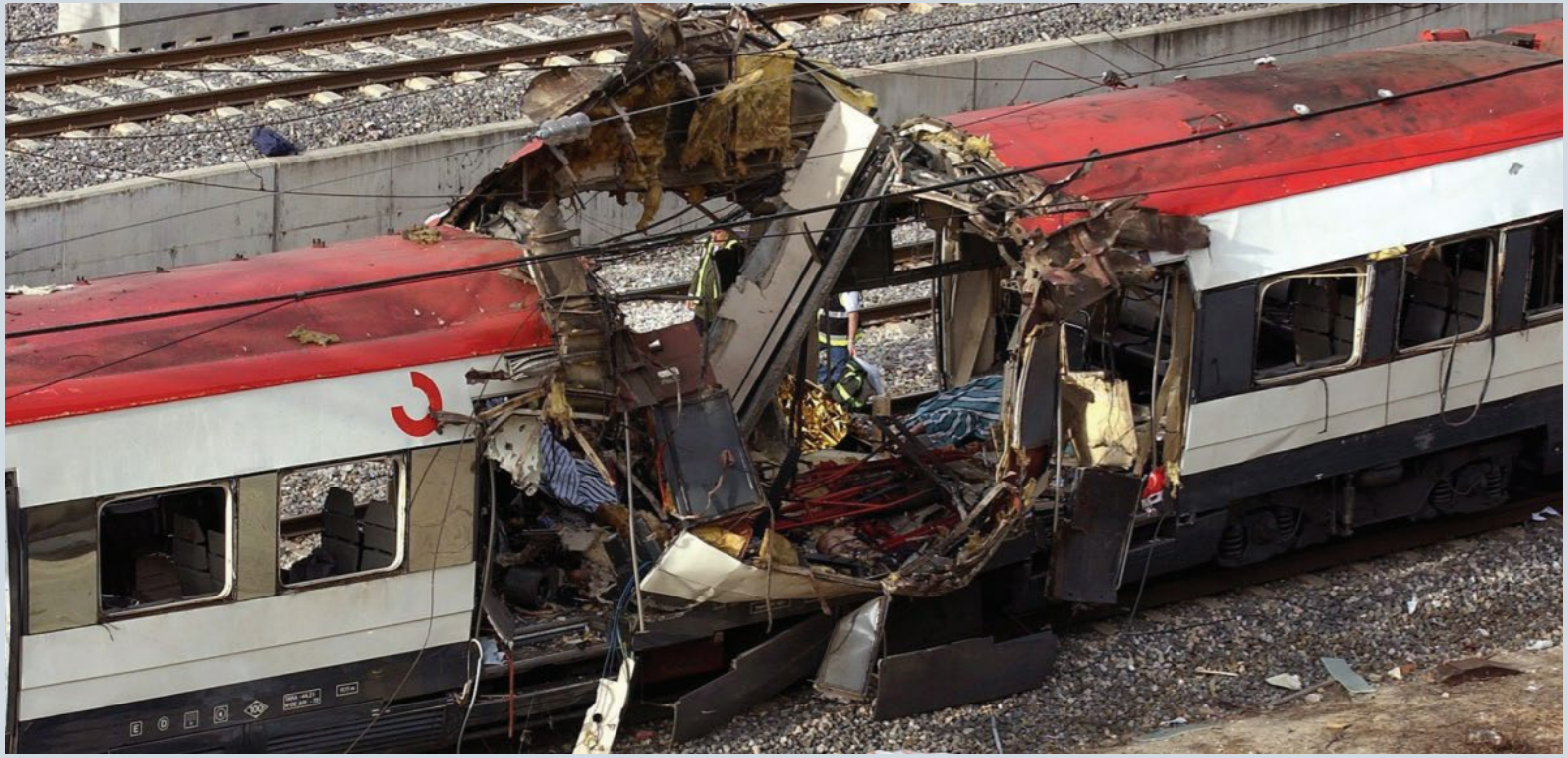
Explosions. Shock. Wounds. First aid considerations

TOPIC 1.12

Outline:

1. Explosions. Explosives. Definitions.
2. Blast injuries.
3. Treatment considerations of blast injuries.
4. Shock. Treatment consideration.
5. Wounds. Treatment consideration.



