Cellular adaptation cont.
3 – Hyperplasia:

Related to hyperplasia, we have examples:
A- endometrial hyperplasia : endometrial cells under goes hyperplasia because of changes happen due to cycle , but sometimes under the influence of excessive hormonal stimulation particularly estrogen , can be pathologic and called **endometrial hyperplasia** .
this is important because endometrial hyperplasia can be considered as sth called “neoplasm”(tumor formation ) ,because if the stimulation or level of estrogen goes up without cyclic changes that might predispose or can progress into endometrial carcinoma .
B- growth factor : as wound healing , if there is wound healing, the cells should response to growth factors which are released at the site in order to stimulate cells to divide to replace lost cells, so in order to cure or heal, there is cell stimulation and replacement. in normal condition after many days, healing process and replacement of epithelial cells start .

However sometimes in certain conditions, the wound site undergoes excessive stimulation , excessive cell division producing overgrowth of scar so we will have scar which is more than what should be at the wound site and this is form of hyperplasia occurs in certain conditions or certain locations.
 The black people have more tendency to have excessive scars than other individual .

C- Sometimes viral infections: viruses stimulate cell growth, so we will have signals to the cells ,so the viruses may produce small mass which we called hyperplasia in the tissues.

\*\* The DR showed us a picture of uterus( with hyperplasia ) the endometrial is very thickened , this is excess of the normal so we called this ( hyperplasia) and it might go up till the condition will cause hyperplasia of endometrium , so it is serious to know and control level of estrogen, so estrogen should not be given without progesterone ( there is what we called combined drug because estrogen alone is very dangerous ).

Another example : prostate hyperplasia , occurs with age ( it is well known that all males after the age of 40 they start to have hyperplasia , and the patients > 70 year most of them will have this form of hyperplasia which affected by ageing .

it is important because hyperplasia may go on and can be predispose to malignancy conditions.

Hyperplasia means normal structure and normal component of tissues with increase number of cell reflected to tissue size. In hyperplasia since the cell divide more than normal, so we will have the same structure (normal structure) but their numbers will be increased.

Prostate have structure called glands and their number in hyperplasia will be increased so all component are normal , however they are more than normal in size and number.

4 - Metaplasia :
it is change from one type of tissue to another type. normally this is common in epithelial cells which lie the cavities especially gastrointestinal tract from mouth down to the oral cavity are epithelial cells. Sometime there is replacement of these epithelial lining cell by another which is totally both are completely normal.
 any changes called metaplasia and this is a reversible process mean if the underlying or initial irritant is removed , the epithelia lining go back to normal so it is a reversible.
 Why the cells change?
Due to presence of something (stressful or injurious agent or toxic substance that cause irritate) the cell try to adapt so they try to change in order to escape the damage by that injurious agent and due to ability of the cells to reprogram themselves .

\*this is involved all type of epithelia squamous ,columner , cuboidal and so on.

However because there is stressful conditions, some of the gens that are dormant or inactivated, they will undergo activation and the cell start to change in order to work and this is called **reprogramming.**

example :

A- squamous metaplasia in respiratory tract can occur mainly to sth very toxic as exposure to smoke of cigarette, so squamous metaplasia in the air way is very common and occurs in all smoker , why ? Because smoke of cigarette contain many toxic agent and the respiratory cells “ciliated columnar cell” lining the airways cannot stand toxic or damage happen. so the respiratory lining try to go into another type of cell which is squamous epithelial ( multilayer epithelia ) not as respiratory epithelia which is single layer. the other thing the sqaumous epithelium is able to produce some keratin layer ( keratin can be resistant to toxicity of the smoke ). So continuous smoking converts epithelia to squamous to defend this injury.

B- esophagus : esophagus lined by stratified squamous epithelium that cannot resist damage effects by acid ,so if the patient have reflux, these epithelium will change or convert to another epithelia ( that is able to resist the acids )which is gastric or intestinal epithelia and this is known as ***Barrett’s esophagus “intestinal – type columnar epithelium” .***

Barrett’s esophagus can predispose to development of the adenocarcinoma which is a cancer that developed from cells ( miller cell ) .

Adenocarcinoma occurs in esophagus that have secretary gland , patients who have reflux , they might to be followed by Barrett’s esophagus and later on may have cancer in esophagus. C- Metaplasia in mesenchymal tissue not common but it can occur .

