

Pathology

Done by •Nehaya +sabaa.....

lecture no. 21.....

Checked by: Baraa Safi

Fat Embolism

الأسئلة :
history :
of car accidents
& fraction &
symptoms of
embolism

Caused by:

- Soft tissue crush injury or long bone fractures, with release of microscopic fat globules into the circulation.
- Presumably, the fat is released by marrow or adipose tissue injury & enters the circulation by rupture of the marrow vascular sinusoids or rupture of venules. Although traumatic fat embolism occurs in some 90% of individuals with severe skeletal injuries , fewer than 10% of such patients show any clinical findings
- **Causes of fat embolism include**
 1. **Fracture of long bones**
 2. **severe burn**
 3. **severe fatty liver causing liver cirrhosis**
 4. **oily intravenous injections (mismanagement)**
 5. **surgical operations (liposuction)** (يمكنه عملية جراحية مثلا)

Fat embolism syndrome:

- a. **Pulmonary insufficiency** (tachypnea, dyspnea) **نفس سريع** snortness of breath **ضيقه النفس**
- b. **Neurologic symptoms** (irritability and restlessness to coma)
- c. **Anemia, thrombocytopenia.** **ال fat يرتبط مع RBC& platelets ويعمل hemolysis**
- d. **Diffuse petechial rash** **72 hours**

Typically, the symptoms appear 1 to 3 days after injury with sudden onset of symptoms



Fat Embolism

Pathogenesis: السبب

■ Mechanical theory:

- Mechanical obstruction by microemboli of neutral fat + platelet & RBC aggregates ثرومبوس زي ال

■ Intravascular coagulation theory: بس mainly مكون

- Chemical irritation (local injury to endothelium) from release of fatty acids + platelet activation & recruitment of granulocytes –release of free radicals, protease & eicosanoids → DIC من fat

fatty embolism syndrom



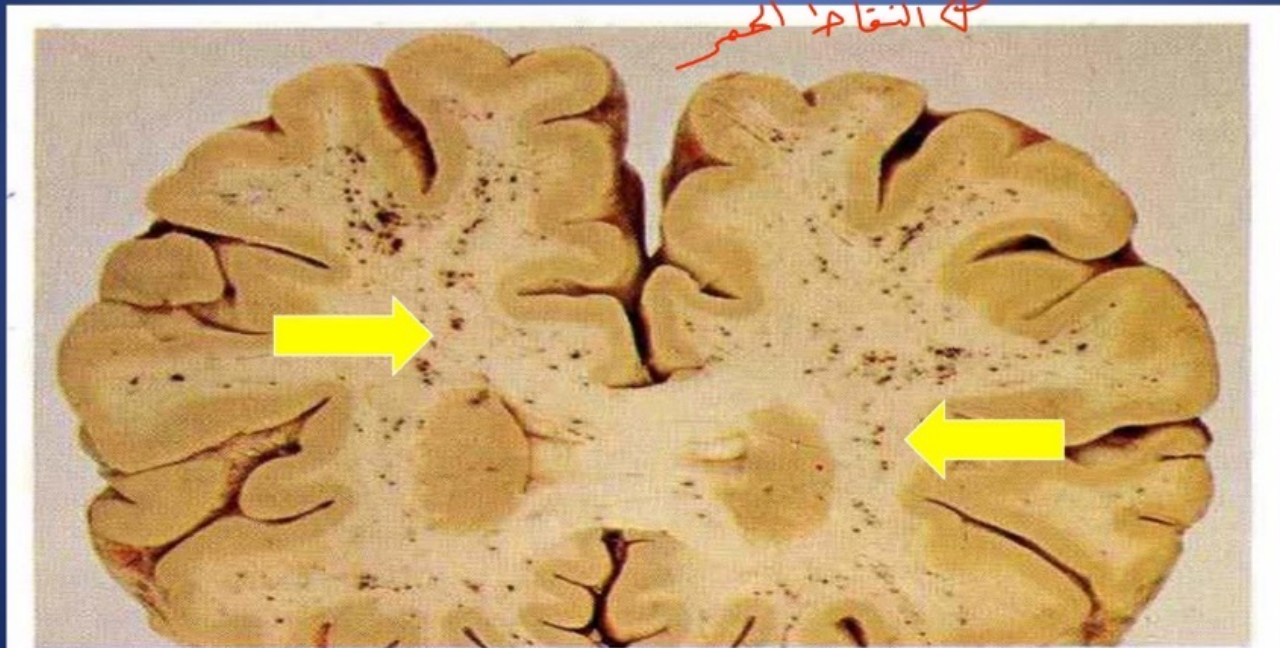
- a characteristic petechial skin rash is related to rapid onset of thrombocytopenia, presumably caused by platelets adherence to **the myriad (tens of thousands) fat globules** & being removed from the circulation.
- Adherence of platelets 
Thrombocytopenia (low platelet count) 
Bleeding tendency (petechial hemorrhage)



