

***Title of Lecture: Pathology***

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***Refer to slide no. :***

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Inflammation

Inflammation can occur anywhere and it's important to understand the causes of inflammation and how the tissues react when there is an inflammatory process and because of that we need to know the inflammation and how to control it and how to prevent the complications of inflammation .

Inflammation is :
a defensive mechanism of the body toward any infectious agent or any foreign material , because without being able to do so, up on exposure to any infectious agent there will be damage which can be severe and very extensive leading to loss of tissues .

And that’s why inflammation it is a disease process and a defense mechanism and without it the tissues might be damaged and lost.

* Main cause of inflammation is :
microbes or microorganisms
* Remember inflammation it is not only caused by microorganism. it can be caused by non-infectious agent ,but infectious agents are the most common .
* What is the aim of this response of the body toward the presence of any infectious agent ?
it is important because the inflammatory response is associated with dilution of the microorganisms or the dilution of toxic substances and should deal with it .
* Because the aim of this response is destroying and elimination of the microorganisms , and even if the body or the tissue can't deal with that microorganism and it can't destroy the microorganism , it makes localization which is something good , because when we make localization we can control it rather than allowing the microorganism to go to other areas.

So , inflammation it is something useful for the body although it can be associated with tissue damage , but always remember depending on different factors the inflammation can lead to tissue damage , or loss of tissue and this might lead to chronic changes and sometimes the inflammation can't be cured totally and the tissue might not be restored and this will lead to scars on the site of inflammation because of fibrosis and collagenesis .

Clinically Inflammation divided into:
1) acute 2) chronic

Depending on the duration of process.

* Acute inflammation :
the inflammation that occur following the exposure to microbes and if this inflammation extends to longer period of time ( inflammation should be an immediate reaction , should last for a week also ) but inflammation can extend to longer period of time and if this period is more than six months the inflammation is considered as chronic inflammation .

Histologically this is not absolutely true , why ?
because the division of the ( chronic / acute inflammation ) is depending on the type of cells that are present on the tissue during the inflammation regardless of the duration , and that’s why chronic inflammation can be initiated from the start of inflammation , After the exposure to certain type of bacteria , these bacteria are associated with certain type of cells ,that infiltrate the tissue and this is chronic regardless the duration .

 And whenever we have neutrophils 🡪 this is an acute inflammation because we depend on the type of cells that infiltrate the tissue then we can say if it is (cute or chronic inflammation) .
 **- (according to the predominant type of cells in the site of inflammation).**

* so acute inflammation it is characterized by the presence neutrophils and chronic inflammation it is characterized by the presence of macrophages, lymphocytes , and plasma cells non-segmented cells ( chronic inflammatory cell ) .
* And sometimes it is mix of acute and chronic inflammation depeding on the cells type .

At any site of inflammation as a response of the presence of microorganism the immune system will recognize the infectious agent and the immune system will respond to it .

If this response involve the leukocytes - white blood cells within the blood- if the inflammation predominated by neutrophil infiltration – neutrophils are in the blood not in the tissue – and after exposure to bacteria neutrophils in a way will be attracted to go out the blood toward the tissue that contains microorganism and that’s why if we look at the tissue we will see inflammatory cells neutrophils and this is called acute inflammation .

\* There are many examples of acute inflammation:
1) sore throat ( because of exposure to bacteria ) .

2) tuma , skin scratch it is a form of acute inflammation because there is damage of the cells which is another stimulant of acute inflammation but non-infectious .

3) Burns initially .

4) insects bite 🡪 because they produce some of foreign materials and enzymes, and the immediate reaction is initiated by neutrophils .

- The presence of neutrophils at any site 🡪 acute inflammation.

-However remember , depending on the duration of inflammation there might be another cell types and according to the cell type we call it acute or chronic inflammation.

- Neutrophils can be easily seen in the tissue🡪 because the nucleus is segmented.

