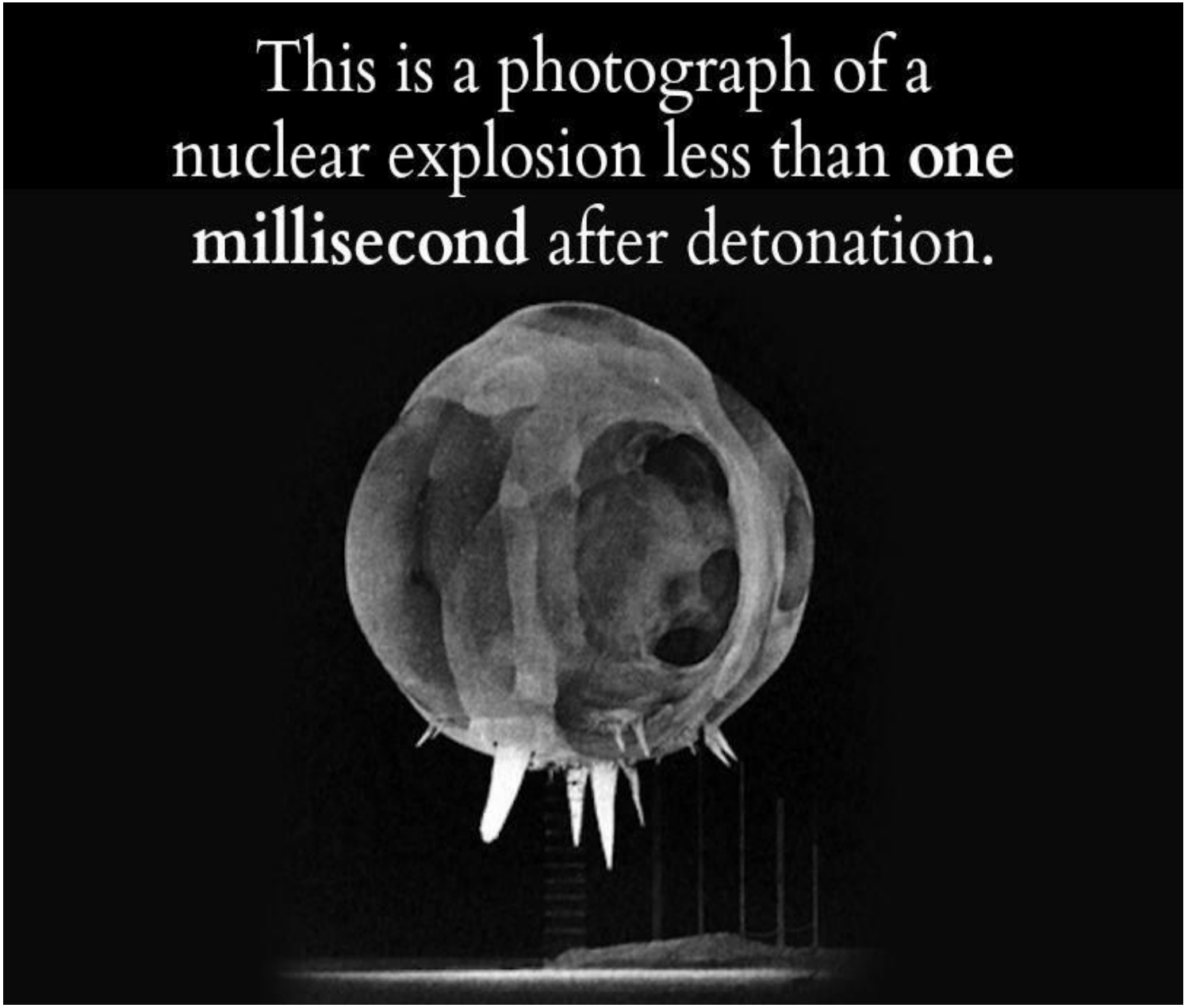
BLAST INJURIES

Dr. P.Paranitharan

This is a photograph of a nuclear explosion less than **one millisecond** after detonation.



Objectives

- Describe different injury patterns following an explosion, circumstances under which they occur and form opinions
- To identify different medico-legal issues following an explosion

Blast injuries

- Injuries following an explosion are referred to as blast injuries
- Blasts are **not always** produced by bombs
- Blast injuries are produced **not only by** exploding bombs but also by other means such as Crackers, Mine explosions, Lightning, Gas cylinders, Aircraft decompression etc

Blast injuries

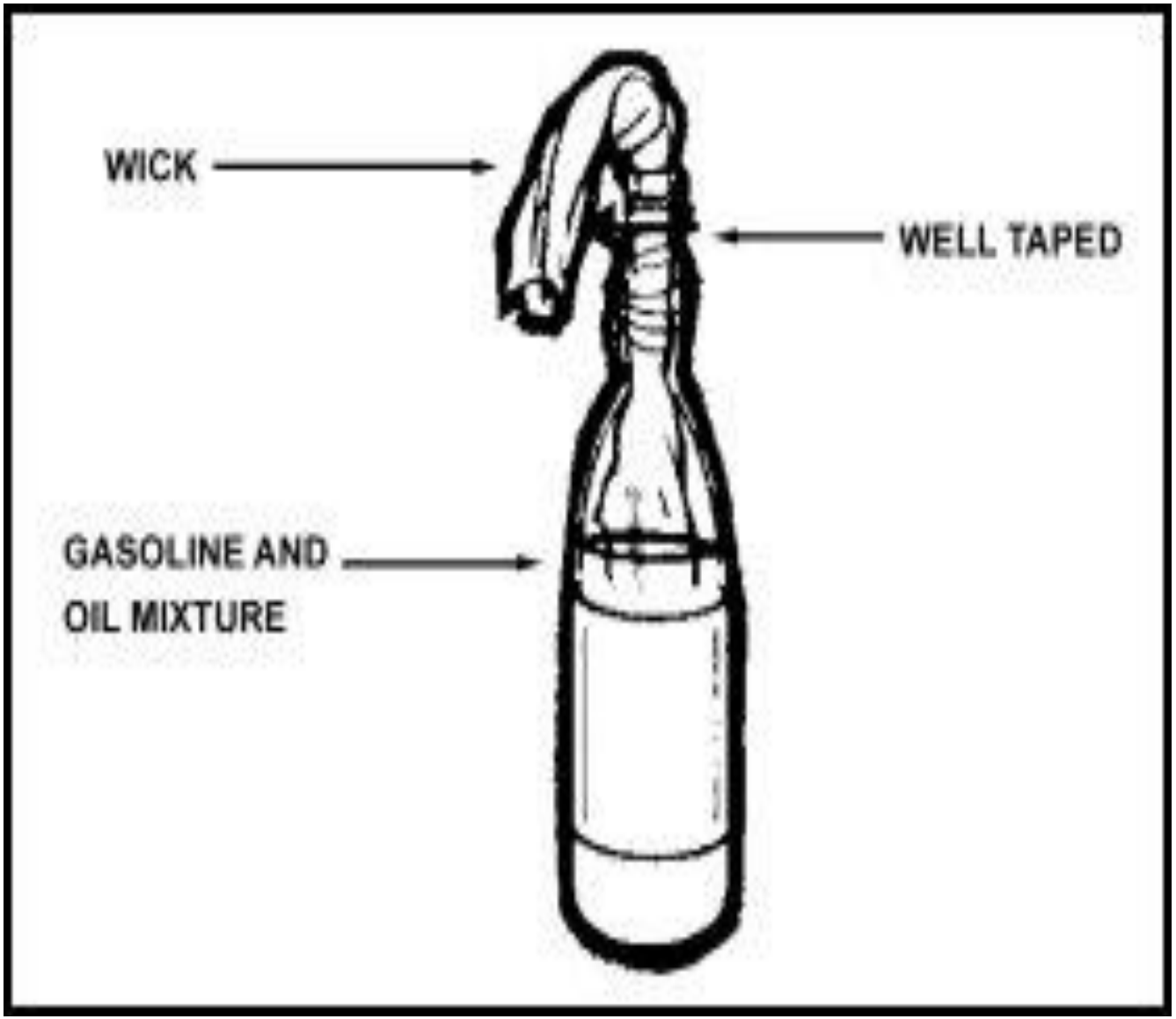
All bombs **do not always** cause blasts and blast injuries