Figure 50 - Fat embolism: Brain. Before his death, the patient had a fractured femur .At PM, coronal section of the frontal brain region shows (multiple small hemorrhagic foci scattered) throughout the white matter.



9.30 Fat embolism : brain

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السائل المحيط بالجنين ← Amniotic Fluid Embolism

بالعادة ال circulation للأم والجنين ما يرتبطوا مع بعض

- ❑ Introduction of amniotic fluid and its contents to the **maternal circulation** via a tear in the placental membranes and rupture of uterine veins during childbirth

*اللي بصير انه يدخل ال amneotic على ال circulation تبع الأم وبالنسبة لجسم الأم هاد اشني غريب فراح يصير anphylactic shack

- ❑ Rare (1 in 40,000 deliveries), but carries 80% mortality rate

ليه مع انها نادرة إلا انه معدة الوفيات فيها عالي جدا

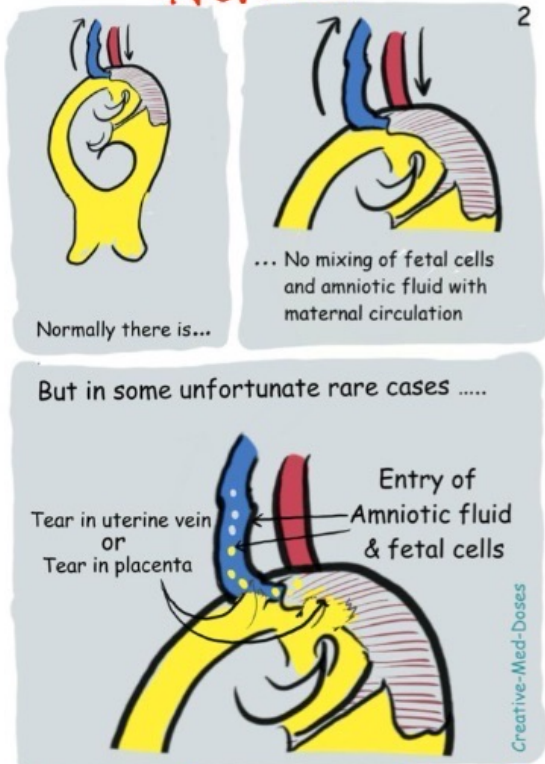
- ❑ **Manifestations:** Respiratory failure (sudden severe dyspnea, cyanosis, and hypotensive shock), seizures, and coma

Elements of baby's amneotic fluid

- ❑ **Histologic analysis:** squamous cells shed from fetal skin, lanugo hair, and mucin derived from the fetal respiratory or gastrointestinal tracts present in the maternal pulmonary microcirculation

شعر الزغب (الوير)

Normal



بقرون تكرار الأوعية الدموية / يمكنه ترويح تعمل cascade
عنه طريقه الـ (external path) (F10) ثمر
بصعل (Thrombosis)

Amniotic Fluid Embolism

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هو واء بال (blood vessels)