Explosions

1. Some definitions

Explosive facility – is a facility on which territory explosive and flammable materials are kept, transported, manufactured and so on.

Explosive substance (explosive) - is a substance or chemical compound, solid or liquid substance (or mixture of substances) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.

combustible mixture– is a mixture of flammable substances with oxidizing agent.

An **explosion** is a rapid increase in volume and release of energy in an extreme manner, usually with the generation of high temperatures and the release of gases.

Explosives

High order explosives. High order explosives have a strong supersonic pressure wave, known as the blast wave or shock wave

Low order explosives. Low order explosions have a subsonic explosion and lack the high order explosive blast wave. Examples of low order explosives include – pipe bombs, gun powder, petroleum-based bombs.

Blast injuries

Explosions have the ability to inflict injuries on many people at the same time resulting in high levels of mortality and morbidity.

The type and severity of the impact depends on many factors including, when and where the event took place, the number of people in the area, material in the area of the explosion, and the type of explosion (nuclear, mechanical, or chemical), how far the victim is from the explosion, what protection they had available to them.

In addition to the blast wave, an explosion can cause blast wind. Blast wind is the flow of superheated air that can interact with people and objects and cause injury or damage.

Chemical explosions cause injuries in four categories (primary, secondary, tertiary, and quaternary). The four categories are based on the impact on the human body due to the blast wave, blast wind, environmental/material factors present in the area of the blast.

Primary Blast Injury

Primary blast injury is caused by the blast wave moving through the body. Since only high order explosives create a blast wave, primary blast injuries are unique to high order explosions. The blast wave causes damage to more extensively to air-filled organs. The resulting barotrauma can affect the lungs, auditory organs, the eye, brain, and gastrointestinal tract.

Blast ear – tympanic membrane rupture and middle ear damage

Blast lung – injury to the lung parenchyma, can have delayed symptom presentation

Blast brain – injury to brain parenchyma, even without direct injury to the head

Blast eye – rupture of the globe of the eye

Blast belly – injury causing abdominal hemorrhage and perforation (immediate and delayed). It can also cause injury to solid organs and testicular rupture.

Secondary Blast Injury

Secondary blast injuries are more common than primary blast injuries. Secondary blast injuries are caused by debris that penetrates or interacts with the body surface. The debris can be from pieces of the explosive device itself and its contents, or material located around the initial blast device at the time of the explosion.

Secondary blast injuries account for the majority of injuries from an explosion event. The blast wave can carry debris a considerable distance causing injuries to anyone in its path. In intentional explosive devices, often they are constructed with the intent to injure as many people as possible. The device could be constructed with nails, metal ball bearings, screws, or other objects with the intent that they will be forcefully displaced during the blast to increase injuries to anyone in their path.

Secondary blast injuries are the most common cause of mortality in victims of an explosion. Exposed areas of the victims' body are at high risk for penetration of debris that is propelled by the explosion. Often areas of highest risk for injury are the head, neck, and extremities.

Tertiary Blast Injury

Tertiary blast injuries are caused when the person in displaced through the air and impacts on another object by the blast wind, or when a structure collapses and causes injury to the person. The resulting injury can be either blunt trauma due to the impact or penetrating injury if the victim is propelled and the striking structure enters the body. Injuries are determined by what the victim strikes. The strength of the explosion determines the severity of the injuries sustained.

High explosive blasts can cause skull fractures, fractured bones, head injuries, or any traumatic injury (open or closed injuries, chest, abdominal, pelvic injuries, amputations, spinal injuries, and any others).

Structural collapse and entrapment can cause crush injuries and compartment syndrome. The longer it takes to extricate the victim the higher their mortality.

Quaternary Blast Injury

Quaternary blast injuries are comprised of all injuries that are not included in primary, secondary, or tertiary blast injury categories. Quaternary blast injuries can be caused by exposure to resulting, fire, fumes, radiation, biological agents, smoke, dust, toxins, environmental exposure, and the psychological impact of the event. As a result of all the debris, wounds can be extremely contaminated with a wide variety of sources.

Fire – burn injuries (flash, partial, full-thickness, airway)

Fumes/smoke/dust – inhalation injuries and respiratory compromise

Toxins – toxidromes from chemical exposures

Environmental – heat/cold, exposure injuries

Radiation – minor injury to death, depending on the type, amount, and exposure time to the source.