a. Incendiary bombs – eg; Molotov cocktail, petrol bombs, Napalm bomb

These bombs will **only produce a fire**

b. Gaseous bombs – eg; Smoke bombs

Generate smoke or gases such as tear gas and war gases(phosgene)


WICK
WELL TAPED
GASOLINE AND
OIL MIXTURE

Incendiary bomb used in world war II

Molotov cocktail- home made

Smoke bomb

Explosions due to Bombs

Bomb is a 'surreptitiously' made explosive device which can be made to liberate energy and gases under pressure responsible for the propulsion and dissemination of the constituents of the device.

Explosions due to Bombs

The different types of bombs commonly used can be divided into

1. Low explosive

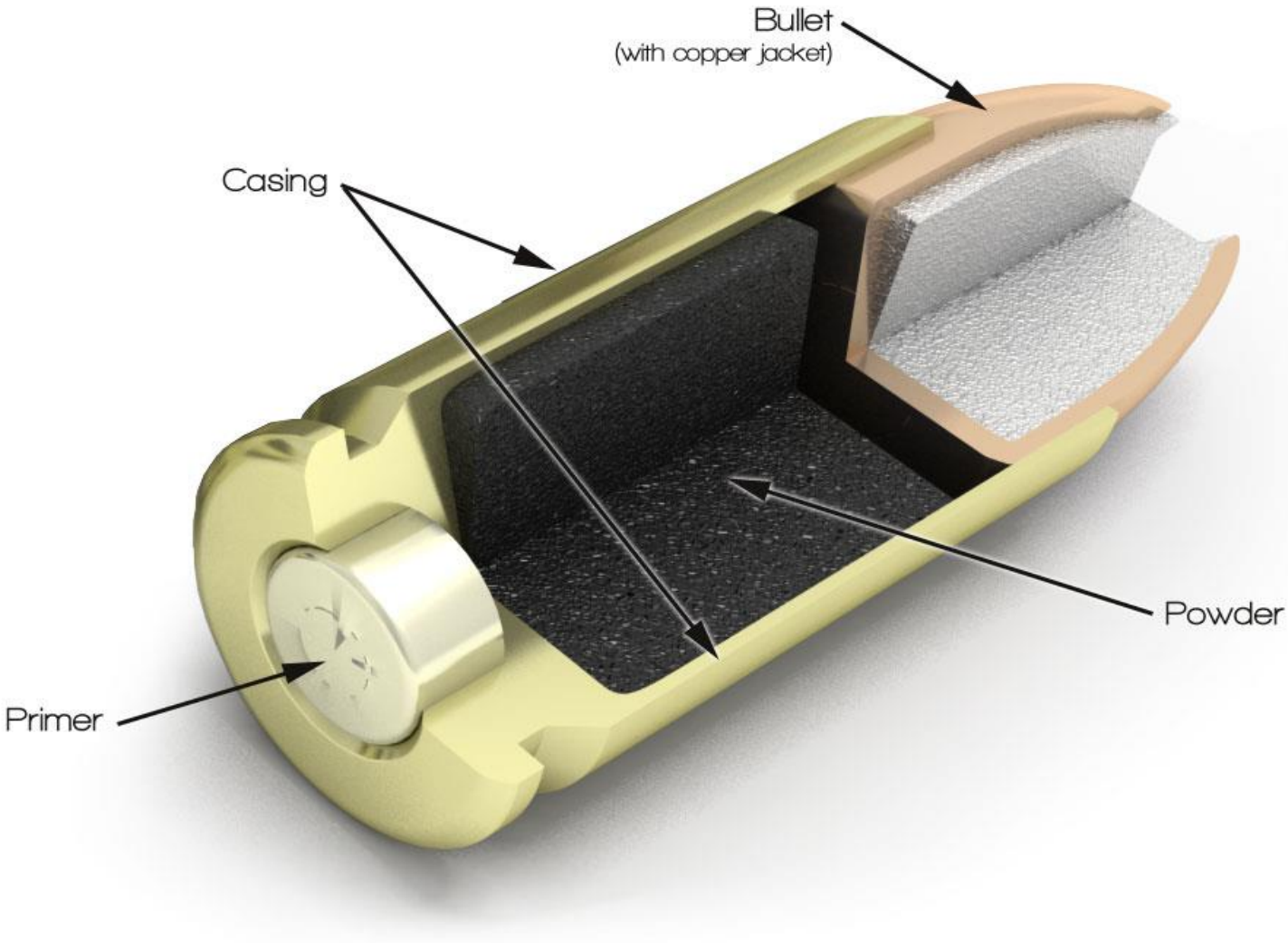
a. Gun powder – It is a mixture of carbon, sulphur and potassium nitrate. It is found in crackers.

