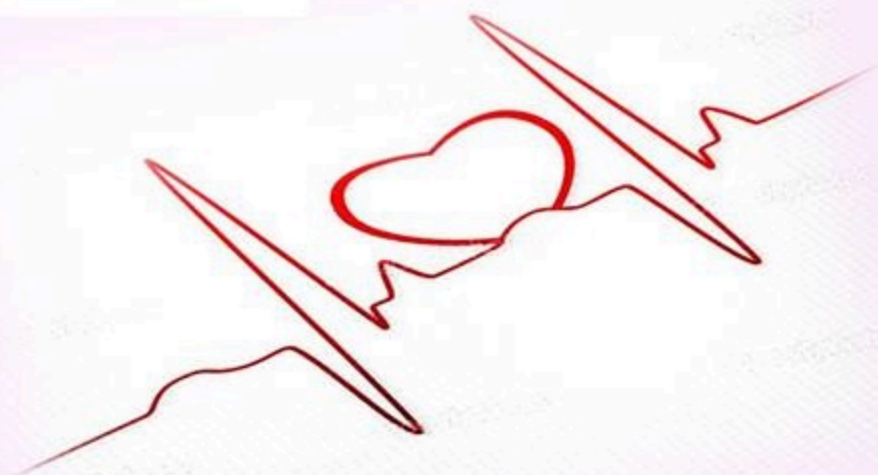




**SHEET**



**SLIDE**



**Lecture Number: 6**



**Doctor: Heyam Awad**



**DONE BY: Dyala Murad**



Designed By: Majida Al-foqaraa'

## Inflammation

**Before starting:** This lecture is one of the easiest and the most joyful (ask section 2) lectures in this course.

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### Our Doctor introduces herself and the topic that she is going to teach ...

"I am Dr. Heyam Awad – consultant histopathologist and associate professor in the faculty of medicine. I'm going to give you a series of lectures about **inflammation**. Today's lecture is going to be very simple, it's just an introduction because I need you to understand the basics of inflammation. If you understand the basics you can build on that. I'm not going to give you any details now. Today's lecture is simple but it's important because you can build on what we are going to say today.

Our reference is **Basic pathology by Robbins**. Most of the lectures of pathology most likely will be based on Robbins. I like to give the basic idea. **So understand not memorize!!** We don't need to memorize, we need to understand the basics. This what being a doctor is about. Information is everywhere, you can find it in all the books and read it but what we need is to understand the basic concepts. OKAY???

You can ask about anything you feel you need to ask about, there are no silly question, and even outside the lecture, if you read something in a book or internet and you want to know more about, feel free to come and ask me. "

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So we will talk about **inflammation**, what do you think this word come from?

It came from "**flame**".

بالعربي inflammation تعني التهاب من اللهب

So inflammation means flame and this give an idea of what an inflammation is. It's a certain response and one of its symptoms is heat and it causes a lot of changes in our bodies, cells, and tissues (we will describe it later)

So far, inflammation came from flame. It's from Latin word which mean lighten up or ignite.

**There's a difference  
between inflammation  
and infection!!!**



## What is inflammation????

In your daily life, what type of inflammation do you know???

**Tonsils** inflammation → **Tonsillitis**

Inflammation of **pancreas** → **Pancreatitis**

Inflammation of **appendix** → **Appendicitis**

Inflammation of **liver** → **Hepatitis**

Inflammation of **gallbladder** → **Cholecystitis**

Inflammation of **kidney** → **Nephritis** (it's not kidnietis. :D)

Inflammation of **stomach** → **Gastritis**

Inflammation of **small intestine** → it depends if it in **duodenum: duodenitis, ileum: ileitis...**

You can recognize a pattern for these names; they all end with **-itis** which means inflammation. But not all inflammation ends with **-itis**, for example: **Pneumonia** is the name of **lung** inflammation.

**Any words that end with -itis means inflammation but not all inflammations' names end with -itis.**

So far, we know some examples of inflammation, we can build up a definition of inflammation. Let's take **tonsillitis** as an example, what is the cause of tonsillitis???

Some body infections.