Air embolism

- Source: air may enter the circulation
- (1) during obstetric procedures (tubal insufflation)
- (2) as a consequence of chest injury (stabbing) or neck stabbing by sharp tool causing puncture of internal jugular vein . Or artificial pneumothorax during operation.
- (3) miss management of intravenous infusion . (بلا نعطي اشئ بال (vein) مثلاً (Cannula) فإس نغزغ الرصوا ومن المحلول هو من ما يتغزغ)
- (4) Scuba diving (صعوم رصايه الكمة اللى بصعل (Air embolism) و بصوت) ح
- Generally, **in excess of 30-50 mL** of air is required to produce a clinical effect; the air bubbles act like physical obstruction (just as thromboembolism & causing distal ischemic injury), bubbles may coalesce to form frothy masses sufficiently large to occlude major vessel

Decompression sickness

- Decompression sickness is a particular form of gas embolism, which occurs when individuals are exposed to sudden changes in atmospheric pressure. Scuba (under water breathing apparatus users) deep sea divers, underwater construction workers, & individuals in unpressurized aircraft in rapid ascent are at risk .

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- When air is breathed at high pressure (e.g., during a deep sea dive) → increased amounts of gas (particularly nitrogen) become dissolved in the blood & tissues.
- If the diver then ascends (depressurizes) too rapidly, the nitrogen expands in the tissues & bubbles out of solution in the blood to form gas emboli.
- Clinically, the rapid formation of gas bubbles within skeletal muscles & supporting tissues in & about joints is responsible for the painful arching of the backs, condition called (the bends)

مهم

تفوس

- Gas emboli may also induce focal ischemia in a number of tissues, including brain, heart, & in the lungs where it may lead to respiratory distress, called the **chokes**. (بصير اختناق)
- Treatment of gas embolism consists of :
 1. placing the individual in a **compression chamber**, where the barometric pressure may be raised, thus forcing the gas bubbles back into solution.
 2. Subsequent, slow decompression, theoretically permits gradual resorption & exhalation of the gases so that obstructive bubbles do not reform.
- A more chronic form of decompression sickness is called **Caisson disease**, in which persistence of gas emboli in the bones leads to multiple foci of ischemic necrosis; the commonest sites are the heads of the femur, tibia, & humeri

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INFARCTION

- Infarct: area of **ischemic necrosis** caused by **occlusion of vascular supply** in a particular tissue.
- **Arterial thrombosis or arterial embolism** underlies the **vast majority of infarctions**.
(العظمية العظمى)
- **Venous thrombosis** can cause infarction, but it more often induces venous **obstruction and congestion**.
(تجمع blood & edema)
- Infarcts caused by venous thrombosis thus usually occur only in organs with a single efferent vein (e.g., testis or ovary).

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INFARCTION

- Infarcts are classified on the basis of their **color** (reflecting the amount of hemorrhage) and the presence or absence of microbial infection:
- **Red (hemorrhagic)**
- **White (anemic)**
- **Septic.** α septic
فيه بكتيريا مانه بكتيريا

Red infarcts

→ Cause the death of ovary

(1) **With venous occlusions** (such as in ovarian torsion).
التواء
hemorrhagic infarction مع انه عندي arterial supply لسنا عندي

(2) In **loose** tissues (such as lung).

(3) In tissues with **dual** circulations such as lung and small intestine. = collection of blood
في الحالة الطبيعية انا
عندي أكثر من
artery يغذي هاي المنطقة
لو وقف سير الدم بواحد
منهم الثاني يغذي المكان
بس بس الي بصير انه
التسكير لال emboli

(4) In tissues that were previously congested because of sluggish venous outflow.
البضوء

(5) When flow is **re-established** to a site of previous arterial occlusion.

