizing hormone (LH) from the anterior pituitary. Consequently, the Leydig cells receive less LH stimulation which results in less T being produced. Estrogens (E) are produced by the Leydig cells and to some extent by the Sertoli cells. The ratio of T to E reaching the anterior pituitary may affect the relative amounts of LH and FSH secreted by the gonadotrophs. Based on studies with rams, inhibin (I) suppresses the discharge of FSH from the anterior pituitary gland. The physiological roles of E and prolactin (PRL) in adult domestic males remain conjectural .Sertoli cells produce an androgen-binding protein (ABP) which serves as a carrier for testosterone and may aid in maintaining a high androgen concentration within the seminiferous tubules or in providing testosterone to the epithelium lining the proximal portion of the epididymis.