**Necrosis : it's a result of cell injury and means a cell ( tissue) death.**

**Causes of inflammation:-**

- 1) Infection** → is one of the causes of cell injury. Anything causes cell injury cause inflammation.
- 2) Traumatic physical injuries** → trauma: if you injured you will notice inflammation condition. Other example of physical injuries cause inflammation is: **ingrown nail.**

**3) Chemical causes** → including: smoking, alcohol, toxins..... Etc

**Anything that cause cell injury cause inflammation**

## What is the purpose of inflammation?????

It's a defense mechanism in our bodies to get rid of the injury.

**Inflammation is not a disease.** It's a mechanism in our bodies aimed to getting rid of injury agents or insult. It's very important.

### Inflammation definition

Protective reaction in vascularised tissue to eliminate causes of cell injury and the necrotic tissues resulting from the initial insult.

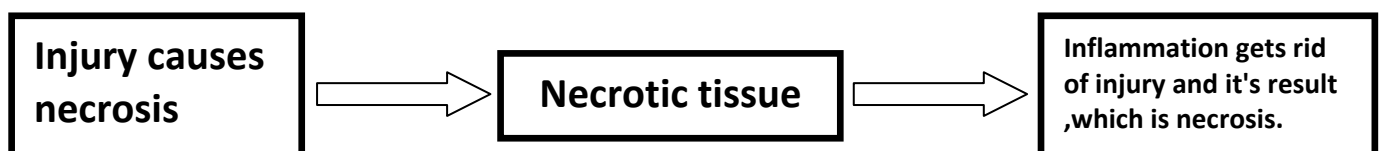
### Explanation:

Is there any tissue not vascularised in the body?

There's no unvascularised tissue in our body. Because all our tissues need Oxygen and nutrients and these come through blood and blood vessels. It's always in any book you read, you find "vascularised tissue", although there's tissue is unvascularised, so why we use this word????

Because all of the agents, that are responsible for inflammation, are present in the blood. Blood is very important. Blood is very important for inflammation, that's why we put this word although it's not logic to use it because all our tissues are vascularised.

So the purpose of inflammation is to eliminate cause of injury cell. This fact explain the statement that said: "**Anything that cause cell injury cause inflammation**"



Patient in case of inflammation has signs and symptoms. If inflammation is a protective mechanism, why there're signs and symptoms?

Because, in the case of inflammation, our body is fighting. **It's a collateral damage simply.** When you fight infection or anything there's collateral damage. Inflammation as mentioned is something to protect us. It's a fighting mechanism, protective mechanism. But during this mechanism some of this protection causes problems in the body. **(It's just a collateral damage caused by the endogenous/exogenous chemicals released by the cells responsible for this inflammation)**

## So what are the signs and symptoms of inflammation?????

\*note: the Doctor said this question will come in the exam.

Look at the picture below:



This is an example of inflammation in the toes; you can notice redness, swelling (edema). It will be painful and hot. The patient also will suffer some loss of function.

### The symptoms and signs of inflammation:

Swelling → *tumor*

Redness → *rubor*

Hotness → *calor*

Pain → *dolor*

Loss of function → *functio laesa*

The first four are the most important and were described more than 2000 years ago by a Roman encyclopedist named Celsus. The fifth was added in the late 19<sup>th</sup> century by Rudolf Virchow (father of modern pathology)

So inflammation cause collateral damage and can cause problems. **It can cause pulmonary disease, for example:**

**A) Tuberculosis (TB):** chronic inflammation caused by bacilli which is an injection.

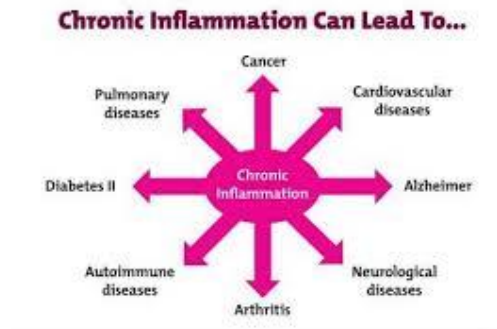
**B) Emphysema:** smoking is the most common cause of **emphysema and Bronchitis.**

**C) Asthma:** It's caused by allergy and allergy condition cause inflammation.

Extra information (not mentioned in the lecture)

**Tuberculosis (TB):** a special type of bacteria which can cause chronic pneumonia. It is highly contagious and can be passed **person** to person. If you suspect you've been exposed to TB you should notify your doctor immediately. Often those exposed will not develop pneumonia immediately and we treat these patients prior to them developing a true infection. For more information about tuberculosis please refer to the [Ben Franklin TB clinic.](#)

**Don't forget that everything cause cell injury cause inflammation!!!!**



You won't be wrong if you say: "**the result of any disease is inflammation**". Inflammation will be involved to a certain point.