In the other side we can see columnar epithelial cells but the fragmented cells in the same slide is neutrophils🡪 acute inflammation ( if it was in the gallbladder we call it cholecystitis , if it was in the pancreas we call it pancreatitis ) .

* In the next slide we can see the alveolar spaces are obstructed by the presence of these fluid cells filling and obstructing the spaces and we call it bronchial pneumonia (form of inflammation within the lung ).

- What is the aim of this response?
- Why the body respond in this way ?

1) in order to eliminate and inactivate the causative agent and the most common causes are microorganisms .

2) for non-infectious agent which is associated with the presence of necrotic cells and dead tissues 🡪 is the removal of these dead tissues once they die should be eliminated and can't be left in the tissue .

Hence , at any site of inflammation ( infectious and non-infectious inflammation ) the inflammatory response is associated with cells even the inflammatory cells at the end will be dead and the tissue which is affected by the inflammation will be damaged all these cells should be removed by phagocytosis .

* If we go through the causes of inflammation :
1) microbial agents are the most common ( bacteria , viruses , parasites) and these microorganisms can cause the inflammation in different ways.
* First the presence of microorganisms themselves can initiate inflammation sometimes the microorganism " endotoxins " can secret some enzymes " exotoxins " they also can initiate the inflammation .
* The other important thing that is the microorganisms stimulate the immune system and the immune system will respond ( for ex : bacteria which is associated with the activation of plasma cells ) which secret the antibodies🡪 the antibodies form complexes with the antigen 🡪 antigen – antibodies complex is enough to initiate the inflammatory cascade .

- Again the non-infectious agents are associated with the initiation of the inflammatory response and these condition is associated with the same inflammatory cascade which could be severe enough and causes some complications like hypersensitive reaction once we have immunological response to anything even if it was (infectious or non- infectious ) the presence of antigen – antibody complex it is associated with inflammatory response .

2) Hyper sensitive reaction :

Asthma : the asthmatic patients usually is hypersensitive toward some antigens in the environment once the patient is exposed to this antigen and he is hypersensitive toward it 🡪 the first thing that happens is hypersensitivity ( the body starts secreting certain type of Igs like IgE which binds to the cell surface "mast cells " and upon second exposure the cell is already sensitized to this antigen and already antibody presents on the cell surface after the second exposure these antibodies start degradation , mast cells have many chemicals which can affect the air ways and the blood vessels and narrowing of the air ways of the asthmatic patient and that is the hypersensitivity reaction .

Hence, hypersensitivity reaction is another cause for the inflammatory process

3) Physical agents 🡪 they can cause trauma so the redness and swelling of the skin is due to the inflammatory reaction and the exposure to extreme temperature cold/ hot is associated with tissue damage, chemical agents alkalis / acids .

4) Any process that is associated with tissue necrosis in a living body it is an inflammation that’s why we can differentiate if this necrosis "cell death" occur during life or after life because if the patient is still alive he/she must have inflammatory reactions by after dying the cell death will not be associated with inflammatory response .

Hence , any process that is associated with necrosis in a living body is an inflammation regardless of the cause .

Ex : the heart :
myocardial infraction (MI ) of the heart because of ischemia 🡪 no O2 🡪 cell death 🡪 inflammatory response by neutrophils .

5) the presence of any foreign body in any tissue is associated with inflammatory response although this is not like the acute inflammation usually the inflammatory response is associated with ( macrophages , and histiocytes ) around the foreign material.

\* Inflammation and infection :
inflammation : the tissue's reactant toward something infectious and non-infectious agents.

Infection: is the presence of microorganism .

* So inflammation and infection is related to each other but still different .