* اللون بين red لانه يكون coronary arteries مسكرة فبالتالي انا راح احط شبكيه بمنطقة infarcted

لانه ال coronary arteries مسكرة فما حيوصل blood supply فحيكون عنا aschemia فانا راح احط

شبكيه في منطقة infarcted اصلاً فبالتالي راح يوصل blood supply لمنطقة ميتة فراح بين red

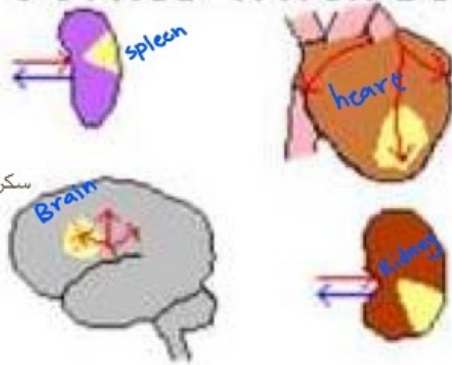
artery يغذي هاي المنطقة
لو وقف سير الدم بواحد
منهم الثاني يغذي المكان
بس بس الي بصير انه
التسكير لال emboli
يكون sudden ما بلحق
الثاني يغذي المنطقة
فبصير hemorrhagic
infarction

Red infarcts

Spongy organs

White Infarcts

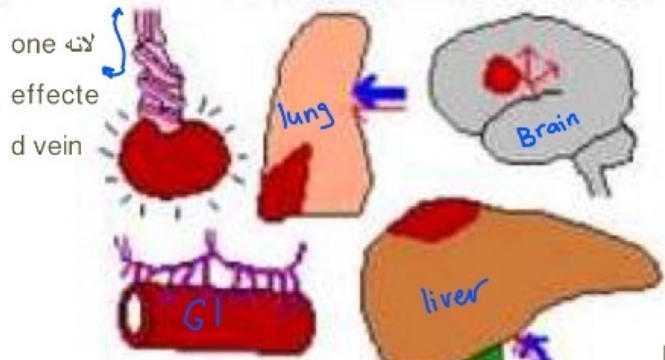
* عادة بتصوير
بال solid organs
* فيها end arteries لو
سكرت فمش غيرها يغذي المنطقة



Arterial Insufficiency
AND
Not Reperfused
AND
Single Blood Supply

twisted
ovary

Red Infarcts



Venous Insufficiency
OR
Reperfused
OR
Dual Blood Supply

Etiology
(reasons)
←



شكلة (زيبه) (wedge-shape)

Figure 54 -Lung infarction. There is lower lobe, sub-pleura, pale pink, **wedge-shaped infarct**. The infarct is swollen, with raised pleural surface over it, & **is surrounded by a dark-red congested border**.

7.38 Infarction: lung

White infarcts

base
V
apex
shaped

- Occur with **arterial occlusions** in **solid organs** with end-arterial circulations (e.g., **heart, spleen, and kidney**)
- Where the solidity of the tissue limits the amount of hemorrhage that can seep into the area of ischemic necrosis from the adjoining capillary beds

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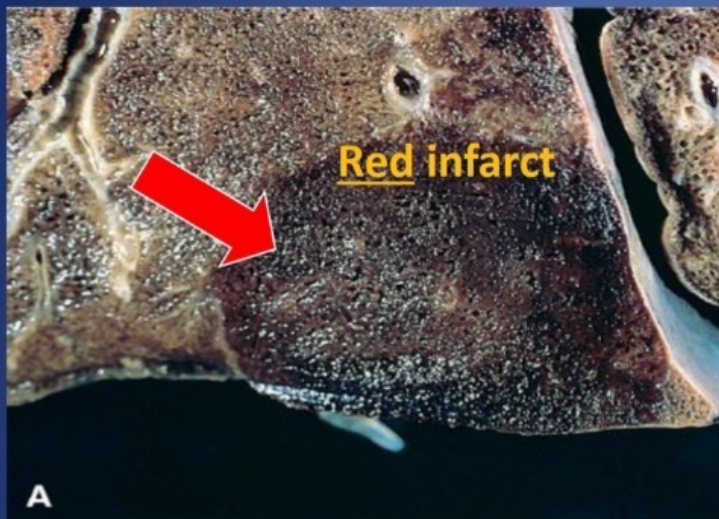
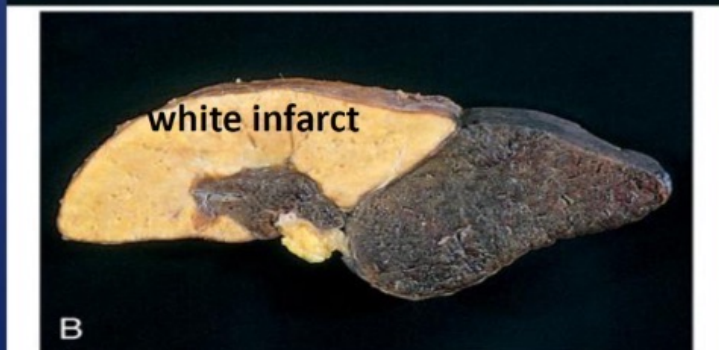