**Chronic inflammation causes autoimmune diseases** like: **Rheumatic disease**, autoimmune disease in intestine (cause Diarrhea) → **Crohn's disease**

Strangely, **chronic inflammation causes cancer**. For example:

- **Gastritis** is an inflammation and if it causes atrophy it well end with cancer.

- **Gallbladder** cancer: one of its causes is stones which cause inflammation.

Smoking causes metaplasia which causes cancer !!!  
(not caused by inflammation.)

\*note: the Doctor said this question will come in the exam.

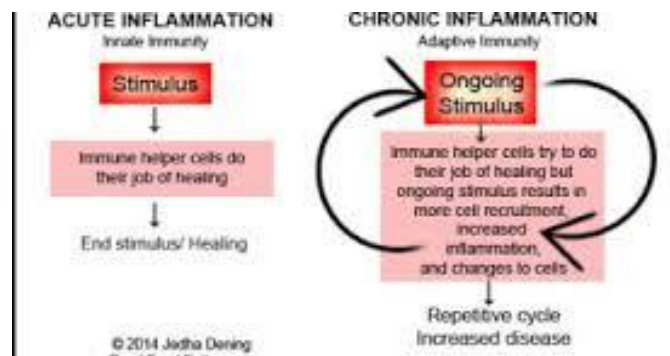
It's not strange that inflammation can cause any problem, although it's a protective mechanism. Again, it's not a disease but can cause any problem in the body, OKAY???

**\* The difference between inflammation and infection:-**

People always mix between them but infection is different from inflammation

**Infection** is always caused by a pathogen, such as: bacteria, virus, and helminthes...etc and the result of that is **inflammation**. Whereas **inflammation** is caused by many things that include **infections**.

**Inflammation** is a protective mechanism. That means: if someone get a disease → his body will react → he will have some collateral damage → but eventually, his body will get rid of the injury and he will be cured. **This is a story of acute inflammation.**



**Acute inflammation** have a stimulus (like: infection) → this will cause an immune response → will end with healing (this is the end of the story of acute inflammation). However acute inflammation does not always end in cure or healing, it may end in chronic inflammation or sometimes abscess formation.

**So there are three outcomes of acute inflammation:**

- 1) Healing
- 2) Abscess formation
- 3) Developing into chronic inflammation

**Chronic inflammation** can start as acute inflammation which is not resolved. **Why sometimes acute inflammation doesn't resolve????**

Because the stimulus is still there. If the body does not get rid of the stimulus like the autoimmune disease for example the acute will become chronic disease. What happens in autoimmune diseases is that: immunity of body recognizes part of the body as non-self (foreign) and starts causing immune responses against it. In this case the stimulus is part of the body (like: body proteins). The body will never get rid of it (stimulus). So it's a continuous process. It becomes a repetitive cycle of inflammation.

Sometimes chronic inflammation starts as chronic (not as acute then chronic) like: chronic disease, such as: celiac diseases. All the autoimmune diseases are started as chronic from the beginning. There's no cure from these diseases but we can control them!!!

Sometimes the cause of chronic inflammation is infection which the body cannot get rid of it. In this case we can cure but the infection stays in the body and it can stimulate later. **Examples of chronic inflammation**

**TB:** the bacteria stay in the body. Bacterial infection is different from Fungi. In the case of Fungi: the body gets rid of it but it can come back again

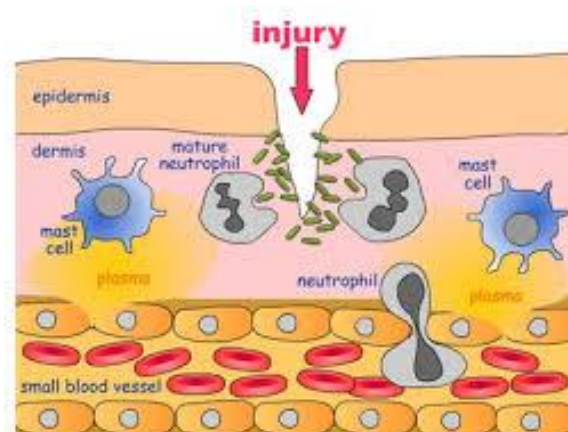
**Gastroenteritis:** patients get cure after giving them three drugs. But if any patient still eats crisps he will get it again!!!!

