**Assignment Title:** Exofoliative cytology

**Matric no:** 15/MHS06/065
**Course Title:** Exfoliative Cytology
**Course Code:** MLS 532

**Question**
1. Write extensively on the exfoliative cytology of the female genital tract. 2. Discus and add notes on the pathology of the respiratory tract. Make reference to Covid-19
**Answer (Max 10mb)**

1. Write extensively on the exfoliative cytology of the female genital tract.

Exfoliative Cytology: It is the study of cells that have been shed or removed from the epithelial surface of various organs. Cells from all organs, which communicate with the exterior of the body, are suitable for study. These cells can be recovered either from natural secretions such as urine, sputum and vaginal or prostate fluids or by artificial means such as paracentesis or lavage. The cells can be collected from the epithelial surfaces by lightly scraping the surface, by swabbing, aspirating or washing the surfaces. Normal cells are cohesive in nature but exfoliated when they attain maturation. During malignant conditions or during infection, the exfoliation becomes exaggerated and the epithelial cells show variation in morphology. Such exfoliated cells, when collected and appropriately stained, give information on the living epithelium from which they are derived. These characteristic cellular and nuclear appearances in cells thrown off from healthy epithelium, differ distinctly from those, derived from inflamed or malignant lesions. Thus by studying the alterations in morphology of the exfoliated cells and their pattern, the diagnosis of various pathologic conditions can be made.

B. Fine Needle Aspiration Cytology (FNAC): This is a technique used to obtain material from organs that do not shed cells spontaneously. It is valuable in diagnosis of lesions of the breast, thyroid, lymph nodes, liver, lungs, skin, soft tissues and bones.

 C. Body Fluids: Body fluids like Urine, Pleural fluid, Pericardial fluid, Cerebrospinal fluid, Synovial fluid and Ascitic fluid can be studied by cytology.

EXFOLIATIVE CYTOLOGY Female Genital Tract (FGT) The cytological specimens collected from FGT include cervical smear, vaginal smear, aspiration from posterior fornix of vagina (vaginal pool smear) and endometrial smear. Cervical smear: Cancer of the uterine cervix is the commonest cancer in the FGT. Almost all invasive cancers of the cervix are preceded by a phase of preinvasive disease, which demonstrates microscopically a continuing spectrum of events progressing from cervical intraepithelial neoplasia (CIN) grade I to III including carcinoma in-situ before progressing to squamous cell carcinoma. This progressive course takes about 10 to 20 years. Early detection even at the preinvasive stage is possible by doing cervical smear (Pap Smear Test). This can identify patients who are likely to develop cancer and appropriate interventions may be carried out.

 Advantages of Pap Smear:

 ● It is painless and simple

 ● Does not cause bleeding

● Does not need anesthesia

● Can detect cancer and precancer

 ● Can identify non-specific and specific inflammations

 ● Can be carried out as an outpatient procedure Patient Preparation: Proper patient preparation is the beginning of good cervical cytology. The patient should be instructed before coming for smear collection, that she should not douche the vagina for at least a day before the examination. No intravaginal drugs or preparations should be used for at least one week before the examination and the patient should abstain from coitus for one day before the examination. Smear should not be taken during menstrual bleeding, because of contamination with blood, endometrial component, debris and histiocytes. Sampling: A cervical cytological sample is considered satisfactory for cytological diagnosis when their composition reflects the mucosal lining of the cervix, encompassing ectocervical, squamous metaplastic cells and endocervical columnar cells in fair numbers. It is generally agreed that majority of epithelial abnormalities that eventually lead to an invasive cancer originate in the squamo-columnar junction (transformation zone). As stated by the British Society for Clinical Cytology (BSCC), a cervical smear if properly taken should contain cells from the whole transformation zone(TZ). The sample should contain a sufficient quantity of epithelial cells, and both metaplastic and columnar cells should be present. According to the Bethesda System, an adequate smear contains an adequate endocervical/transformation zone component. Lubricant should not be used while examining, as it can obscure the cells during smear examination.