Biological – variety of illness related to the agent released

Treatment considerations

Surgical approaches for trauma

-provisional skeletal fixation

-reperfusion

-debridement

Extensive zones of injury are the rule, as the blast energy frequently dissects fascial planes and advances contamination far beyond the visible primary soft tissue wound. Radical, serial debridements with longitudinal extension of wounds should be employed to fully evaluate the extent of evolving tissue necrosis and remove the burden of significant, gross contamination.

Initial Management (secondary blast injury)

- Even when blast victims have small entrance wounds, surgeons should maintain a low threshold for performing thorough debridement
- All open fractures are considered contaminated and should receive early antibiotic treatment
- Obviously contaminated wounds should be irrigated with sterile saline and dressed with iodophore (Betadine)- soaked sponges; once dressed, re-exposure should wait until operative exploration
- Tetanus prophylaxis should be administered unless immunization within five years can be documented
- Extremity fractures should be splinted to provide mechanical stability and relieve pain

4. Shock

Shock is a state with reduction in systemic tissue perfusion, resulting in decreased delivery of oxygen and reduced removal of waste products, leading to tissue injury.

There is a circulatory failure manifested as hypotension (i.e., reduced tissue perfusion).

Shock is initially reversible, but must be recognized and treated immediately.

Four types of shock are recognized: distributive, cardiogenic, hypovolemic, and obstructive. However, these are not exclusive, and many patients with circulatory failure have a combination of more than one form of shock (multifactorial shock)

Three stages of shock

Stage I - compensated, or nonprogressive

Stage II - decompensated or progressive

Stage III (also called irreversible)

Stages of shock

Stage I – compensated (non-progressive)

In Stage I of shock, when low blood flow (perfusion) is first detected, a number of systems are activated in order to maintain/restore perfusion. The result is that the heart beats faster, the blood vessels throughout the body become slightly smaller in diameter, and the kidney works to retain fluid in the circulatory system. All this serves to maximize blood flow to the most important organs and systems in the body. The patient in this stage of shock has very few symptoms, and agressive treatment may slow progression.

Stage II - progressive

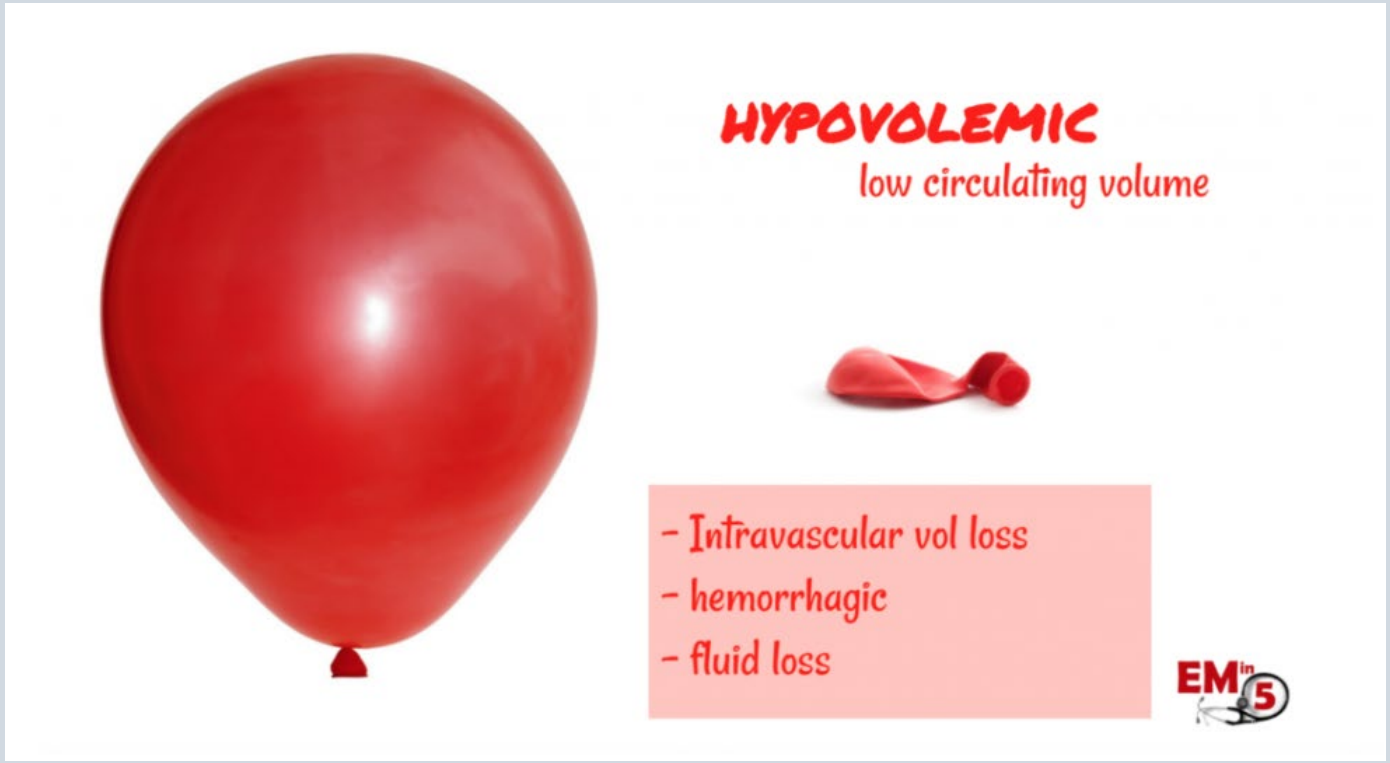
In Stage II of shock, these methods of compensation begin to fail. The systems of the body are unable to improve perfusion any longer, and the patient's symptoms reflect that fact. Oxygen deprivation in the brain causes the patient to become confused and disoriented