D- Bone metaplasia : in soft tissue or joint or when there is a fracture , sometime if the healing of fracture is inappropriate may , bone metaplasia may occur.

However, it’s not famous as epithelial metaplasia

The Dr showed us slides and she said about them :-

In Barrett’s esophagus epithelium is like intestine epithelium, there is no change and this is to show that the function is lost and the appearance

Metaplasia can occur at any site of chronic irritation, if we have site of irritation by foreign bodies or inflammation then metaplasia may happen.

Squamous epithelia can change to something else and other types of epithelia can change to squamous. For example, columnar epithelium in cervix can change to squamous due to chronic infection (this is metaplasia ) .

Other thing which is very related although, but not adaptive response is dysplasia.

Epithelium is changed from normal to another depending on the site. However, if the irritation or toxic substances exposure persists it may cause or sustain something abnormal, the cells that are normal “metaplasia” start to be abnormal and this is called dysplasia.

It’s believed that development of cancer at any site is a multistep process and it starts from changes that progress and will make abnormal accumulation in the cells to form cancer so the dysplasia is precancer condition .

Primarily in some locations dysplasia may be reversible but most of cases when reach to the level of dysplasia (especially severe dysplasia) it can proceed to full malignancy.

So all things that associated with metaplasia and dysplasia they should be followed up such as patient with uterine cervix viral infection can cause metaplasia then metaplasia can cause dysplasia that may be followed with cancer and that’s why it’s so important to scream program for patients with viral infections’ to prevent development of dysplasia .

Dysplasia can occur anywhere in some diseases the patients must follow up if they have dysplasia all the parts that involved in disease process must be removed such as in ulcerative colitis where the colon with dysplasia should be removed .

Dysplasia in early stage could be reversible and mild but with time it could be severe such as viral infection in cervical dysplasia, in some cases it can be reverse if the problem treated early.

Dr showed picture :
You can recognize dysplasia by looking to cells directly. Dysplasia and cancer related especially to nucleus. nucleus in neoplastic cells are very large, hyperchromatic (darker in color ) and they lose the maturation . the sqaumous epithelium always in the base, small and mild active because the cell dividing. with migration to the surface , the cell mature, increase in the size , they lose their ability to divide and nuclei start to be smaller because it’s function become less until reach the surface which is cell full with cytoplasm and nucleus is a small part of it ( we can see mitosis on the surface ) so all of that are features of dysplasia .

Feature in dysplasia is similar to that in malignancy conditions ( dysplasia is step lead cancer).

\*\*\* Once the cell are capable to change and adapt , it is possible to withstand and injury, however, sometime injurious agents can go on and on , cell cannot adapt ,once the cell reach this level two thing may occur. They start to sustain injury so sth will occur ***that is called cell injury which start with cell exposure to injurious agent.***

Injury divided into ***reversible*** and ***irreversible*** , in reversible if we removed irritant condition the cell go back to normal , usually these injuries are mild , so the cells do not loss all function and essential parts , they can go back to normal state .

Some time these injuries may be severe or cannot stand this condition and the cell start to die this is irreversible injury.

\*remember in reversible injury can start as functional loss and this is can occur in many cases. So function may be lost before morphology as in ***MI*** (myocardial infarction ), when cardiac muscle exposed to hypoxia, it will start to loss it’s function and that is why the patient may die and the examination does not show any change in structure of cardiac cells .

There is two types of reversible injury ***CELLULAR SWELLING*** and ***FATTY CHANGES***, both are can be reversible ,although fatty changes not necessary to be be always reversible ,sometime it can be irreversible.
1- Cellular swelling : After exposure to injurious agent ( most common cause of injury is hypoxia that mean s oxygen availability to tissue is decreased ).

What is the importance of oxygen to the cell ?

For oxidative phosphorylation , synthesis of ATPs molecules with presence of O2 will be abundant , but in hypoxia, the synthesis of ATP become much lesser.

In hypoxia, no O5, oxidative phosphorylation in mitochondria is going to stop and it is aerobic respiration and this process is going to be shifted to anaerobic. In anaerobic process there is two things ,ATP molecules produced in each cycle much less ( in aerobic 36 molecules) but in anaerobic 2 molecules of ATP, in addition to that these process is associated with accumulation of molecules that lead to increase the acidity of the cell and this is a damage factor !! .