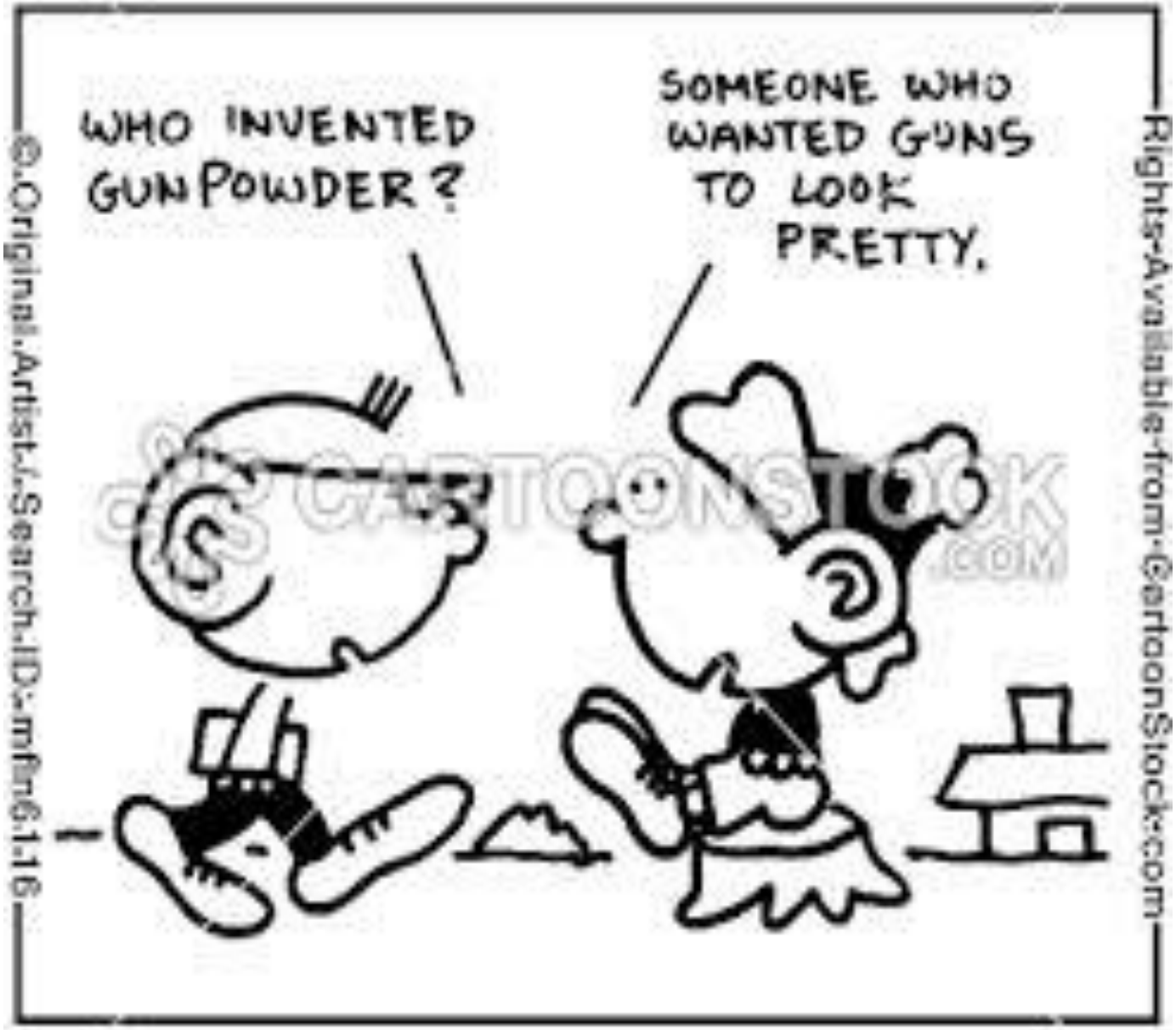
The explosion produced by the burning gunpowder will produce a fire, a large volume of gases and a noise.

Explosions due to Bombs

Ideally suited for crackers. In the case of bomb one must add metal balls, wires, nails to get the desired effect

b. Nitrocellulose – This is used in cartridges. It also burns slowly and has a pushing effect and propels the missiles


Bullet
(with copper jacket)
Casing
Powder
Primer


WHO INVENTED GUNPOWDER?
SOMEONE WHO WANTED GUNS TO LOOK PRETTY.
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Explosions due to Bombs

2. High explosives

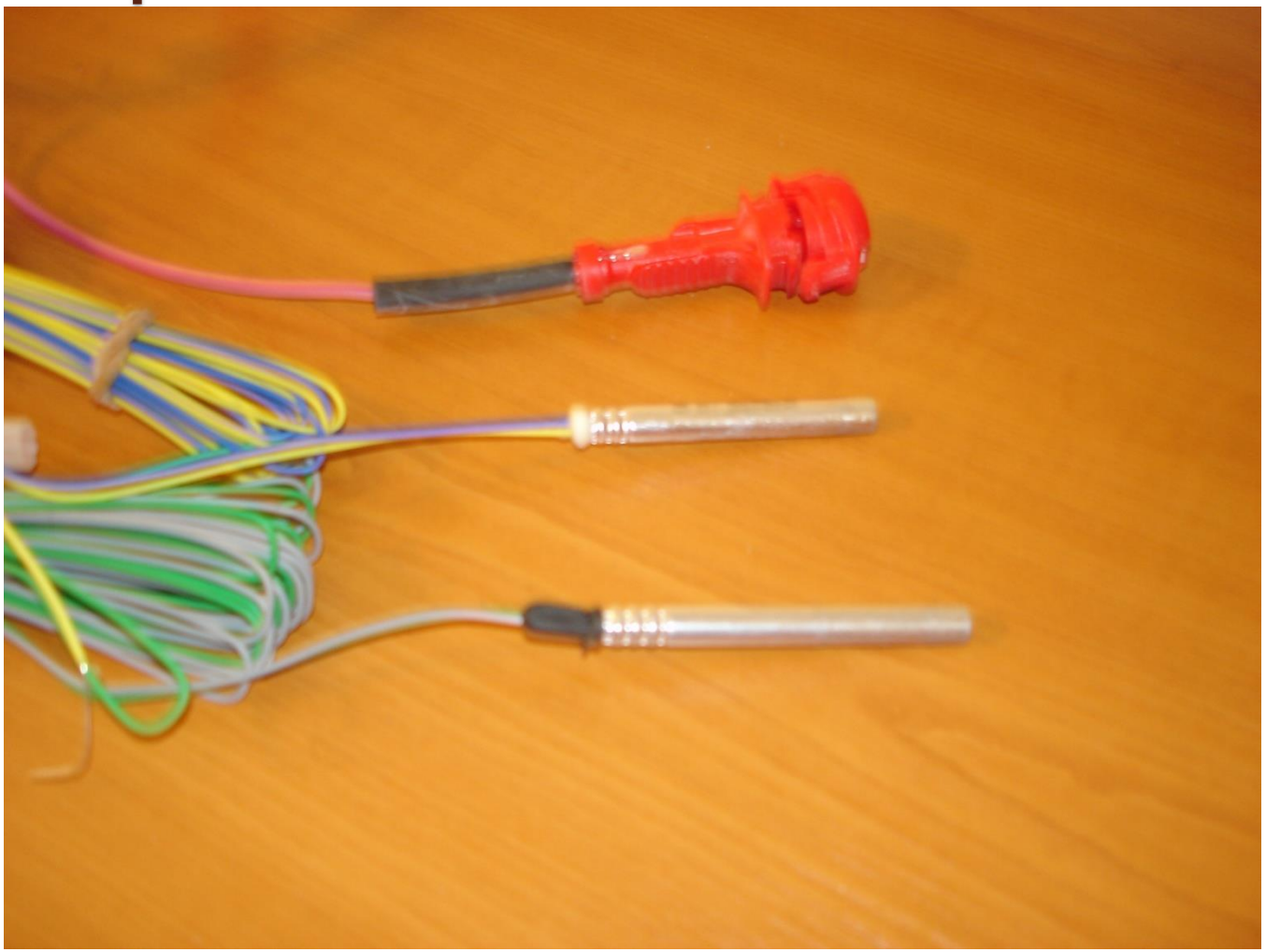
a. Dynamite (gelignite + gelatine)- The main constituents of dynamite are nitroglycerine, nitrocellulose and KNO_3, $NaNO_3$, NH_4NO_3

