

Prostate embryology, anatomy and physiology

Embryology

5 paired epithelial buds project posteriorly from urethra into USM at 13-16 weeks under the influence of DHT

Top pairs derived from mesoderm – form TZ/periurethral zones

Low secretory activity

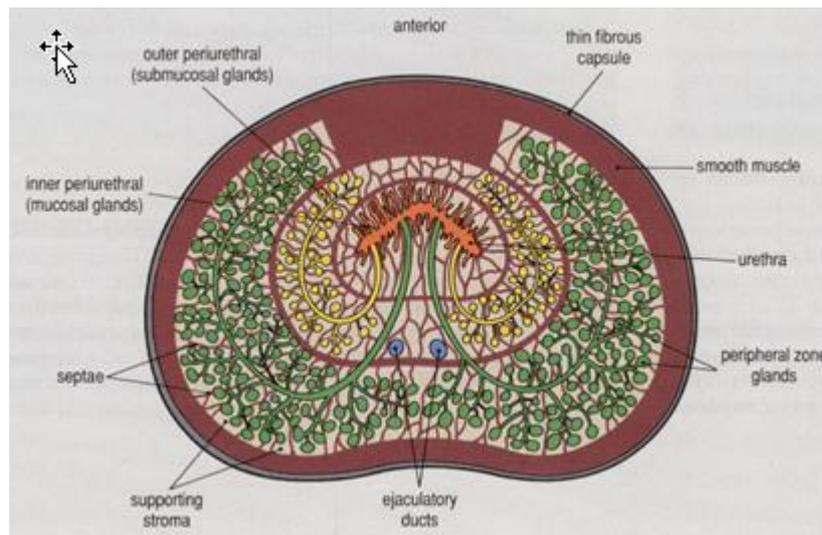
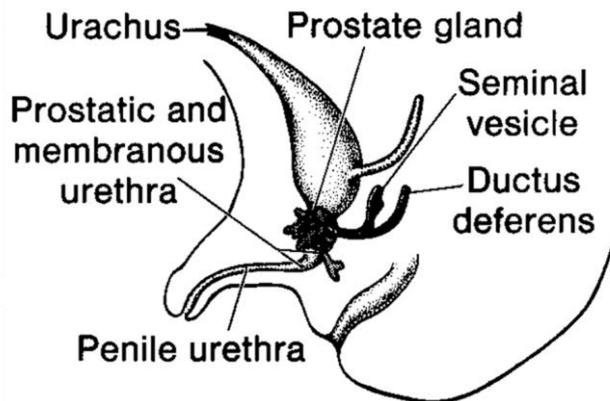
Apoptosis

Lower pairs derived from endoderm – PZ

Outer duct - high mitosis, low secretion

Mid duct – less mitosis, high secretion

Inner duct – no mitosis, no secretion, apoptosis



Stromal-epithelial interaction

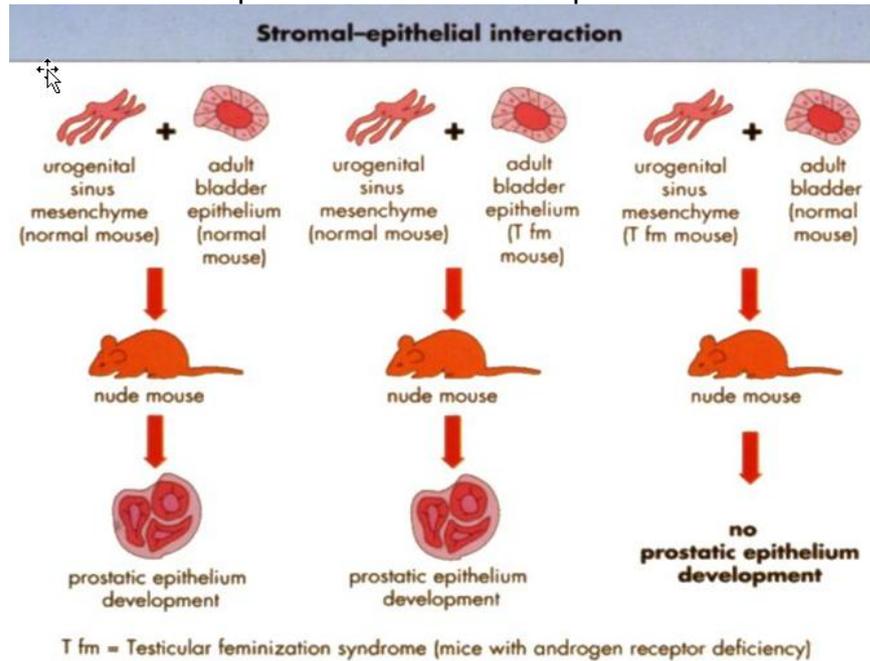
Prostate development requires presence of surrounding stroma

Determined by classic work by Jerry Cunha 1983

Urogenital sinus mesenchyme (USM) induces prostate epithelial differentiation from adult bladder epithelium