Factors affecting specimen collection:

The experience of the person who is taking the smear is very important in getting smears with adequate cellular composition. Clinicians must receive appropriate training in taking cervical scrape samples and slide preparation. The cervix must be clearly visualized and the entire transformationzone is scraped. It is also the responsibility of sample takers and quality assurance programmes to monitor the quality of specimens, so as to minimize / avoid inadequate samples and preparation / fixation artifacts. Periodic feed back to clinicians regarding the quality of their samples is important in this regard.

Sampling Devices: The collection device may play an important role in sample adequacy. The shape, surface, texture and material of the device may determine how much of the scraped material is deposited on to the glass slide and is available for screening and analysis. Several methods of obtaining cytologic material from the uterine cervix are available. However, use of cotton swab for collection of cervical smear is to be discouraged, in view of the drying artifacts and loss of cells, which are caused by this method.

● Smears obtained with original Ayre’s spatula are often easier to screen. Wooden spatula is preferable to plastic spatula, because of its mildly rough surface that can collect more material. The disadvantages are that the method may occasionally be traumatic to the patient, and the tip of spatula that does not fit the external os may fail to remove some of the valuable material from the squamo-columnar junction.

● Based on the original wooden Ayre’s spatula, many devices of different shapes and sizes have been introduced to improve sampling. This includes Endo-cervical Brush, Cervex, Cytobrush, etc.

 ➤ The pointed Aylesbury version of cervical spatula was designed to sample cells from both endocervix and the transformation zone (TZ) of the cervix.

➤ The Cervex brush device is a flexible plastic brush, which follows the shape of the endocervix, transformation zone and ectocervix as well and is suitable for every cervix shape

➤ Endo-cervical brush is a small bottlebrush like device with one end having fine bristles made up of nylons. This device is strictly for taking materials from endocervix. Gently insert the brush in endocervix and rotate one turn pressing in the upper and lower wall.

 ➤ The cytobrush is similar to that of endocervical brush except that the projected tip is without bristles. This can be used for obtaining cells from the whole cervix. Single sampling devices and methods have their limitations in obtaining adequate smears from the cervix. A combination of two devices, usually spatula and endocervical brush, give better results. Triple smear or the vaginal-cervical-endocervical (VCE) technique can provide the best results. However, feasibility and cost factor need to be taken into consideration. In postmenopausal women, the squamo-columnar junction recedes making it difficult to obtain good amount of endocervical cells and cells from TZ. Hence a combination of two devices, spatula plus endocervical brush is preferred. In those with a prolapsed uterus, the cervix is first soaked with normal saline and scrape is collected with cytobrush. To obtain a satisfactory smear from a bleeding cervix, the blood is wiped with wet cotton and smear is obtained by wooden spatula. There has been some concern that the use of the endocervical brush can result in the appearance of a much greater number of endocervical cells in a smear and that their arrangement in large sheets might mimic malignancy. To avoid this problem clinicians should inform the laboratory when an endocervical brush is used for collecting the smear. Preparation of Smear: After smear collection, the cellular sample is evenly smeared on to the centre of the non-frosted area of the glass slide, by rotating both sides of the scrape end of the spatula in multiple clockwise swirls in contact with the slide and fixing it immediately Excessively thin or thick smears can result in false-negative reports. The smear should be visually inspected after fixation. If it does not appear satisfactory, repeat it during the same examination and submit both slides for cytological examination. Some studies have shown that two-slide cervical smears detect more abnormalities than a one-slide smear. Two smears do increase screening costs over a single-slide smear, but those costs are not double that of a single-slide examination. A two-instrument collection on a single slide increases screening time only minimally over a single instrument.

**VAGINAL SMEAR:**

Introduce an unlubricated speculum, scrape the lateral vaginal wall at the level of cervix with a spatula. The broad and flat end of Ayre’s spatula is used for this purpose. The cellular material is rapidly but gently smeared on a clean glass slide and the smears are fixed immediately. If no spatula is available a cotton swab dipped in normal saline can be used. Vaginal pool smear: The aspiration can be performed after the introduction of unlubricated speculum. The technique allows collection of cells under direct vision from posterior fornix pool. When a speculum is not employed the pipette is gently introduced in to the vagina until resistance is encountered. It is important to compress the suction bulb during the introduction of the pipette to avoid collecting the cellular material of the lower vaginal origin. The cellular material is spread on a clean glass slide and fixed immediately.