b. T.N.T (trinitrotoluene)

Used in hand grenades and mortars

c. Research development explosives (RDX)

Detonator – device used to trigger an explosive device



Rocket bombs

CLAYMORE MINE

EFFECTS OF A BOMB EXPLOSION

The effects of a bomb explosion depends on the

- Type of explosive
- Proximity of the victim to the site of explosion
- Place of explosion is an open or closed place

It is possible to reconstruct the nature of the bomb and also the relative position of the victim in relation to the point of explosion

Effects of explosion

- Blast Effect
- Fire
- Heat
- Blast wave
- Shrapnel
- Explosive agent
- Smoke & gases
- Falling masonry due to disruption of a building
- Traumatic asphyxia following the ensuing stampedes
- Aggravation of preexisting natural disease

Blast effect

- Occurs at the moment of explosion
- shattering and devastative effect
- Due to release of enormous energy
- Complete disruption and fragmentation of body
- Fragments are propelled to great distance

- **Marshall TK. Deaths from explosive devices. Med. Sci. Law 1976 ; 16 : 235-239**

Blast effect

a. Complete disruption or fragmentation of the body and the surroundings

Usually seen in high explosive bombs in respect of suicide bombers and those in the immediate vicinity of the bomber or the explosion

b. Mutilation of the body with a limb or limbs blown off (initiative or primary explosives)

Eg; traditional hand bombs

c. Local disruption limited to a particular area of the body- Seen in hand grenade explosions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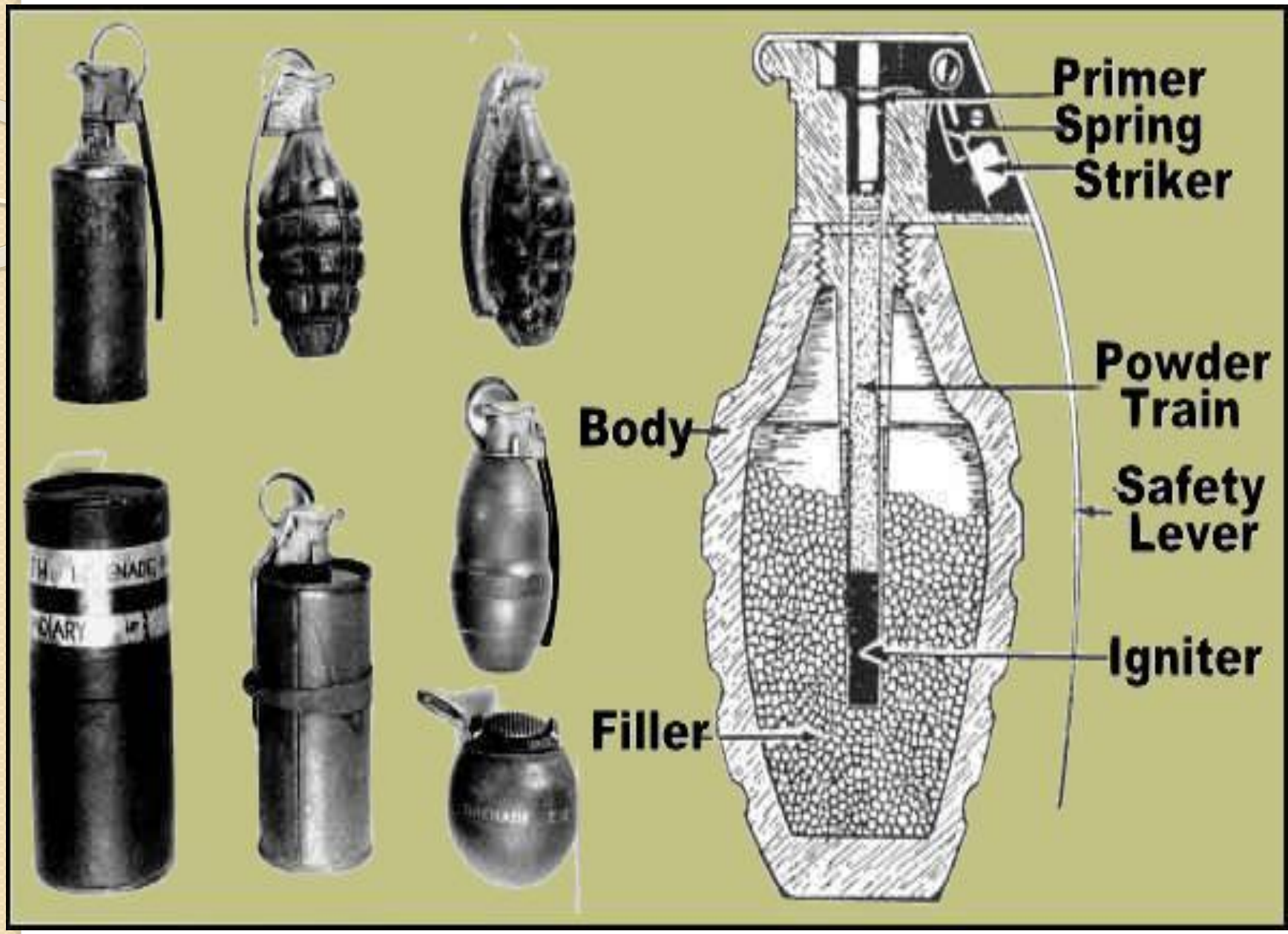