Absolute requirement for USM androgen receptor (not present in testicular feminisation)

Further growth of prostatic epithelium regulated by interaction with basement membrane and stromal cells - ? defect in stromal component responsible for inhibition of cell proliferation and development of BPH



Anatomy

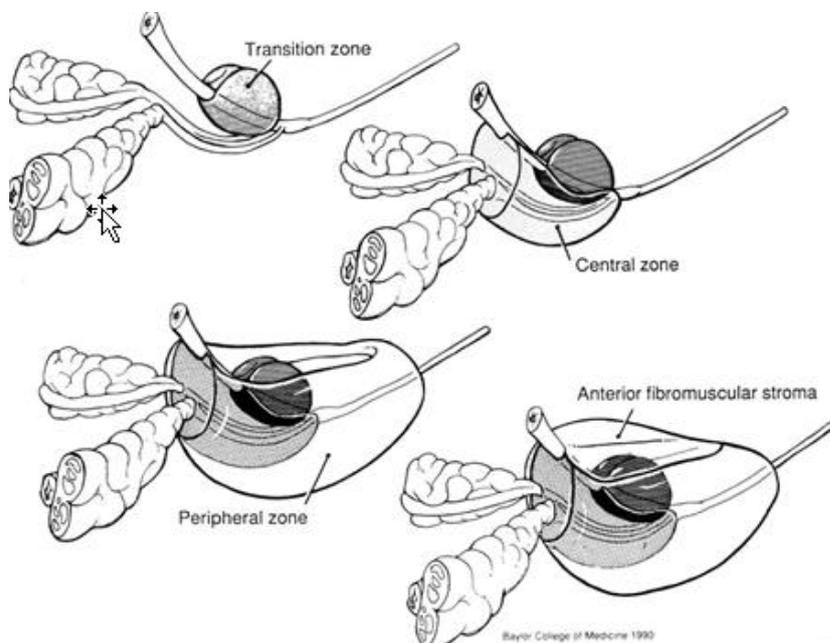
70% glandular (simple columnar or cuboidal epithelium); 30% fibromuscular stroma. Glandular elements:

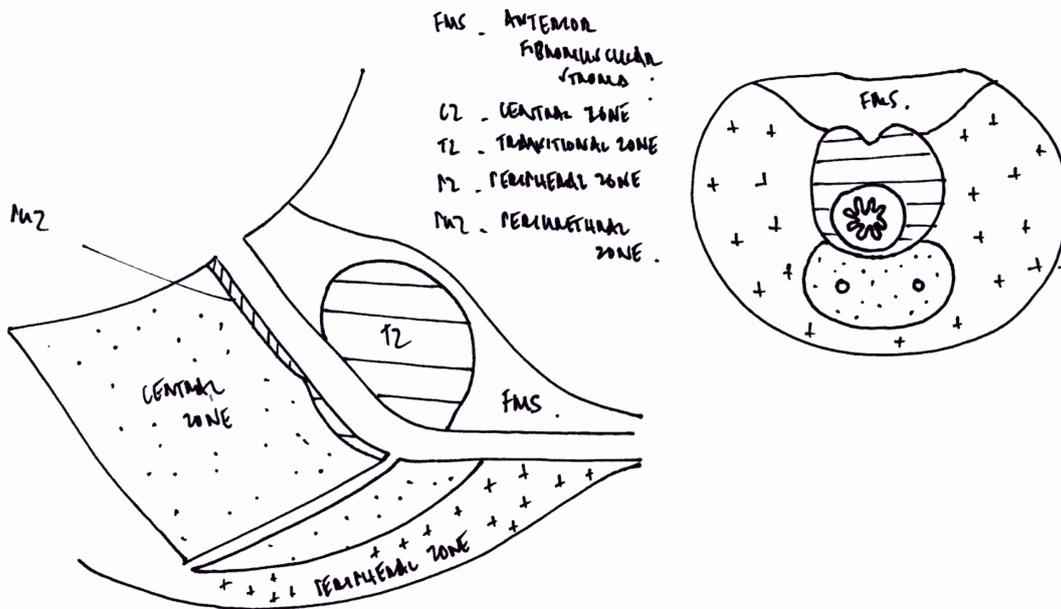
- 70% peripheral zone (70% cancers)
- 25% central zone (5-10% cancers)
- 5-10% transitional zone lateral lobes (20% cancers)
- 1% periurethral zone middle lobe

NB. urethral angle (typically 35°) divides periurethral zone from TZ (see below)

Central zone - Wolffian structures – under influence of T

Remaining prostate – urogenital sinus mesenchyme – under influence of DHT





Pre-prostatic sphincter

Signet ring, deficient posteriorly (remember anterior fibromuscular stroma)

Innervation of sphincter predominantly adrenergic and cholinergic, with others (NANC):

Cholinergic

epithelial secretion

Adrenergic

98% in stroma, not epithelium

90% $\alpha 1$ (60% $\alpha 1a$)