Endometrial aspiration smear: After preliminary visualization and cleaning of cervix a sterile cannula is introduced into the uterine cavity and aspiration is then carried out with a syringe. The specimen is squirted on a clean glass slide, gently spread and rapidly fixed.

QUESTION 2

 Discus and add notes on the pathology of the respiratory tract. Make reference to Covid-19
ANSWER

The **respiratory system** (also **respiratory apparatus**, **ventilatory system**) is a biological system consisting of specific organs and structures used for gas exchange in animals and plants. The anatomy and physiology that make this happen varies greatly, depending on the size of the organism, the environment in which it lives and its evolutionary history. In humans and other mammals, the anatomy of a typical respiratory system is the respiratory tract. The tract is divided into an upper and a lower respiratory tract. The upper tract includes the nose, nasal cavities, sinuses, pharynx and the part of the larynx above the vocal folds. The lower tract includes the lower part of the larynx, the trachea, bronchi, bronchioles and the alveoli.

The branching airways of the lower tract are often described as the respiratory tree or tracheobronchial tree. The intervals between successive branch points along the various branches of "tree" are often referred to as branching "generations", of which there are, in the adult human about 23. The earlier generations (approximately generations 0–16), consisting of the trachea and the bronchi, as well as the larger bronchioles which simply act as air conduits, bringing air to the respiratory bronchioles, alveolar ducts and alveoli (approximately generations 17–23), where gas exchange takes place. Bronchioles are defined as the small airways lacking any cartilagenous support.

The first bronchi to branch from the trachea are the right and left main bronchi. Second only in diameter to the trachea (1.8 cm), these bronchi (1 -1.4 cm in diameter) enter the lungs at each hilum, where they branch into narrower secondary bronchi known as lobar bronchi, and these branch into narrower tertiary bronchi known as segmental bronchi. Further divisions of the segmental bronchi (1 to 6 mm in diameter) are known as 4th order, 5th order, and 6th order segmental bronchi, or grouped together as subsegmental bronchi.

Compared to the, on average, 23 number of branchings of the respiratory tree in the adult human, the mouse has only about 13 such branchings.

The alveoli are the dead end terminals of the "tree", meaning that any air that enters them has to exit via the same route. A system such as this creates dead space, a volume of air (about 150 ml in the adult human) that fills the airways after exhalation and is breathed back into the alveoli before environmental air reaches them. At the end of inhalation the airways are filled with environmental air, which is exhaled without coming in contact with the gas exchanger.

**Mechanics of breathing**

In mammals, inhalation at rest is primarily due to the contraction of the diaphragm. This is an upwardly domed sheet of muscle that separates the thoracic cavity from the abdominal cavity. When it contracts the sheet flattens, increasing the volume of the thoracic cavity. The contracting diaphragm pushes the abdominal organs downwards. But because the pelvic floor prevents the lowermost abdominal organs moving in that direction, the pliable abdominal contents cause the belly to bulge outwards to the front and sides, because the relaxed abdominal muscles do not resist this movement. This entirely passive bulging (and shrinking during exhalation) of the abdomen during normal breathing is sometimes referred to as "abdominal breathing", although it is, in fact, "diaphragmatic breathing", which is not visible on the outside of the body. Mammals only use their abdominal muscles only during forceful exhalation .Never during any form of inhalation.

As the diaphragm contracts, the [rib cage](https://en.wikipedia.org/wiki/Rib_cage) is simultaneously enlarged by the ribs being pulled upwards by the [intercostal muscles](https://en.wikipedia.org/wiki/Intercostal_muscles). All the ribs slant downwards from the rear to the front (as shown in Fig. 4); but the lowermost ribs *also* slant downwards from the midline outwards. Thus the rib cage's transverse diameter can be increased in the same way as the antero-posterior diameter is increase by the so-called pump handle movement.