Primer
Spring
Striker
Powder
Train
Body
Safety
Lever
Igniter
Filler

Injuries of a bomb handler

Amputation of the right hand and injuries in the front

FIRE

- In incendiary bombs this is the principle outcome producing direct burns on the skin
- The presence of flame burns or singing of hair indicates the close proximity of the victim to the site of explosion
- If the bodies are thrown away due to the blast effect and blast wave may escape severe burns and charring

HEAT

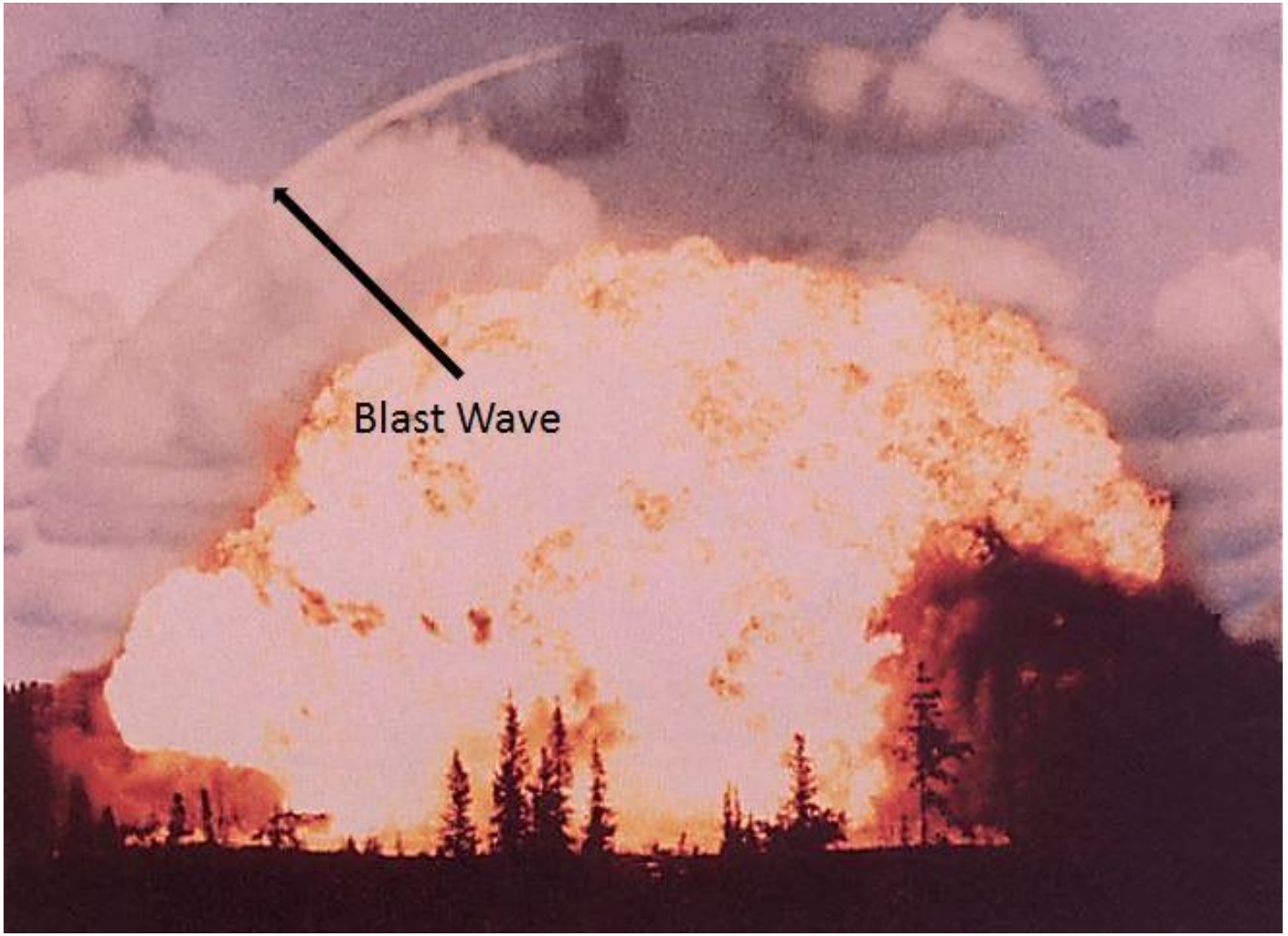
- The heat will radiate in all directions causing burns or scorching to the exposed areas of the body

- It also indicates that the victim was closer to the point of explosion

Blast wave

The blast wave can cause the following effects

- Windage – knocks over a person
- Otic blast – rupture of the ear drum can occur
- When the intensity of the blast wave is more it may pass through the muscle and other solid tissues like the liver, heart, kidneys or air/gas filled organs like the lung or the stomach and intestines
- The internal shearing effect to the tissues when there is an air-tissue interphase will result in haemorrhages in the alveoli followed by pulmonary oedema and ARDS