Fig. 55 : A, Hemorrhagic wedge-shaped **pulmonary** (red infarct).



B, Sharply demarcated pale infarct in the **spleen** (white infarct).

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Infarction

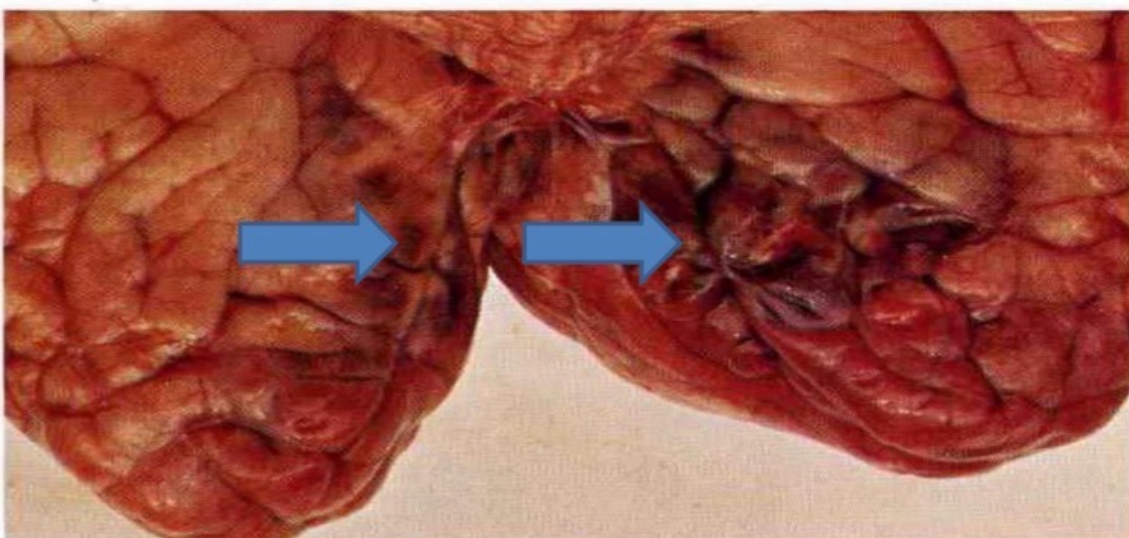
معد

- Infarcts tend to be wedge-shaped, with the occluded vessel at the apex and the organ periphery forming the base
- The main histological finding: ischemic coagulative necrosis, except the brain, in which liquefactive necrosis occurs.

in solid organs

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F 56 : Infarction: Brain. The patient had tentorial herniation obstructing the posterior cerebral arteries, which results in recent hemorrhagic infarction of the infero-medial aspects of both occipital lobes .



9.47 Infarction: brain

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Shock

- Definition: Systemic hypoperfusion and reduced oxygen delivery due to either reduced cardiac output, or ineffective circulatory blood volume.
- is a life-threatening medical condition and is a medical emergency. If shock is suspected call 911 or get to an emergency department immediately.
- Results of shock:
 - Hypotension, impaired tissue perfusion. cellular hypoxia.
 - The main symptom of shock is low blood pressure. Other symptoms include rapid, shallow breathing; cold, clammy skin; rapid, weak pulse; dizziness, fainting, or weakness.



Shock

blood supply for all organs

- Definition: **Systemic hypoperfusion** and reduced oxygen delivery due to either reduced cardiac output, or ineffective circulatory blood volume.