The enlargement of the thoracic cavity's vertical dimension by the contraction of the diaphragm, and its two horizontal dimensions by the lifting of the front and sides of the ribs, causes the intrathoracic pressure to fall. The lungs' interiors are open to the outside air, and being elastic, therefore expand to fill the increased space. The inflow of air into the lungs occurs via the [respiratory airways](https://en.wikipedia.org/wiki/Respiratory_airways). In health these airways (starting at the nose or mouth, and ending in the microscopic dead-end sacs called [alveoli](https://en.wikipedia.org/wiki/Pulmonary_alveolus)) are always open, though the diameters of the various sections can be changed by the [sympathetic](https://en.wikipedia.org/wiki/Sympathetic_nervous_system) and [parasympathetic nervous systems](https://en.wikipedia.org/wiki/Parasympathetic_nervous_system). The alveolar air pressure is therefore always close to atmospheric air pressure (about 100 [kPa](https://en.wikipedia.org/wiki/Pascal_%28unit%29%22%20%5Co%20%22Pascal%20%28unit%29) at sea level) at rest, with the pressure gradients that cause air to move in and out of the lungs during breathing rarely exceeding 2–3 kPa.

During exhalation the diaphragm and intercostal muscles relax. This returns the chest and abdomen to a position determined by their anatomical elasticity. This is the "resting mid-position" of the thorax and abdomen when the lungs contain their [functional residual capacity](https://en.wikipedia.org/wiki/Functional_residual_capacity) of air which in the adult human has a volume of about 2.5–3.0 liters. Resting exhalation lasts about twice as long as inhalation because the diaphragm relaxes passively more gently than it contracts actively during inhalation.

The volume of air that moves in *or* out (at the nose or mouth) during a single breathing cycle is called the [tidal volume](https://en.wikipedia.org/wiki/Tidal_volume). In a resting adult human it is about 500 ml per breath. At the end of exhalation the airways contain about 150 ml of alveolar air which is the first air that is breathed back into the alveoli during inhalation. This volume air that is breathed out of the alveoli and back in again is known as [dead space](https://en.wikipedia.org/wiki/Dead_space_%28physiology%29) ventilation, which has the consequence that of the 500 ml breathed into the alveoli with each breath only 350 ml (500 ml - 150 ml = 350 ml) is fresh warm and moistened air.[[6]](https://en.wikipedia.org/wiki/Respiratory_system#cite_note-tortora1-6) Since this 350 ml of fresh air is thoroughly mixed and diluted by the air that remains in the alveoli after normal exhalation (i.e. the [functional residual capacity](https://en.wikipedia.org/wiki/Functional_residual_capacity) of about 2.5–3.0 liters), it is clear that the composition of the alveolar air changes very little during the breathing cycle . The oxygen [tension](https://en.wikipedia.org/wiki/Partial_pressure) (or partial pressure) remains close to 13-14 kPa (about 100 mm Hg), and that of carbon dioxide very close to 5.3 kPa (or 40 mm Hg). This contrasts with composition of the dry outside air at sea level, where the partial pressure of oxygen is 21 kPa (or 160 mm Hg) and that of carbon dioxide 0.04 kPa (or 0.3 mmHg).

During heavy breathing ([hyperpnea](https://en.wikipedia.org/wiki/Hyperpnea%22%20%5Co%20%22Hyperpnea)), as, for instance, during exercise, inhalation is brought about by a more powerful and greater excursion of the contracting diaphragm than at rest (Fig. 8). In addition the "[accessory muscles of inhalation](https://en.wikipedia.org/wiki/Accessory_muscles_of_respiration)" exaggerate the actions of the intercostal muscles (Fig. 8). These accessory muscles of inhalation are muscles that extend from the [cervical vertebrae](https://en.wikipedia.org/wiki/Cervical_vertebrae) and base of the skull to the upper ribs and [sternum](https://en.wikipedia.org/wiki/Sternum), sometimes through an intermediary attachment to the [clavicles](https://en.wikipedia.org/wiki/Clavicle).[[6]](https://en.wikipedia.org/wiki/Respiratory_system#cite_note-tortora1-6) When they contract the rib cage's internal volume is increased to a far greater extent than can be achieved by contraction of the intercostal muscles alone. Seen from outside the body the lifting of the clavicles during strenuous or labored inhalation is sometimes called [clavicular breathing](https://en.wikipedia.org/wiki/Clavicular_breathing%22%20%5Co%20%22Clavicular%20breathing), seen especially during [asthma](https://en.wikipedia.org/wiki/Asthma) attacks and in people with [chronic obstructive pulmonary disease](https://en.wikipedia.org/wiki/Chronic_obstructive_pulmonary_disease).