Blast Wave

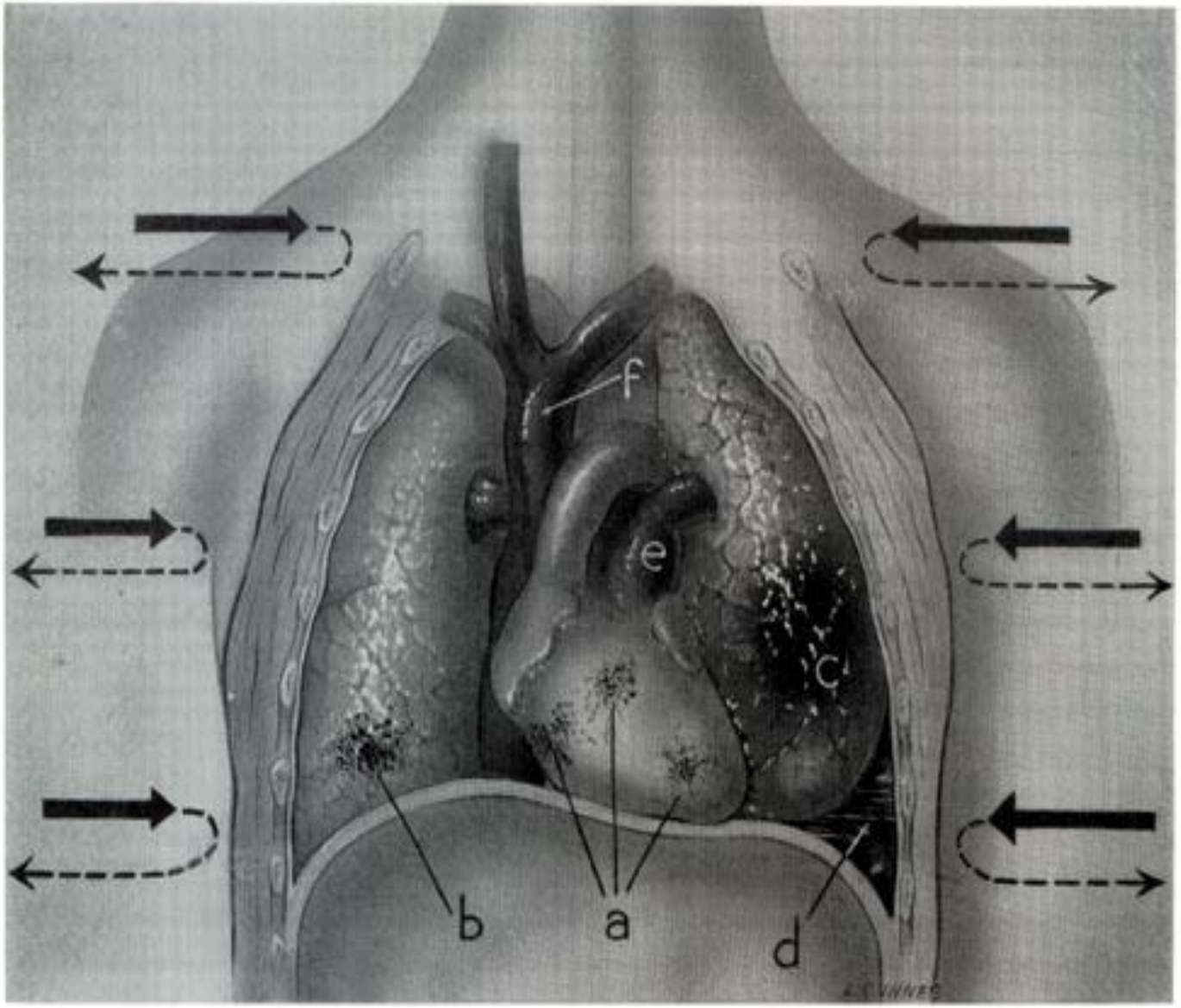