Stage III - irreversible

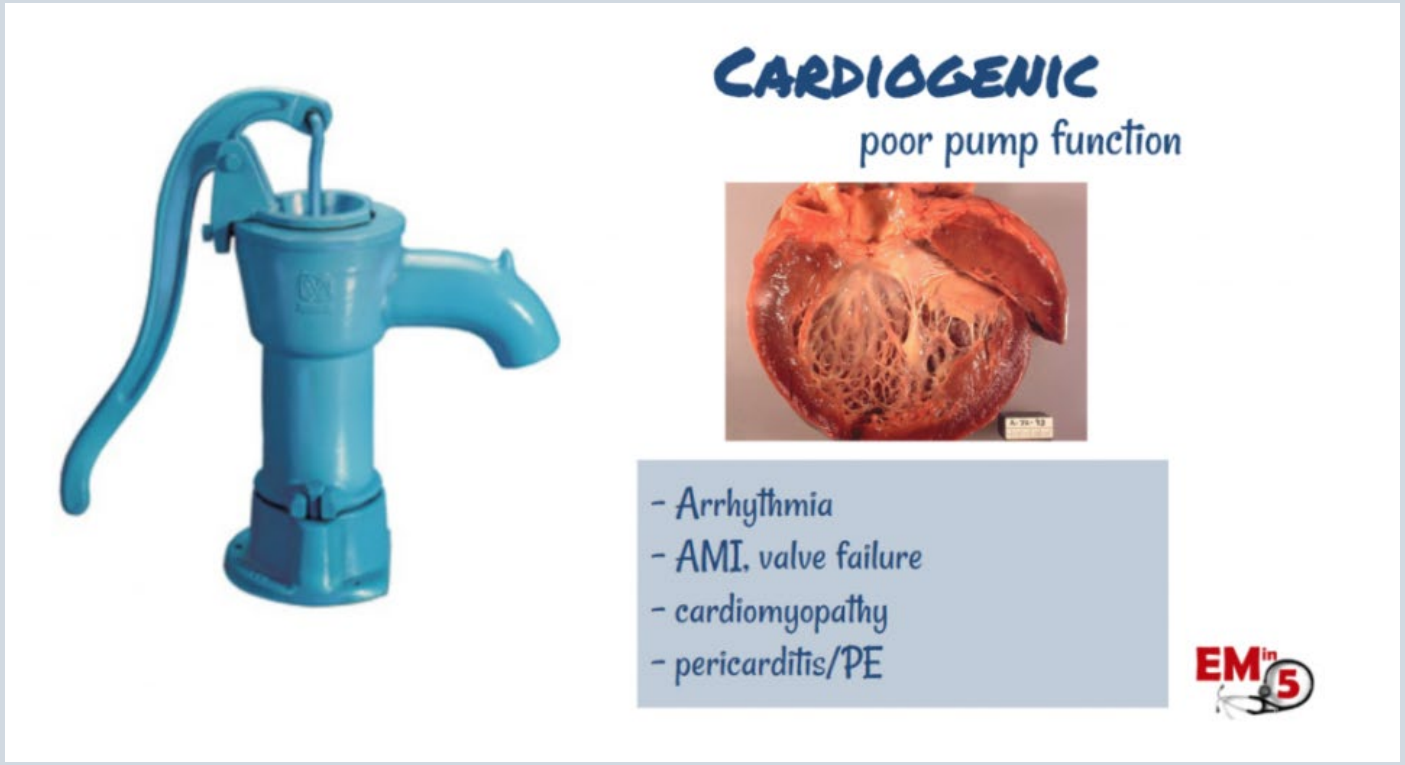
In Stage III of shock, the length of time that poor perfusion has existed begins to take a permanent toll on the body's organs and tissues. The heart's functioning continues to spiral downward, and the kidneys usually shut down completely. Cells in organs and tissues throughout the body are injured and dying. The endpoint of Stage III shock is patient death.