• طبيب أولاً بدك تعرف انه ال blood pressure يعتمد على

شغلتين: ال resistance وال cardiac output

- Results of shock:

في حال قل ال vasodilation ال resistance راح يقل فبالتالي يقل ال BP

• طبيب عندك ال cardiac output وهو العامل الثاني الي يعتمد عليه ال BP هاد يعتمد على

حاجتين برضه ال heart rate وال volume في حال قل اي منها يقل ال cardiac output فيقل ال BP

– hypotension.

– impaired tissue perfusion.

* في حال عندي (heart attack) MI العضلات راح تموت فيقل

– cellular hypoxia.

ال contraction فيقل ال volume فيقل ال cardiac output وبقل ال BP

sympathatic --> epiniphrine --> vasoconstriction

- There are tow mechanisms to increase BP :



kidney --> renin --> *vasoconstriction

*vasoconstriction

* Na & water retention

Major types of shock

- **Cardiogenic shock:** results from low cardiac output due to myocardial pump failure.
- **Hypovolemic shock:** results from low cardiac output due to loss of blood or plasma volume (e.g., due to hemorrhage or fluid loss from severe burns).
- **Anaphylactic shock** , caused by hypersensitivity or allergic reaction (ممكنا بسبب قرصة نحلة)
- **Neurogenic shock**, Neurogenic shock is caused by spinal cord injury, usually as a result of a traumatic accident or injury. (مرتبط بال (spinal cord))
- **Septic shock**
Bacterial infection

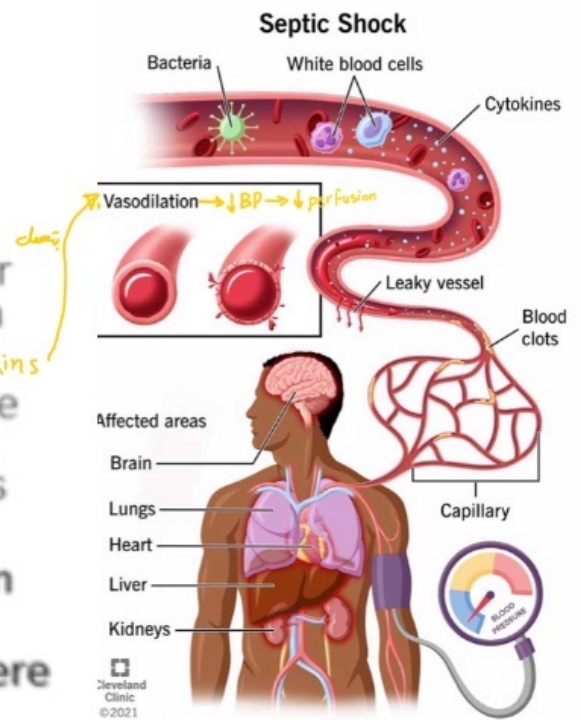
Vasovagal syncope

- Vasovagal syncope is the most common cause of fainting^{الإغماء}.
- It happens when the blood vessels open too wide or the heartbeat slows, causing a temporary lack of blood flow to the brain.
- It's generally not a dangerous condition. To prevent fainting, stay out of hot places and don't stand for long periods.



Septic shock

- High mortality rate
- is a life-threatening condition that happens when your blood pressure drops to a dangerously low level after an infection. Any type of bacteria can cause the infection.
- **Gram-positive bacteria** constitute the most common cause of septic shock, followed by gram-negative organisms and fungi.
- Systemic arterial and venous dilation leads to tissue hypoperfusion.
- Septic shock is the last and most severe stage of sepsis. Sepsis occurs when your immune system has an extreme reaction to an infection. The inflammation throughout your body can cause dangerously low blood pressure. You need immediate treatment if you have septic shock. Treatment may include antibiotics, oxygen and medication.