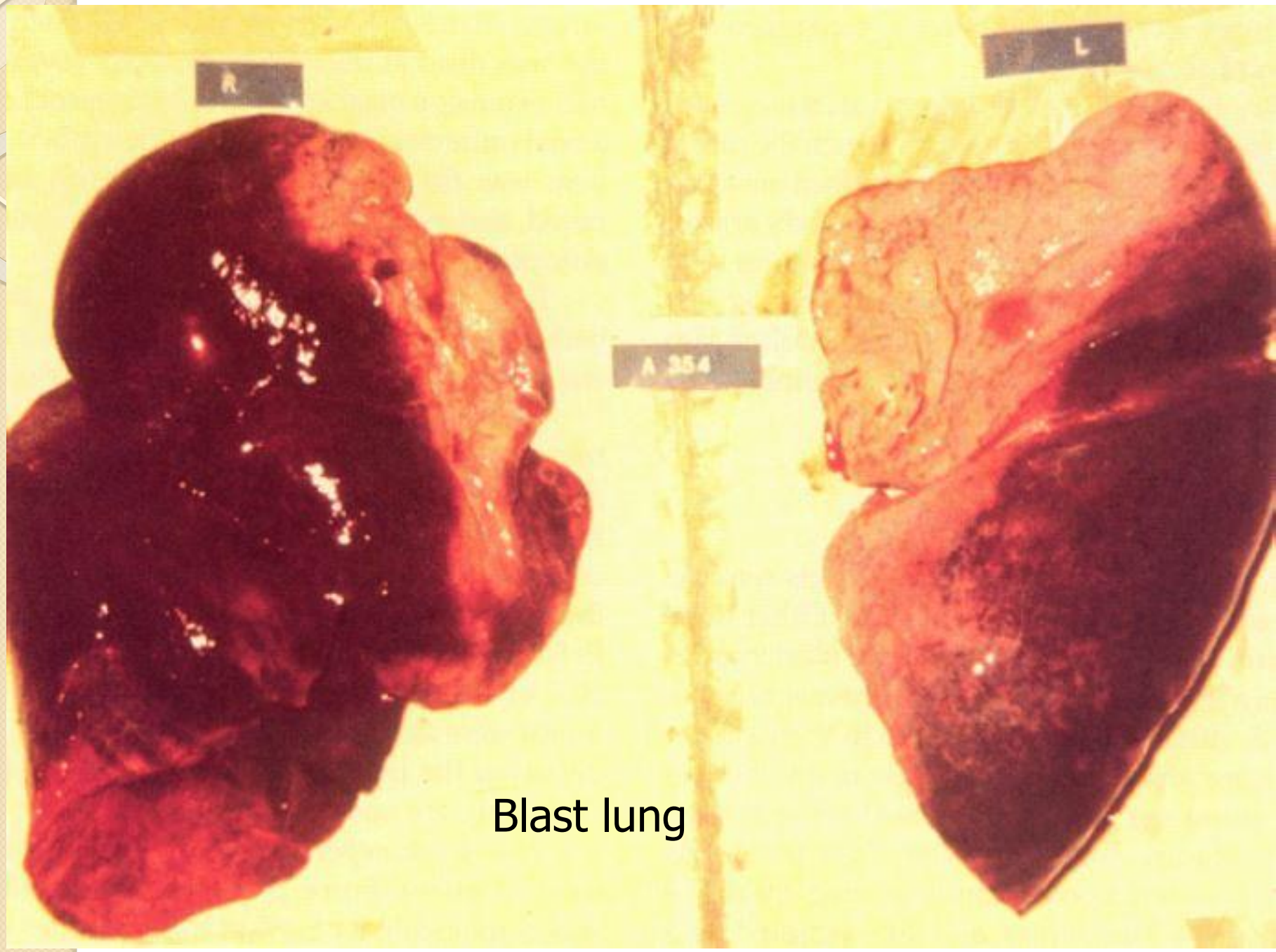
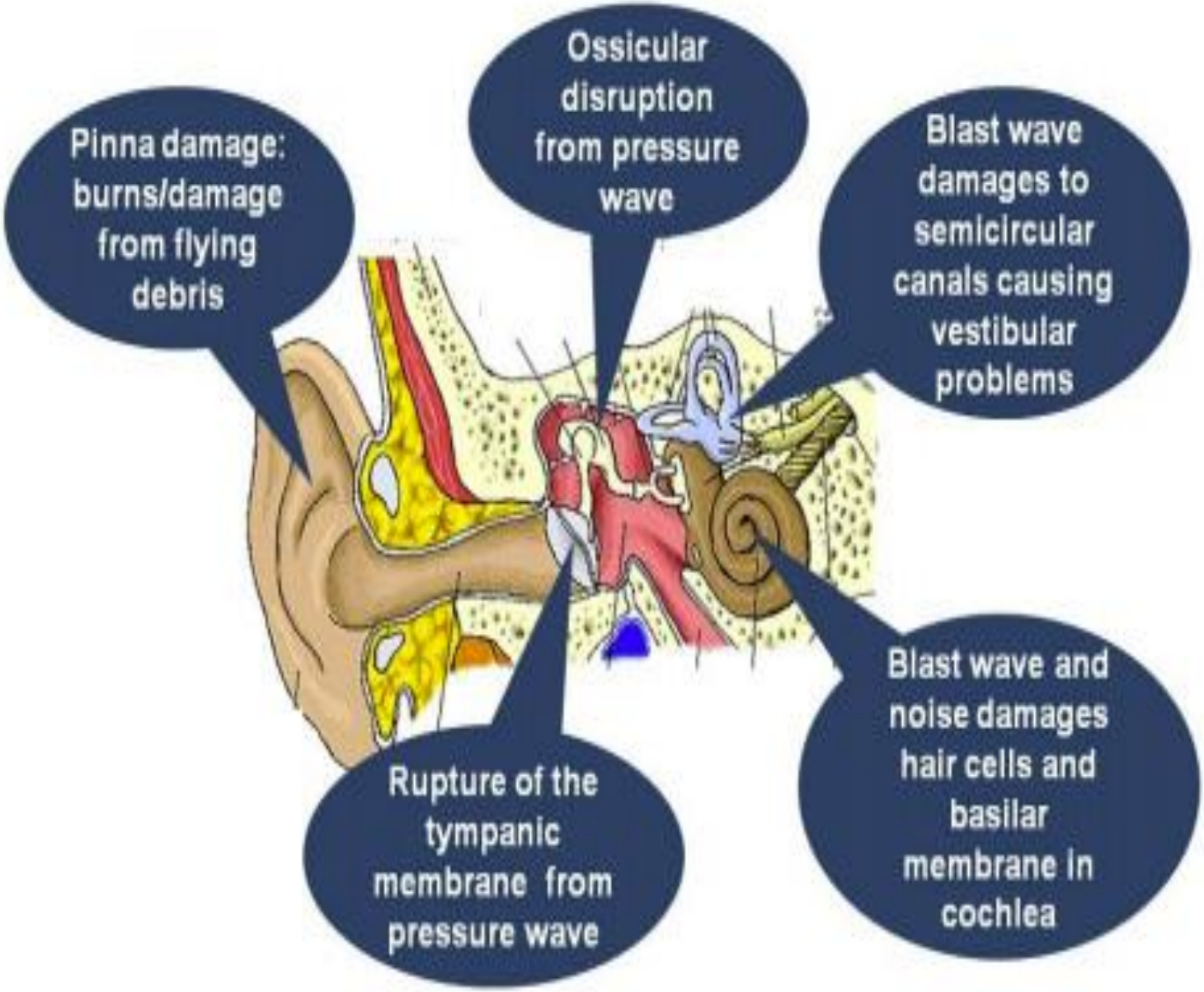