Types of shock

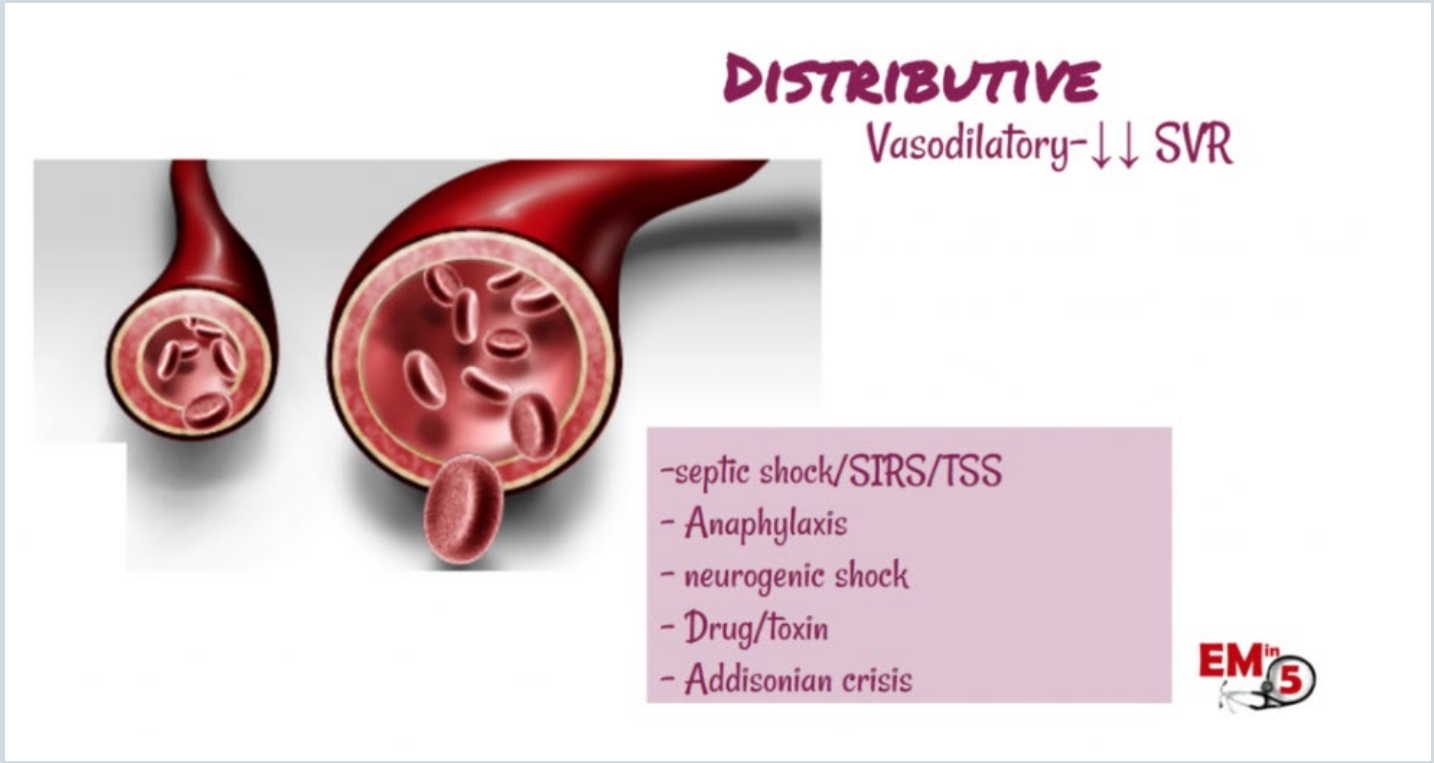
1. **Hypovolemic**
2. **Cardiogenic**
   - obstructive
3. **Distributive**
   - neurogenic
   - anaphylactic
   - septic