Inflammation has two effects :
something beneficial and it is away of defense or it can be harmful and can cause damage to the tissue

* The beneficial of inflammation :
1. The dilution of toxics 🡪so the damage effect decrease :
* inflammation is associated with floating of the flamed tissue with fluid and the first thing that occur at any site , the fluid go outside the blood and dilute the toxic agent and this is associated with less damage .
1. Increase the entry of antibodies :
when there is an infectious agent , plasma cells start making antibodies and in order to facilitate the antibodies to reach the microorganism and initiate the destruction of microorganism we need the antibody to attach to the target cell and that’s why inflammation partly is associated with vascular changes to increase the flow of the blood to the site of inflammation .
* When we gave the patient certain drug🡪 this will facilitate the drug to reach the site of action because the blood flow to that site of the inflammation is more .
* Inflammation will provide the deposition of fibrin protein :

Fibrin : a protein within the blood and the active part of it is the fibrinogen these proteins because of vascular changes will go outside the blood at the area of inflammation .

So at the area of inflammation there is a fluid full of some proteins like fibrin .

* What is the importance of fibrin ?

fibrin creates the site of inflammation and makes localization

At any site of damage the deposition of fibrin will facilitate the migration at the inflammatory cells to the site of inflammation and interrupt the inflammatory cells and the microorganisms .

Hence fibrin :

1. Facilitate the migration of the inflammatory cells that is needed to work at the site of inflammation .
2. Fibrin help us to make localization for the microorganism at the site of inflammation and facilitate the process of destruction .

At any inflammatory site , cells are under stress and we need to regenerate the inflammation site and this needs nutrition and oxygen in order to let the cells to regenerate .

And this also is provided by vascular changes at the site of inflammation 🡪 rapid blood flow at the site of inflammation 🡪 more nutrition and oxygen .

The presence of the microorganism stimulates the immune system in the blood and the immune cells should be in direct contact with the microorganism and recognize it in order to make the inflammatory response so the immune system will start making the anti-bodies in addition to this the immune system will stimulate other cells , so the inflammatory changes will help the immune system be build up and in the end the microorganism should be eliminated .

Inflammation also has harmful effects :

1. Depending on the severity we expect that the inflammatory process should end with complete elimination of microbes but sometimes the inflammation is sever .
2. The site of inflammation 🡪 contribute to this because certain areas of inflammation like skin commonly is associated with complete resolution because the regeneration capacity of the skin is different than the brain like meningitis this means that the inflammation is going to be something permanent .

However inflammation is associated with destruction and damage of certain cells by the enzymes of inflammation and micr organisms and so on .

In certain cases inflammatory reaction is associated with something serious

* Swelling which result from the movement of the fluids from the blood to the tissues , normally the amount of fluid that move to the tissue and present within the intracellular spaces are very low and due to inflammation there will be some changes in the cell wall which allow the fluids to enter the tissue and swell it ,and we can deal with it in most sites of the body .
* In certain sites when the tissue is presents within limited area within a small spaces and rounded by bone this can be very serious

In larynx inflammation which is associated with tissue swelling will obstruct the air ways and the swelling in this case is more serious than the inflammation process itself .

Let's talk about the brain which is enclosed by the skull ( bone ) so the swelling will make pressure of the brain against the bone and this pressure is very serious and can result in serious neural damage .

So at any case of brain injury the first thing we have to do is prevent the swelling in order to prevent serious complications and in case of uncontrolled brain swelling the skull will be opened .

Inflammation can be recognized clinically at any site so the features of inflammation is very important because nowadays we are lucky to have many kinds of antibiotics and the inflammation can be controlled in most of the times and because of symptoms ( swelling , redness ) we can recognize that this is an inflammation and it is not something else .

So symptoms of inflammation is very important because some of these changes can lead to tumors so , it is easier to have some inflammatory response rather than something very serious so we have to know the signs .

What are the signs of inflammation ?

1. Redness it is a special feature of inflammation ( the site of inflammations it is red because of the dilation of the vessels at the site of inflammation ) .
2. The vasodilation at the site of inflammation is associated with increasing in the temperature in case of **arthritis** the first thing happens is redness then swelling and skin on palpitation at the site of inflammation is higher in temperature than other areas this is something local .
3. Fever it is systemic not local inflammatory process specially infectious agents is associated with fever because for example the bacteria is able to release pyrogenes which reach the hypothalamus at the centers of heat and control it .