**Hepatitis:** chronic inflammation caused by a virus in our bodies.

**TB and hepatitis** are very important infection cause **chronic inflammation.\***

So far, we know the difference between acute and chronic inflammation and the cause of both. Let's touch the mechanisms (we will not have much detail here. Just overview to what we are going to talk about after Eid ALAdha). These are things that happen in inflammation due to **mediators**. The story is:

There's a stimulus → body will respond → the response is through chemical agents in our body which we call them **mediators of inflammation** → these mediators cause all the cascade of events that lead to result which can be: healing or chronic inflammation. This same thing which are responsible for the collateral damage.





### \* Vasodilatation

If you have an injury the first thing that happened is vasodilatation. The blood vessels respond by dilatation, WHY???. To bring more blood and cells to the area and provide chemical agents which are important for the inflammatory response. So vasodilatation is caused by lot of things (prostaglandin and nitric acid) which come from body cells.

### \* Increased vascular permeability

What is vascular permeability? Why we need it???

Vascular permeability is exchange of materials. We need to exchange material between blood and the injured tissue, this happens through increase permeability. There're lot of mediators that cause this. The most important one is **histamine** (cause lots of thing). Other chemical agent is **chemotaxis**, what's meant by chemotaxis????

Chemo means chemical, taxis means something that attract (the cell call each other to come). So other cells are stimulating to the area of injury. That why we start with neutrophils and then we end with lots of other cell (will be explained later). Some types of infections actually release chemical substances which induce chemotaxis, so they're actually signaling for the body cells to come to kill it.

### \* Pain

Pain is one of the symptoms of inflammation. It caused by **Prostaglandin** and **Bradykinin**

### \* Fever

Heat of the inflamed area is one of inflammation symptoms. But also fever of all body is caused by chemical agent released by inflammatory cells

## \* Tissue damage

Inflammation is aimed to get rid of tissue damage but still inflammation causes tissue damage and this is caused by two important cells you need to know: **neutrophils** and **macrophages**.

The idea of slide#15, which was explained above, is to understand that inflammation is caused by chemical agents and cells. All these chemical agents come from inflammatory cells. So the main thing is the cells which synthesize and release the chemical agents.

Let's have an idea of what happen to the cells. The pictures below represent the **Neutrophils**

Neutrophils are already present in the blood, during inflammation response they migrate to the area of inflammation. To act these cells need to go from the capillaries (from the blood) to the tissue. In normal situation this doesn't happen, normally white blood cells are present in the blood and don't go out. But for inflammation, they need to go out to tissue. So they first migrate and become near to endothelium.



Blood vessels are tube-like and these cells go to the side of the tube exactly as we go to the door in order to leave the room. **This is called margination** (they go to the margin). THAT'S NUMBER ONE!!!

NUMBER TWO is **rolling**, they change a bit their shape to be suitable with receptors (key and lock theory). They need certain receptors to bind with endothelial cells, so they can go out (migrate) and they cause chemotaxis throughout stimulus (we will discuss these details later in coming lectures)

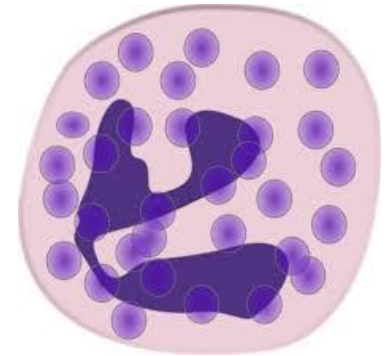
### **The importance of neutrophils:**

Neutrophils are the first line of defense, that's why in acute inflammation we only have the neutrophils and then, at the later stages, macrophages come (we will discuss why later) but the first line of defense is neutrophils. So it's the most important cell in inflammation. **In acute inflammation the only cells we have are neutrophils and**