Hypovolemic shock



Cardiogenic shock



Distributive shock

Management principles and priorities in care of shock

Assessment

It is vital to recognize if shock is present!

Clinical features:

The increasing of heart rate – is one of the first thing to change

Tachycardia

The classic presentation of the pulse: fast, weak and thread

Peripheral vasoconstriction

Management principles and priorities in care of shock

1. Investigate treatment as soon as possible! (the golden hour)
2. Establish and maintain a clear airway
3. Ensure adequate ventilation
4. Keep oxygen saturation over than 95%
5. Adequate intravenous access (2 peripheral large cannulas)
6. Continuous cardiac monitoring
7. Urinary catheter
8. Recording a fluid balance
9. Physiologically desirable position
10. Maintain optimum temperature

Wounds

5. Wounds

Wounds are defined as a disruption of the normal structure and function of skin and underlying soft tissue that is caused by trauma or chronic mechanical stress.

Classification:

Acute wound: a disruption of the skin and/or underlying soft tissue that has a **well-organized healing process** with predictable tissue repair

- Stab wounds
- Cut wounds
- Lacerations
- Bruises

Chronic wound: a wound with an **impaired healing process**, usually involving a prolonged inflammatory phase. All chronic wounds begin as acute wounds.

- Vascular ulcers (venous and arterial)
- Diabetic ulcers
- Pressure ulcers

Classification

Open and closed wounds

Open wound: a wound with **skin breakage** and exposure of underlying tissue to the outside environment

- Lacerations
- Punctures
- Gunshot wounds

Closed wound: a wound with **intact skin**, and underlying tissue not directly exposed to the outside environment

- Contusions
- Hematomas
- Crush injuries

Bite wounds - wounds (caused by animals or humans i.e., “fight bite”) are associated with an **increased risk of infection.**

Acute would treatment

Open wound treatment

Clean surgical wound treatment

Indications:

- Age of the wound: Primary surgical wound treatment is possible up to 6–8 hours after injury. If the wound is > 8 hours old, see treatment for dirty open wounds.
- Extent of the wound: The patient should have intact circulation, sensation, and movement.
- Type of wound: clean, sharply defined wound with adjustable wound edges

Localization: Anatomical location of the wound determines healing time (e.g., head wounds heal more quickly than extremity wounds because of increased vascularity).

Procedure:

- **Cleaning and disinfection**
- Local anesthesia
- Inspection
- Excision of the wound edges and wound irrigation
- Tension-free adaptation of the wound edges using suture material or staples
- Sterile dressing and immobilization
- **Tetanus protection**

6–8 hours rule: Primary surgical wound treatment should not be used for injuries older than 6–8 hours because of the high risk of infection!

Dirty wound treatment

Indications: The goal is to remove devitalized tissue, contamination, and residual suture material that may disrupt the body's ability to heal.

- **Infected wounds**
- Wounds with foreign bodies (e.g., bullets, infected surgical wounds with remaining suture material)
- Bite wounds and other contaminated wounds

Procedure

- Cleaning via **pressured irrigation** using warm, **isotonic saline**
- **Debridement** (removal of dead, damaged or infected tissue)
- Ensure **drainage**
- **Moist dressing** and immobilization
- Delayed/secondary surgical wound treatment after 3–8 days
- **Tetanus protection**

Additional treatment:

- Antibiotic treatment is indicated for all dirty wounds.

Thank you!

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