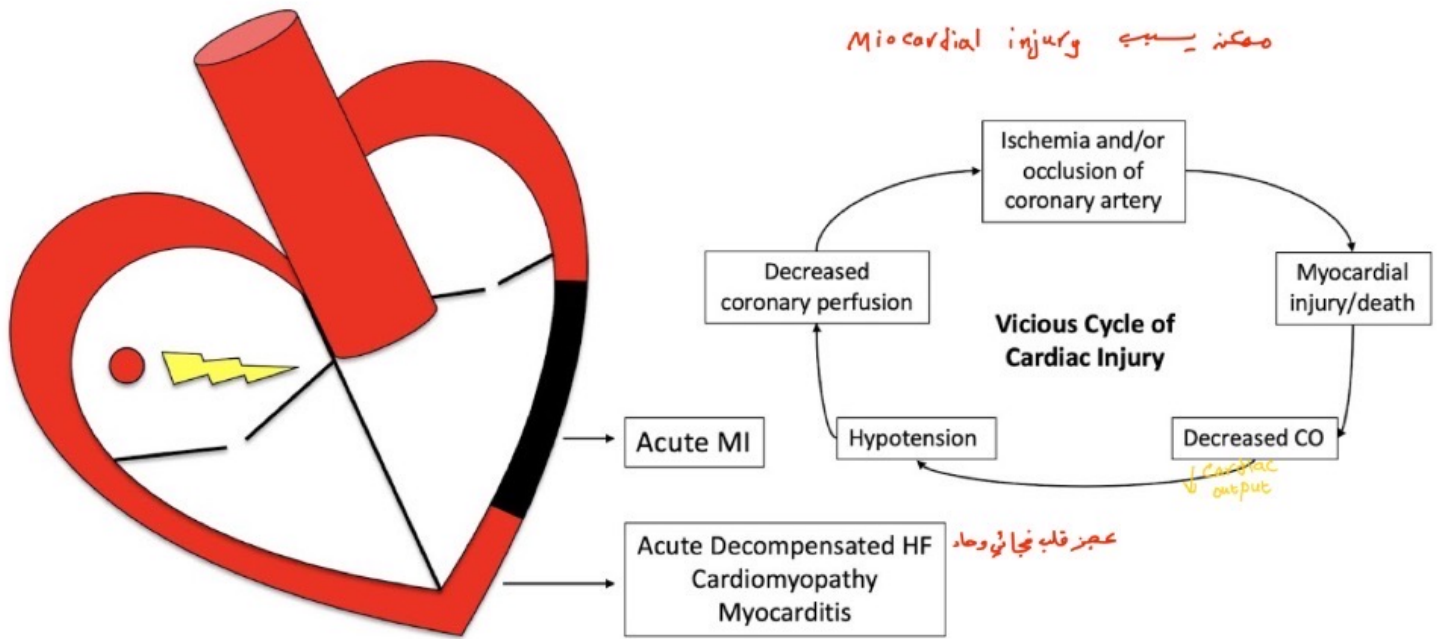


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Septic shock

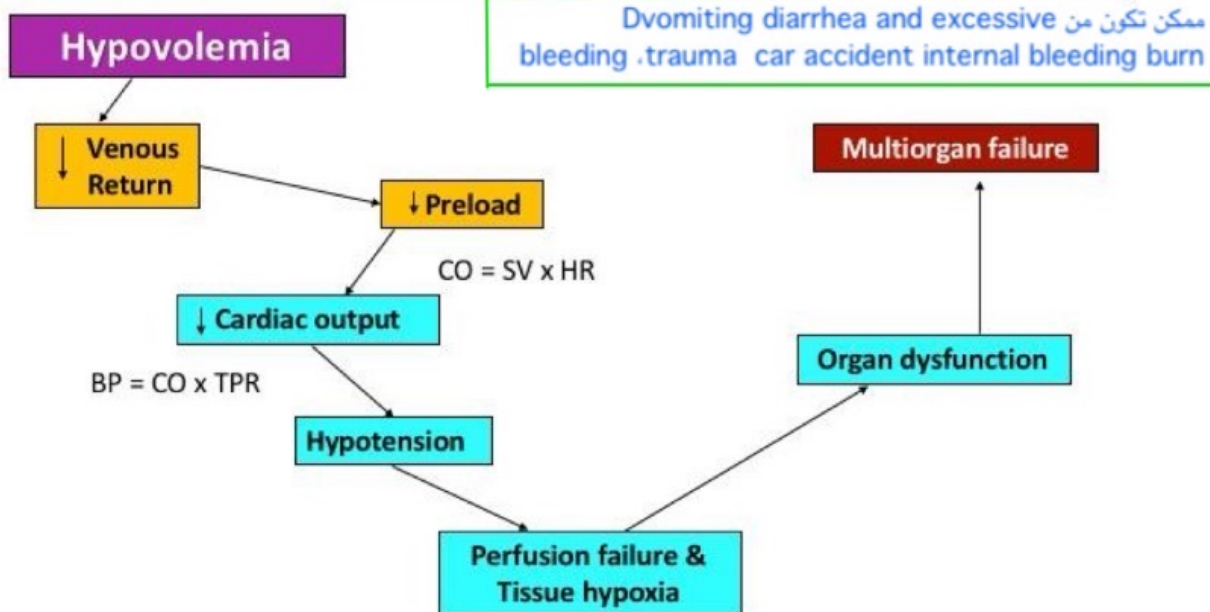
- Pathogenesis :An inflammatory stimulus (eg, a bacterial toxin) triggers production of pro-inflammatory mediators, including **tumor necrosis factor (TNF)** and **interleukin (IL)-1**. *Cause ↓bp + ↓perfusion*
- The septic response may accelerate due to continued activation of neutrophils and macrophages/monocytes.
- Upregulation of lymphocyte molecules and rapid lymphocyte apoptosis, delayed apoptosis of neutrophils, and enhanced necrosis of cells/tissues also contribute to the pathogenesis of sepsis.

Cardiogenic Shock



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Pathophysiology of Hypovolemic shock



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الشاب يكون ال shock عنده أشد من الكبير لوزنه الشب بتحمل ترقه الجسم

Stages of Shock

Shock is a progressive disorder that leads to death if the underlying problems are not corrected

١ - الجسم قادر على أنه يرجع وضعه للوضع الطبيعي

- **Non-progressive phase: Compensatory mechanisms maintains perfusion of vital organs.**

- Epinephrine
-renin_A

- **Progressive phase: Tissue hypoperfusion with metabolic and circulatory worsening.**

(الجسم ممكن يرجع بس هو دخل في مسار ال
(Metabolic disturbances)

- **Irreversible stage: Severe irreversible tissue and cellular injury that even if the hemodynamic defects are corrected, survival is not possible**

حتى لو عالجنها رح يصير Sever irreversible changes