During heavy breathing, exhalation is caused by relaxation of all the muscles of inhalation. But now, the abdominal muscles, instead of remaining relaxed (as they do at rest), contract forcibly pulling the lower edges of the [rib cage](https://en.wikipedia.org/wiki/Rib_cage#Function) downwards (front and sides) .This not only drastically decreases the size of the rib cage, but also pushes the abdominal organs upwards against the diaphragm which consequently bulges deeply into the thorax.The end-exhalatory lung volume is now well below the resting mid-position and contains far less air than the resting "functional residual capacity". However, in a normal mammal, the lungs cannot be emptied completely. In an adult human there is always still at least 1 liter of residual air left in the lungs after maximum exhalation.[[6]](https://en.wikipedia.org/wiki/Respiratory_system#cite_note-tortora1-6)

The automatic rhythmical breathing in and out, can be interrupted by coughing, sneezing (forms of very forceful exhalation), by the expression of a wide range of emotions (laughing, sighing, crying out in pain, exasperated intakes of breath) and by such voluntary acts as speech, singing, whistling and the playing of wind instruments. All of these actions rely on the muscles described above, and their effects on the movement of air in and out of the lungs.

Although not a form of breathing, the [Valsalva maneuver](https://en.wikipedia.org/wiki/Valsalva_maneuver%22%20%5Co%20%22Valsalva%20maneuver) involves the respiratory muscles. It is, in fact, a very forceful exhalatory effort against a tightly closed [glottis](https://en.wikipedia.org/wiki/Glottis), so that no air can escape from the lungs. Instead abdominal contents are evacuated in the opposite direction, through orifices in the pelvic floor. The abdominal muscles contract very powerfully, causing the pressure inside the abdomen and thorax to rise to extremely high levels. The Valsalva maneuver can be carried out voluntarily, but is more generally a reflex elicited when attempting to empty the abdomen during, for instance, difficult defecation, or during childbirth. Breathing ceases during this maneuver.

### FUNCTIONS OF THE LUNGS

#### LOCAL DEFENSES

Irritation of nerve endings within the [nasal passages](https://en.wikipedia.org/wiki/Nasal_cavity) or [airways](https://en.wikipedia.org/wiki/Airway), can induce a [cough reflex](https://en.wikipedia.org/wiki/Cough_reflex) and [sneezing](https://en.wikipedia.org/wiki/Sneezing). These responses cause air to be expelled forcefully from the [trachea](https://en.wikipedia.org/wiki/Vertebrate_trachea) or [nose](https://en.wikipedia.org/wiki/Nose), respectively. In this manner, irritants caught in the [mucus](https://en.wikipedia.org/wiki/Mucus) which lines the respiratory tract are expelled or moved to the [mouth](https://en.wikipedia.org/wiki/Mouth) where they can be [swallowed](https://en.wikipedia.org/wiki/Swallowed).[[6]](https://en.wikipedia.org/wiki/Respiratory_system#cite_note-tortora1-6) During coughing, contraction of the smooth muscle in the airway walls narrows the trachea by pulling the ends of the cartilage plates together and by pushing soft tissue into the lumen. This increases the expired airflow rate to dislodge and remove any irritant particle or mucus.

