6. TRIGONE DEVELOPMENT - female

Development of the vestibule:

The *urorectal septum* divides the cloaca into the *posterior anorectum* and *anterior urogenital sinus (UGS).* The sinus bulb/Müllerian tubercle forms an eminence on the posterior wall of the UGS and divides the UGS into the vesicourethral canal above and definitive UGS or vestibule below.

The upper section of the vesicourethral canal forms the *allantoic diverticulum/urachal remnant/median umbilical ligament. The middle section* of the vesicourethral canal expands to form the *urinary bladder*. *The lower section* of the vesicourethral canal forms the bladder neck, *glandular urethra, and the membranous urethra*.

Early in female development, the definitive UGS/vestibule is in continuity with the vesico-urethral canal. However, the *Müllerian tubercle/colliculus feminalis, (tilts backwards and) develops posterior to the membranous urethra.*

The colliculus feminalis contains the lower end of the vagina, and distal ends of the Gartner's ducts. Because the colliculus feminalis develops posterior to the membranous urethra, the vagina, and Gartner's ducts, open into the posterior extension of the definitive UGS/vestibule.

The introitus of the vagina, and openings of Gartner's ducts, are in the same horizontal plane as the opening of the membranous urethra (distal urethral orifice). The introitus of the vagina and tiny openings of the Gartner's ducts, open in the posterior and middle sections of the vestibule.

When the *genital swelling* (clitoris) develops, the *vestibule, extends forwar*d, (of the opening of the membranous urethra) on the ventral aspect of the genital swelling to form the *anterior section of the vestibule*.

SEGMENTS OF PARAMESONEPHRIC (GARTNER'S) DUCT (f):
Paroöphoron, in broad ligament.
Brief segments on the anterolateral walls of the uterus and vagina, may form cysts.
Gartner's ducts enter glandular and membranous urethra, run posterior to urethral crest, and open on colliculus feminalis, behind the distal urethral orifice.
Neonatal paraurethral cysts may develop from the terminal ends of Gartner' ducts.

Vestiges of Gartner's ducts: (f)

In the absence of testosterone, Gartner's ducts largely disappear, but rudimentary segments remain.
The *paroöphoron* is a vestigial duct in the broad ligament of the uterus, medial to, and line with, the duct of the epoöphoron.

Gartner's) ducts descend on the *anterior walls* of the fused paramesonephric/Müllerian ducts (future uterus and cervix). At the level of the upper end of the vagina, the ducts run in parallel, on either side of the midline, posterior to the vesicourethral canal (future bladder, glandular urethra, and membranous urethra).

Brief segments of Gartner's ducts may persist in the anterolateral walls of the uterus, and anterolateral walls of the upper end of the vagina, where they may develop *Gartner's duct cysts.*

A pair of *thin linear ducts (equivalent to the ejaculatory ducts of the male),* in the posterior wall of the glandular urethra and membranous urethra, (often mislabeled as Skene's gland ducts), may persist, posterior to the urethral crest in the glandular and membranous urethra.

Posterior to the membranous urethra, the terminal ends of *Gartner's ducts* run through the Müllerian tubercle/colliculus feminalis. In the colliculus feminalis, anterior to the vagina.

The tiny *openings of Gartner's ducts* are *anterior to the introitus of the vagina*, on the *posterior lip of the distal urethral meatus*.

FEMALE TRIGONE – TERMINOLOGY:

The female trigone consists of

a) trigone of the bladder (*base* interureteric ridge, *apex* at internal urethral orifice of the glandular urethra).
b) urethral crest (in the glandular and membranous urethra)
c) trigone of the colliculus feminalis (*base* between the openings of Garner's ducts, *apex* at the distal urethral orifice of the membranous urethra).

Development of the trigone (f).

Panels of mesoderm:

Narrow vertical mesodermal panels develop on either side of the midline, *anterior to Gartner's ducts* and *posterior to the* (lower end of) *bladder section of the vesicourethral canal, the glandular urethral and membranous urethral sections of the vesicourethral canal,* and superior to the trigone section of colliculus feminalis.