**monocytes (tissue macrophages). NO OTHER CELL IS SEEN IN ACUTE INFLAMMATION!!!**

**The shape of neutrophils:-**

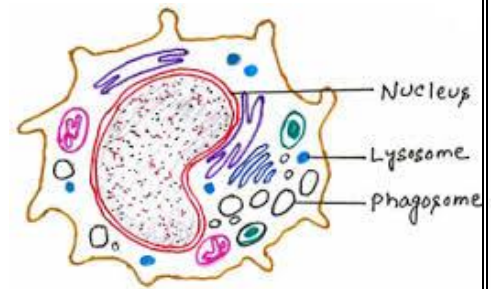
- The nucleus has 3 lobes
- Dots in cytoplasm represent granules. These granules have the inflammatory agents (chemical agents) which are released from these granules.



The following picture represents the second important cell in inflammation which is **monocyte (macrophage):-**

**How do you know that's macrophage????**

- Morphology of nucleus.
- Number of lysosomes
- Engulfment that happens within macrophage. For this reason, macrophage is important in both acute and chronic inflammation

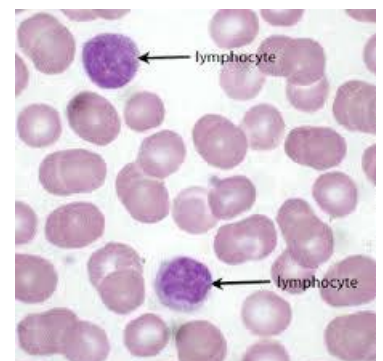


The one cell that we can see in both acute and chronic inflammation is macrophage because it engulfs the agents and the tissue which are destroyed (necrotic tissue).

**Lymphocyte**

**The shape of lymphocyte:-**

- Big nucleus and very little cytoplasm.
- No granules → which means they don't secrete substance.



Big nucleus means that it has a lot of genetic material encoded to generate antibodies. There're two types of lymphocyte: B and T

Both T and B lymphocytes are produced in bone marrow, but B lymphocytes mature in bone marrow and are part of the humeral response, while T lymphocytes mature in the thymus gland and are part of the cell mediated response.

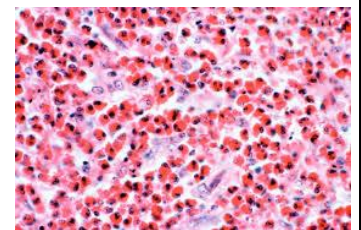
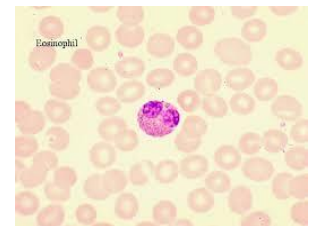
**Plasma cell** has nucleus at the top or at the margin and lots of cytoplasm. B-lymphocyte has a big nucleus and very little cytoplasm because they have the genetic material responsible for secreting antibody. When B-lymphocyte changes to Plasma cell, the cell shape will change because of the need to synthesis and store antibodies inside it. Plasma cell nucleus is small and there's a lot of cytoplasm. And this is the explanation of the difference of morphology between lymphocyte and plasma cell.

Plasma cells' nucleus is clock-shaped. Because genetic material arrange in the nucleus to secrete antibodies (heterochromatin).

## Eosinophils

In which types of inflammation we see eosinophil??

Eosinophil is an important cell. It can be seen in cases of allergy and parasites infection. It secretes **histamine** which cause the symptoms of allergy like: redness and itching.



So far, we know all cell types that are seen in inflammation: neutrophil (acute inflammation only), macrophage (both acute and chronic inflammation), lymphocyte and plasma cell (between immunity and inflammation), eosinophil and sometimes basophil (less than others). After Eid we will have more details.

Interesting websites:

- Chronic pulmonary infection.

<http://lungcenter.osu.edu/specialtyprograms/chronicpulmonaryinfections/>

- Autoimmune digestive disorders.

<http://www.everydayhealth.com/autoimmune-disorders/autoimmune-digestive-disorders.aspx>

Don't lose hope. Everything happens for a reason.

You never know what tomorrow may bring.

تقبل الله طاعاتكم  
أضحى مبارك وكل عام وأنتم بخير

Your colleague: Dyala Murad Al-Frigat ☺