[Respiratory epithelium](https://en.wikipedia.org/wiki/Respiratory_epithelium) can secrete a variety of molecules that aid in the defense of the lungs. These include secretory [immunoglobulins](https://en.wikipedia.org/wiki/Immunoglobulin%22%20%5Co%20%22Immunoglobulin) (IgA), [collectins](https://en.wikipedia.org/wiki/Collectin%22%20%5Co%20%22Collectin), [defensins](https://en.wikipedia.org/wiki/Defensin%22%20%5Co%20%22Defensin) and other peptides and [proteases](https://en.wikipedia.org/wiki/Proteases), [reactive oxygen species](https://en.wikipedia.org/wiki/Reactive_oxygen_species), and [reactive nitrogen species](https://en.wikipedia.org/wiki/Reactive_nitrogen_species). These secretions can act directly as antimicrobials to help keep the airway free of infection. A variety of [chemokines](https://en.wikipedia.org/wiki/Chemokine%22%20%5Co%20%22Chemokine) and [cytokines](https://en.wikipedia.org/wiki/Cytokine) are also secreted that recruit the traditional immune cells and others to the site of infections.

[Surfactant](https://en.wikipedia.org/wiki/Pulmonary_surfactant) immune function is primarily attributed to two proteins: SP-A and SP-D. These proteins can bind to sugars on the surface of pathogens and thereby [opsonize](https://en.wikipedia.org/wiki/Opsonize) them for uptake by phagocytes. It also regulates inflammatory responses and interacts with the adaptive immune response. Surfactant degradation or inactivation may contribute to enhanced susceptibility to lung inflammation and infection.

Most of the respiratory system is lined with mucous membranes that contain [mucosa-associated lymphoid tissue](https://en.wikipedia.org/wiki/Mucosa-associated_lymphoid_tissue), which produces [white blood cells](https://en.wikipedia.org/wiki/White_blood_cell) such as [lymphocytes](https://en.wikipedia.org/wiki/Lymphocyte).

 In the case of the corona virus

COVID-19, the disease caused by the new coronavirus, can cause lung complications such as [pneumonia](https://www.hopkinsmedicine.org/health/conditions-and-diseases/pneumonia) and, in the most severe cases, acute respiratory distress syndrome, or ARDS. Sepsis, another possible complication of COVID-19, can also cause lasting harm to the lungs and other organs.

### COVID-19 Pneumonia

In pneumonia, the lungs become filled with fluid and inflamed, leading to breathing difficulties. For some people, breathing problems can become severe enough to require treatment at the hospital with oxygen or even a ventilator.

The pneumonia that COVID-19 causes tends to take hold in both lungs. Air sacs in the lungs fill with fluid, limiting their ability to take in oxygen and causing shortness of breath, cough and other symptoms.

While most people recover from pneumonia without any lasting lung damage, the pneumonia associated with COVID-19 may be severe. Even after the disease has passed, lung injury may result in breathing difficulties that might take months to improve.

### Acute Respiratory Distress Syndrome (ARDS)

As COVID-19 pneumonia progresses, more of the air sacs become filled with fluid leaking from the tiny blood vessels in the lungs. Eventually, shortness of breath sets in, and can lead to acute respiratory distress syndrome (ARDS), a form of lung failure. Patients with ARDS are often unable to breath on their own and may require ventilator support to help circulate oxygen in the body.

Whether it occurs at home or at the hospital, ARDS can be fatal. People who survive ARDS and recover from COVID-19 may have lasting pulmonary scarring.

### Sepsis

Another possible complication of a severe case of COVID-19 is sepsis. Sepsis occurs when an infection reaches, and spreads through, the bloodstream, causing tissue damage everywhere it goes.

“Lungs, heart and other body systems work together like instruments in an orchestra,” Galiatsatos says. “In sepsis, the cooperation between the organs falls apart. Entire organ systems can start to shut down, one after another, including the lungs and heart.”

Sepsis, even when survived, can leave a patient with lasting damage to the lungs and other organs.

### Superinfection

Galiatsatos notes that when a person has COVID-19, the immune system is working hard to fight the invader. This can leave the body more vulnerable to infection with another bacterium or virus on top of the COVID-19 — a superinfection. More infection can result in additional lung damage.