10% $\alpha 2$

smooth muscle contraction

Neuroendocrine cells

Serotonin, calcitonin, TSH, somatostatin

regulation of secretion & cell growth

NANC

Substance P, neuropeptide Y, enkephalins, VIP

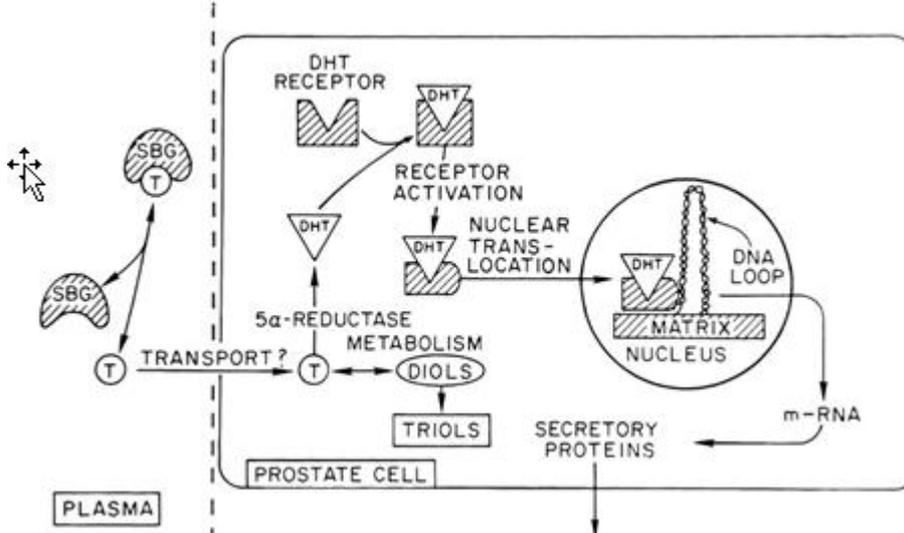
Function unknown



FIG. 2. Semi-diagrammatic representation of fibres of preprostatic sphincter passing round the urethra to interdigitate with the muscle fibres on the deep aspect of the striated muscle of the urethra.

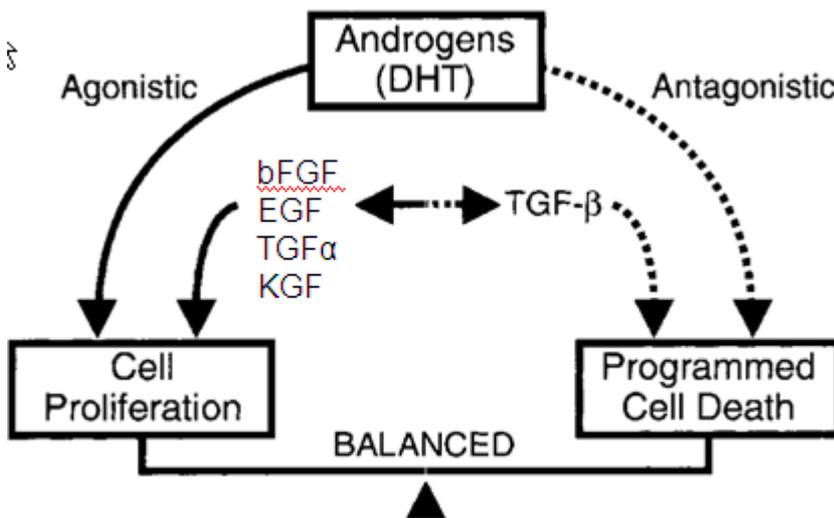
Bladder Neck v Preprostatic Sphincter	
Bladder Neck	Preprostatic sphincter
Both sexes	Males
At bladder neck	Supraverumontanal
Cholinergic innervation	Adrenergic innervation
Continnence mechanism	Genital sphincter

Endocrinology and physiology



Prostate function unknown - secretory
 Testosterone required for normal function
 Permissive role for growth; androgen withdrawal = prostate involution
 Majority of serum testosterone from testis – unbound T bioavailable form
 DHT formed within prostate epithelial cells – 40x more active vs. T
 DHT diffuses to stroma (most of the androgen receptors; paracrine effect)
 Stromal nuclei produce growth factors
 Growth factors drive epithelial cells
 Stimulatory
 bFGF, KGF (FGF-7) and EGF* and IGF (80%)
 TGF α (20%)
 Inhibitory
 TGF β

* EGF believed to be dominant factor regulating prostate epithelial growth



Prostatic secretion

Proteins and non-proteins (see below)
 Zinc maintains quaternary structure of sperm chromatin

PSA aids liquefaction of seminal fluid

Citrate thought to act as buffer for seminal fluid (~750x conc. vs. other tissues)

Prostatic Secretion

Proteins

Acid phosphatase
PSA
Leucine aminopeptidase
Diamine oxidase
B Glucuronidase
Plasminogen activator
Complement C3 and C4
Transferrin, transferritin
Growth factors
Annexin 1

Non proteins

Citrate
Spermine
Spermidine
Putrescine
Zinc
Myoinositol
Cholesterol