**ATP is energy storage molecule ,can be used for many things , the most one is ion pump cross the membrane , normally NA+ go inside cell. however, we do not want NA+ concentration to increase inside the cell , that is why we have ion pump in the membrane . When molecules go inside, the pump return them outside (this is depend on ATP), SO IF THERE IS no ATP or less amount of it NA+ enter the cell and remain in cytoplasm, the concentration will be increased. This cause water to come inside cell then swelling that is first thing to happen with injury.**

In anaerobic process associated with glycolysis.

Anaerobic… glycolysis….glycogen depletion…accumulate of lactic acid …. Nucleous destruction .

**Another form of reversible injury is fatty change :**fatty change is accumulate of fatty droplet that are not normally stored , and it can occur in different organs ( commonly liver and heart ).
We have two source for fats which are adipose tissue and diet. once we have fat, it is absorbed as **FFA( FREE FATTY ACID )** AND chylomicron complexes with albumin in intestine. they go to blood and circulate until reach their final store ( adipose tissue ) and in the liver this complex disassociate. FFA and chylomicron is recomplexed with another protein ( apoprotein) to form lipoprotein and this complex released into circulation and FFA reach different sites to be used .
any process that interface with fat synthesis or metabolism can cause fatty changes, they may increase FFA or FFA can be released from liver more than normal or in some condition FFA in circulatory system is not used or toxic substances like ethanol that affects fat catabolism … etc

If we do not have this protein (lipoprotein) in the liver, the release of FFA from liver to circulate is going to be obstructed and cause accumulate of these fatty acid molecules (fatty changes) .

If these factors are removed , this can be reabsorbed by liver and back to normal .

Fatty changes not always reversible, it can be irreversible so that, the most common cause for fatty change in the liver is alcoholism, if the patient take alcohol for long period of time, the fatty change might be irreversible.

Pathogenesis of fatty changes can be reversible and that is why we have these changes and the most common is alcoholism which is very chronic and another reason is malnutrition (FFA that should be released in malnutrition ,it would be lost and adipose tissue will be broken ).

Another reason for fatty change is diabetes obesity, exposure to hepatoxins such as CCL4 and any other chronic illness .

**\*\* Irreversible cell injury** mean cell death and we called it ***necrosis .***

***Necrosis : cell death which is evident by changes in morphology of the cell ( their shapes are changed then the function is going to be lost )***and cell death in living tissue resulting from progressive degradation of enzymes. The result of necrosis, we will have dead cells!!. **APPERANCE of necrotic cells under light microscope:** the most common evidence is the changes that affect nucleus. Dead cell will end with fragmentation of nucleus (and actually we lost the nucleus, it become small fragmentation ☹ ) with another cytoplasmatic changes.
 These nuclear changes are known as:

1- ***pkynosis: comes*** just before karolysis that involved in protein shrinkage and clumping and nucleus will be smaller like a ball .
2- ***karyolysis:*** lysis of nucleus due to DNA activity.
3- ***karyorrnhexis***  :DNA is damage and complete fragmentation of nucleus and the cell will be without nucleus.
**types of necrosis :
1.cogulative necrosis**

**2.liquefactive necrosis**

**3.casesous necrosis**

**4.fat necrosis**

**5.gangerous necrosis**

**6.fibronoid necrosis( occur in blood vessel )**

it is important to know type of necrosis because each one indicate the underlying case.

Coagulation necrosis occur due to ischemic injury .

Liquefactive necrosis …. Cells are degraded to thick liquid and this is seen with us and the most common cause is bacterial infection, so any location with yellowish material which is called pus means there is bacterial infection .

Caseous necrosis :- most and only common cause is tuberculosis this is necrosis with inflammatory structure called granuloma .

TB ( tuberculosis ) obligatory microorganism enter the cell ( lymphocyte or histiocyte ) then it degraded and these microorganism don’t die within the cells because they are resistant and histiocyte become larger and form collection called grauloma if these microorganism persist they induce some changes lead to degradation of the cell within the centre of granuloma and that’s what we called caseous necrosis

* Granuloma:- collection of histiocyte (type of stimulated cells )

if u have any question , then ask doctor ☺ or u can check the record. tell us about any mistake, and recall :
**جلَّ من لا يسهو** ☺