The normal cervix: cytology, colposcopy, and histology

Alan G. Waxman, MD, MPH
University of New Mexico School of Medicine
Department of Obstetrics and Gynecology
Albuquerque, New Mexico
Disclosures

• Alan G. Waxman, MD, MPH – Faculty – No Disclosures

• Please see www.asccp.org/CompOnlineCME for full program disclosures

Images used with permission:

• Ferris D, Cox T, O’Connor D, Wright C. Modern Colposcopy. Wolters Kluwer, ASCCP; 2002
• Personal collections as noted on slides
Objectives

- Review the epithelial features of the normal transformation zone
- Discuss the process of squamous metaplasia
- Explain the normal features of the transformation zone according to age
- Describe features that define a satisfactory colposcopy
Origin of cervical epithelium

• Vagina is originally lined by **columnar epithelium** derived from fusion of the *Mullerian ducts*
  • Lines the endocervix and is continuous with the endometrium

• Gradually replaced by a core of **stratified squamous epithelium** originating in the *urogenital sinus*
  • Lines the vagina, portio vaginalis of the cervix

• Rudimentary cervix by 16 weeks gestation
Types of cervical epithelia

**Stratified squamous**
- Covers the ectocervix and vagina
- Multilayered epithelium, rests on basement membrane
- ***Smooth pink color***

**Tall columnar**
- Lines the endocervix
- One cell layer thick, mucin-secreting, numerous folds
- ***Bright red irregular color***

**Metaplasia: immature and mature**
- Lies between columnar and squamous epithelium
- ***Faint acetowhite color after vinegar application***
2 types of epithelium

- Squamous
- Columnar
Squamous (Smooth PINK)

Columnar (Irregular Red)
Columnar epithelium

Infolding of epithelium

Gland cleft
Columnar epithelium

• Single layer tall columnar cells lining endocervical canal
  • Course proximally from SCJ through endocervical canal to internal os
  • Majority secrete mucus; may have cilia

• Covers villi that contain central loop capillaries
  • ***Vessels are poorly concealed: epithelium is “red” compared to squamous “pink”

• Endocervical cells invaginate into the stroma to depth of 5-8mm
  • Are called “glands” but are technically crypts
  • Infolding of epithelium creates texture on surface
Columnar epithelium

Stroma with blood vessels
Columnar epithelium **redder** than squamous
Columnar epithelium

Mucus

18-year-old adolescent
Stratified squamous epithelium divided into 4 layers:

- Superficial
- Intermediate
- Parabasal
- Basal
Stratified squamous epithelium

• Estrogen continuously remolds squamous epithelium in premenopausal women
  • Epithelial proliferation
  • Epithelial maturation
  • Epithelial desquamation

• Divided into layers
  • Basal / parabasal / intermediate / superficial
  • Regeneration from the basal layer under influence of estrogen
Stratified squamous epithelium (*PINKER* than columnar)

30-year-old Individual

RED Columnar
65-year-old postmenopausal individual

No columnar epithelium visible

Stratified squamous epithelium
Squamocolumnar junction (SCJ)

Interface between the columnar epithelium and squamous epithelium

• **Original SCJ** is defined at birth
  • Separates the original glycogenated squamous epithelium from the original columnar epithelium
  • Embryologically determined caudal extent of columnar epithelium
  • Cervical “transformation” begins here
Life cycle of the SCJ

- Adolescence
- Reproductive years
- Postmenopause
The SCJ
The evolution of the SCJ

Squamous

Columnar
The SCJ “moves” centrally by the process of squamous metaplasia

- Metaplasia: transformation of one cell type into another
- Squamous metaplasia is the process of transformation of columnar into squamous epithelium
- Squamous metaplasia is a *normal* process of cervical maturation
Mechanism of squamous metaplasia

- Columnar cells changed into immature metaplastic cells
  - Become indistinguishable from squamous cells as they mature

- Transformation zone thought to arise from transformation of columnar epithelium through subcolumnar reserve cell hyperplasia
  - These reserve cells become metaplastic cells that then become the new squamous epithelium
Active squamous metaplasia
Metaplasia
Metaplasia
How squamous metaplasia occurs

Mechanism of reserve cell hyperplasia

Estrogen lowers vaginal pH

• Estrogen levels increase in neonatal period and at puberty
• Cervical eversion mediated by estrogen
• Exposes endocervical columnar epithelium to more acidic vaginal environment
• “Acid burn” stimulates metaplasia of columnar epithelium
How squamous metaplasia occurs

Reserve cells below columnar cells
Factors inducing squamous metaplasia

• Etiologic factors
  • Mechanical irritation
  • Chronic inflammation
  • pH changes
  • Environmental conditions

• Probably begins when the original SCJ moves out of the os
  • Exposes delicate columnar cells to acidic vaginal environment
Proliferation of reserve cells - immature squamous cells directly below the remaining columnar cells
Mature stratified squamous epithelium
Squamous metaplasia

- Tips of columnar villi are traumatized by acidity of the vagina
- Immature cells gradually mature and the cells begin to produce glycogen
- Can be a random distribution on the cervix
  - Patchy, uneven areas of metaplasia
  - Immature tips have acetowhite appearance
Islands of metaplasia interspersed with columnar epithelium
Normal transformation zone

Squamous metaplasia
Metaplasia

****Faintly acetowhite after vinegar
Colors of cervical epithelium

- acetowhite immature squamous metaplasia
- red columnar epithelium
- pink squamous epithelium
What is the transformation zone?

• Physical zone or area on the cervix
• Area between the original SCJ and the new SCJ
• TZ gets larger as the individual ages and remodeling or transformation occurs
• The new SCJ appears to “move” closer to the external os and then inside the endocervical canal
  • Process completed following menopause
Transformation zone

Last gland opening

New SCJ

T Z o n e

T Z o n e
Lesion in transformation zone

Transformation zone

SCJ

Lesion in transformation zone
Components of the TZ

Nabothian cysts:

• Formed when the opening of the endocervical infoldings become blocked by metaplasia
• Accumulated mucus forms “cysts”
• Vessels accentuated over the cyst
• No treatment is necessary
What happens to those mucus secreting “glands” when they become blocked by squamous cells?

Answer
Nabothian cyst
Nabothian cyst: good place to learn normal vessels

Branching vessels
Usually *yellow*
Nabothian cyst branching vessels
Multiple nabothian cysts
Components of the TZ

Islands of columnar epithelium
  • Result from uneven process of squamous metaplasia
  • Mini SCJ’s
  • If obliterate, may produce Nabothian cyst
Components of the TZ

“Gland” openings with mucin secretion

- Not true glands
- Infoldings of columnar epithelium
Gland openings

Image from Greenwald, Spitzer, Sedlis. ACOG Basic Colposcopy
Immature metaplasia with multiple gland openings
Components of the TZ

- Mature squamous epithelium
- Final result of squamous metaplasia
  - Original SCJ and squamous epithelium interface becomes a squamous-squamous junction
General assessment of the cervix and SCJ at the colposcopic exam: if fully visualized

- The entire new SCJ on the cervix can be visualized (360° of columnar epithelium)
- If any lesion is visible, must see it entirely
- May require manipulation or endocervical speculum for complete visualization
Is the general assessment of the SCJ and lesions fully visualized?

- Fully Visualized
- Not Fully Visualized
Summary

• Reviewed the epithelial features of the normal transformation zone
• Discussed the process of squamous metaplasia
• Explained the normal features of the transformation zone according to age
• Described features that define a fully visualized cervix and SCJ at colposcopy