- The clinical manifestations of shock depend on the precipitating insult. *(Gastric ab sit and collaps / Diabetes / Hypertention / collaps) ممكن يكونه عنه*
- In hypovolemic and cardiogenic shock: hypotension, a weak rapid pulse, tachypnea, and cool, cyanotic skin. *توضيح ما Periphries عم يوصلهم دم*
- In septic shock: the skin may be warm and flushed owing to peripheral vasodilation.

Prognosis varies with the origin of shock and its duration. *التشخيص* **leukaemia, AIDS, TB, immunocompromised or lymphoma** *ممكن يكونه بسبب*

- More than 90% of young, healthy patients with hypovolemic shock survive with appropriate management

high infection *death of muscle*
 • Septic or cardiogenic shock is associated with substantially worse outcomes *ما يتعالج بأي antibiotic بسببه أكثر من microorgani*

Treatment

- Septic shock is treated with antibiotics and fluids.
- Anaphylactic shock is treated with diphenhydramine (Benadryl), epinephrine (an "Epi-pen"), and steroid medications (solumedrol).
- Cardiogenic shock is treated by identifying and treating the underlying cause.
- Hypovolemic shock is treated with fluids (saline) in minor cases, and blood transfusions in severe cases.
- Neurogenic shock is the most difficult to treat as spinal cord damage is often irreversible. Immobilization, anti-inflammatories such as steroids and surgery are the main treatments.
- Shock prevention includes learning ways to prevent heart disease, injuries, dehydration, and other causes of shock.