Ureteric buds:

At the level of the trigonal part of the future bladder, the mesonephric (Gartner's) ducts form *ureteric buds,* that detach from the Gartner's ducts, and attach to the upper borders of the mesonephric panels. The ureteric buds, will develop a lumen,
grow cephalad to form ureteric diverticula which are destined to form the ureters and collecting systems of the kidneys.

The ureteric buds attach to the *anterior surfaces of the upper ends of the mesodermal panels*.

Trigone of the bladder:

The panels of mesoderm, *united in the midline*, insert into, and are incorporated into the *posterior wall* of the bladder, to form the *trigone of the bladder.*
The *bladder* segment of the vesicourethral canal *expands to form the bladder.*
Expansion of the bladder widens the upper borders of the mesodermal panels.
The ureteric diverticula, develop openings anterior to the upper ends of the mesodermal panels to form the *ureteral orifices.*
The *posterior walls of the intravesical segments of the ureters*, are continuous with the (subepithelial) mesoderm of the interureteric ridge (base of the bladder trigone).

Urethral crest:
The narrow vertical mesodermal panels, insert into and are incorporated in the *posterior wall of the glandular and membranous urethra*, to form, the *urethral crest of the glandular and membranous urethra.*

Gartner's ducts run posterior to the urethral crest. The ducts of Gartner are often mislabeled as Skene's gland ducts. However, Skene's glands drain in the urethral sinuses, on both sides of the urethral crest.

Trigone of colliculus feminalis:
The lower ends of the mesodermal plates insert in the *trigone of the colliculus feminalis anterior to the distal ends of Gartner's ducts*.

Formation of the female trigone is complete.
The base of the *bladder trigone* is the interureteric ridge, and apex is at the internal urethral orifice. The apex of the bladder trigone joins the upper end of the urethral crest in the glandular urethra and membranous urethra.
The *urethral crest* in the glandular and membranous urethra, joins the apex of the trigone of the bladder, to the apex of the trigone of the colliculus feminalis.
The base of the *trigone of the colliculus feminalis*, is the line between the openings of Gartner's ducts. The apex of the trigone of the colliculus feminalis, joins the lower end of the urethral crest in the membranous urethra.

The embryologist's trigone (f):

The embryologist's trigone in the female consists of:

a) Trigone of the bladder: large triangle formed by the interureteric ridge (between the ureteral orifices), and the lateral borders which converge on the internal urethral orifice, to join the upper end of the urethral crest in the glandular urethra.

b) *Urethral crest:* in the posterior midline of the glandular urethra and the membranous urethra. The distal end of the urethral crest joins the trigone of the colliculus feminalis.

c) *Trigone of the colliculus feminalis*: small triangle between the openings of Gartner's ducts and lower end of the urethral crest in the membranous urethra.

On *colliculus feminalis* (Müllerian tubercle), the tiny *openings of Gartner's ducts* are anterolateral to the *introitus of the vagina.*

Urologist's trigone:
Epithelium lining trigone of the bladder between the ureteral orifices and internal urethral orifice of the urethra, as seen at cystoscopy.

Urothelium of the lower urinary tract:
Urothelium that lines the bladder, glandular urethra, membranous urethra is derived from *endoderm* of the vesicourethral canal and urogenital sinus. *Epithelium* that covers *colliculus feminalis*, is endoderm, derived from the definitive urogenital sinus/vestibule.

Epithelium of the trigone:

Epithelium of the trigone (trigone of the bladder, the urethral crest of the glandular urethra and membranous urethra, and trigone of the colliculus feminalis), is *mesoderm*, derived from the midline panels of *mesoderm*, that form the trigone.

Intravesical segments of the ureters:

The lower ends of the ureteric diverticula, insert in the posterior wall of the bladder, to form the intravesical segment of the ureters (ureterovesical junctions). The *ureteral orifices* open at the ends of the interureteric ridge. The *sheath of mesoderm backing the posterior walls of the intravesical ureters*, is continuous with the (subepithelial) *mesoderm of the* (interureteric ridge at the base of the *trigone of the bladder.*

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From https://anatomydevelopment.com/#undefined

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