FIGURE 10.—Schematic showing of pathologic physiology of blast injury (wave of positive pressure shown by solid arrow, wave of negative pressure by dotted arrow): Petechial hemorrhage, cardiac (a), petechial hemorrhage, pulmonary (b), gross pulmonary hemorrhage (c), pleural hemorrhage (d), engorged pulmonary artery (e), and engorged vena cava (f).



Blast lung


Pinna damage: burns/damage from flying debris
Ossicular disruption from pressure wave
Blast wave damages to semicircular canals causing vestibular problems
Rupture of the tympanic membrane from pressure wave
Blast wave and noise damages hair cells and basilar membrane in cochlea

Injuries due to shrapnel

Can cause various external and internal injuries

- Depends on their nature, the velocity of propulsion and the proximity of the victim to the point of explosion

- Those who are far away may only sustain punctate abrasions, small contusions and small irregular puncture lacerations referred to as the **Marshall's triad**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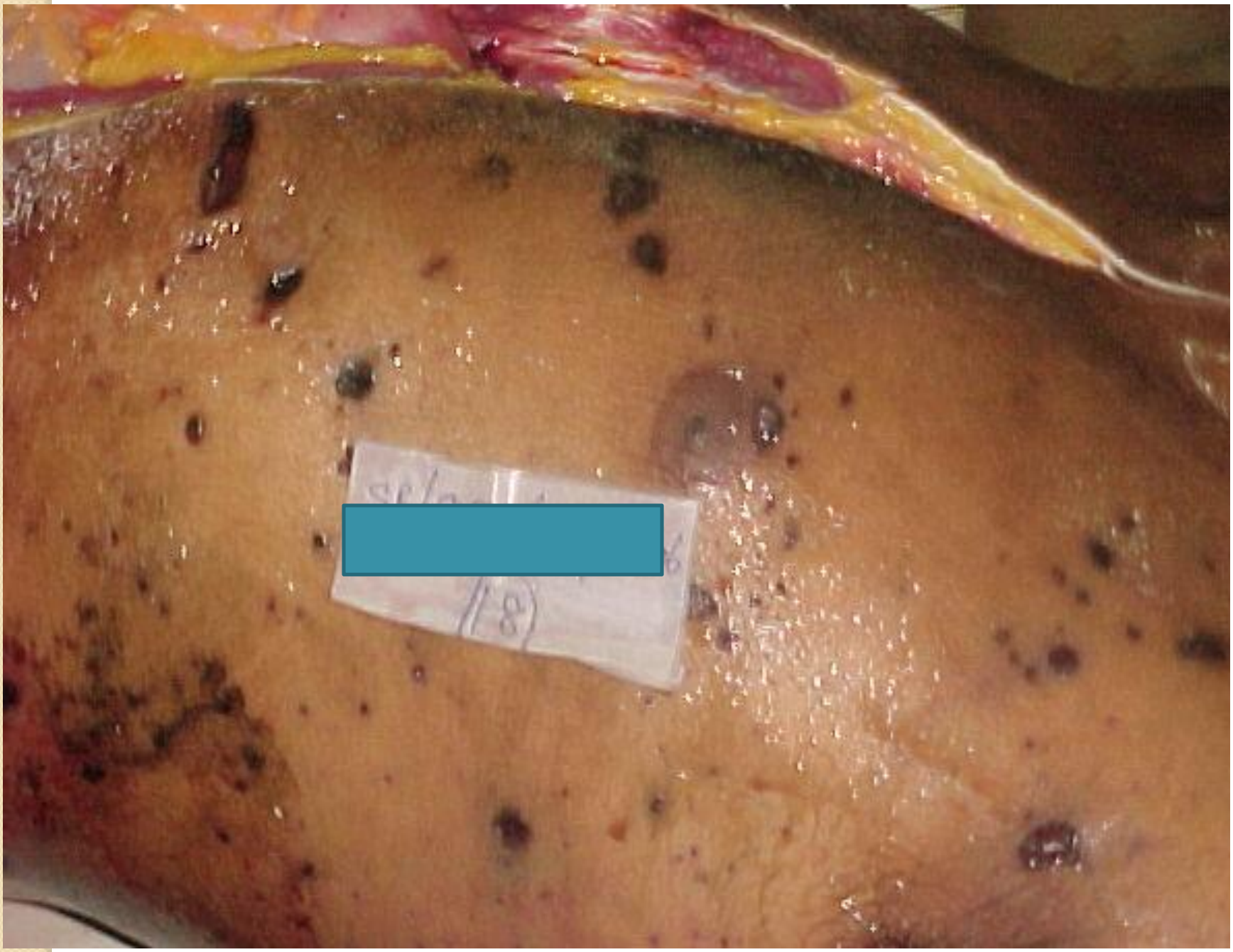
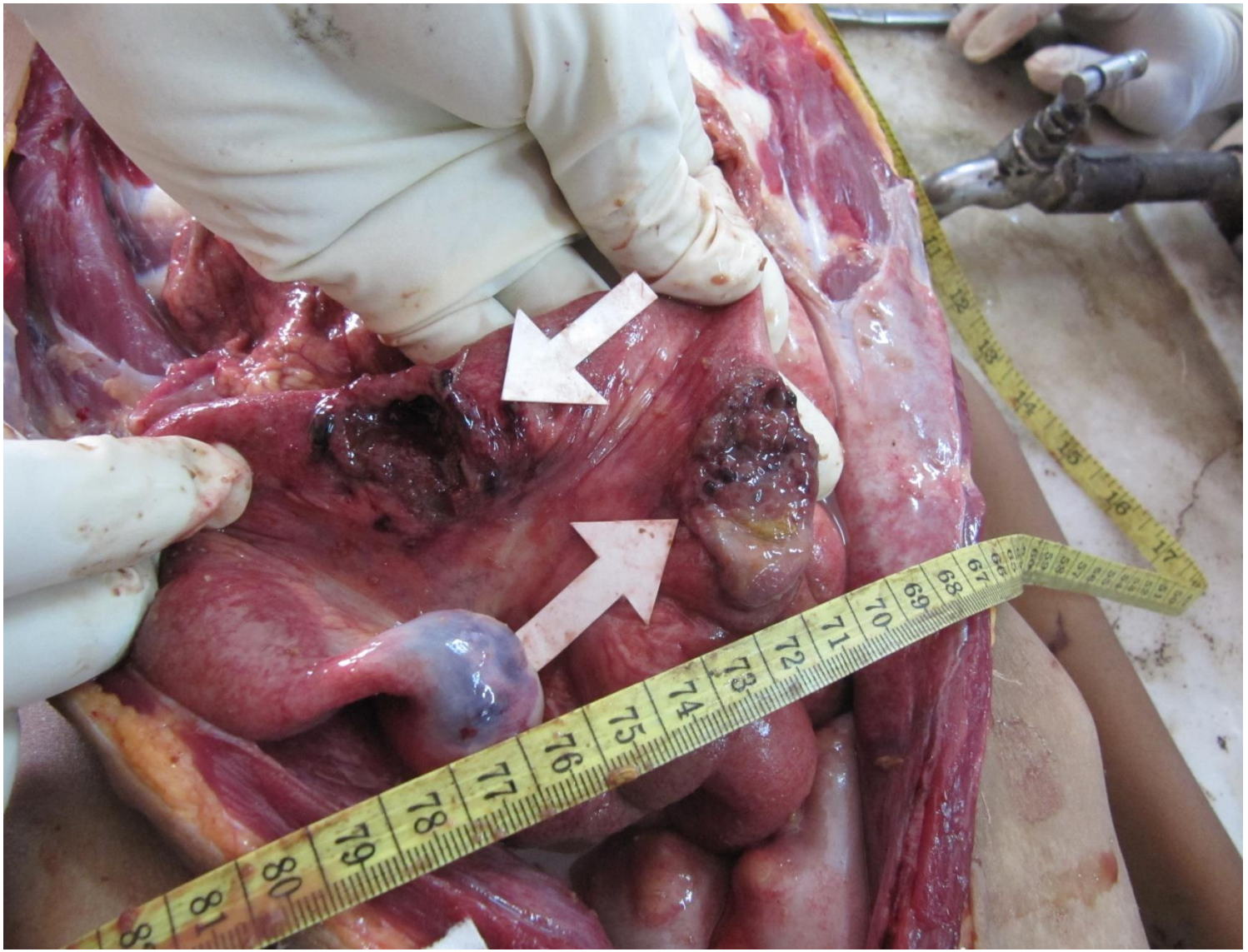


FIGURE 8.62 *Numerous wounds and peppering by debris projected in a terrorist bomb blast. Blast injuries occur only in close proximity to the device – most injury is caused by flying projectiles. (Reproduced by kind permission of Professor TK Marshall.)*



Classification of Shrapnel

- Primary - incorporated into the bomb. thousands of small metal balls
- Secondary - fragmented container
- Tertiary - from the surroundings
- Dust tattooing - the dust from the area driven by the blast wave.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Smoke and gases

- Irritation of the eyes, throat and respiratory passages (tear gas)
- Asphyxiation
- Poisoning (Arsine, Carbonyl chloride, Cyanide etc)
- Burns (ammonia & Chlorine cylinders)
- Laryngeal oedema, acute bronchitis, alveolitis etc

Falling masonry & others

- collapse of the building – masonry- various injuries
- Traumatic asphyxia
- Stampede injuries by excited crowd trying to get out from the premises

Medico-legal investigation of a bomb explosion - Medicolegal issues

- The number of individuals dead
- The identities of these individuals
- Site of explosion
- The type of bomb
- Identification of various components of the explosion
- Position of the individuals in relation to the site of explosion

Medico-legal investigation of a bomb explosion

- The injury pattern suggest a manufacturer, carrier or a victim of a bomb explosion

- Pathophysiology of the injuries, cause of death and other related matters such as volitional activity and period of survival

AUTOPSY

Important issues to be addressed at the time of autopsy

- Identification
- Interpretation of injuries
- Trace evidence
- Preautopsy X-rays‘
- Reconstruction

Reference

1. Lecture Notes in Forensic Medicine
   Volume 1 by Dr LBL de Alwis
2. Knight's Forensic Pathology
   4th edition
3. Text book of Clinical Forensic Medicine and Forensic Pathology – 1st Edition by Prof. N. Chandrasiri

THANK YOU