NAME _____ DATE _____ PERIOD _____

UNIT 8: DEATH, INJURY AND AUTOPSY NOTES

Investigation of Death: Introduction to manner, mechanism, cause and body changes after death

Objectives

- Discuss the definition of death
- Distinguish between four manners of death: natural, accidental, suicidal, and homicidal
- Distinguish between cause, manner, and mechanisms of death
- Explain the development of rigor, algor, and livor mortis following death
- Estimate the time of death
- Describe the stages of decomposition of a corpse
- Use evidence on stomach contents to estimate time of death
- Use insect evidence to estimate time of death
- Explain how environmental factors can affect the estimated time of death

<u>Historically</u>

- In the 17th century, anyone in a _____ was presumed dead and buried.
- This fear of being buried alive lead to the practice of placing a _____ with a string that ran inside the coffin-if someone was buried alive by mistake, they could ring the bell

<u>Definition of Death</u>

- Cessation, or end, of life
- Irreversible cessation of _____
- Cessation of all _____
- Experts do _____ agree on a single definition

<u>When does a coroner get involved??</u>

- _____
- Role of the Coroner:
  Certifies the person is dead
  Obtains preliminary observations about death
  May or may not be a physician
  Elected position
  Identifies the body
  Notifies next of kin
  Collects and returns personal belongings
  Issues a death certificate
  May or may not be a physician
  _____
  A physician who oversees the death scene and performs autopsies, typically a pathologist

Post-Mortem-'after death'

- _____ (PMI)
- The time between _____
- This helps to establish _____
- Important in:
    - Determining if suspect has an alibi at time of victim death
    - Determining if victim was alive or dead before a fire or being found in a lake
    - Is decedent a murder or accident victim?
- A combination of methods is used to determine time of death
- The longer the post-mortem interval, the _____

The Manner of Death

- The manner of death can be
    - _____, the most common
    - _____
    - _____
    - _____
    - Undetermined
- Sometimes the manner of death is difficult to determine

Classify the Manner of Death in the Following:

- A man with a heart condition is assaulted and dies from a heart attack during the assault._____
- An elderly woman dies due to neglect by her son, who lived with her. _____

Cause and Mechanism of Death

- *Cause of the death* is the _____
    - Examples: disease, physical injuries, a stroke, poisoning, and heart attacks to name a few.
    - _____: underlying cause of death as opposed to the final cause.
        - Example: a healthy man is kicked in the kidneys during a beating and soon dies of kidney failure. Proximate cause= the beating
- *Mechanism of death* is the _____that brought about the cessation of life
    - Example: if the cause of death is shooting, the mechanism may be loss of blood.

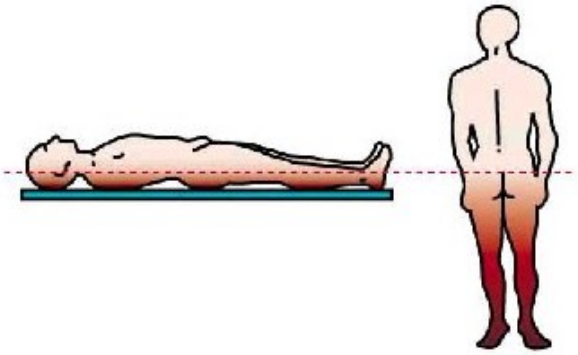
Body Changes after Death

Stage 1: _____

1. The _____, blood is no longer pumped, delivery of oxygen and glucose to cells stops.
2. The lack of oxygen and glucose means there is less energy for cells.
    i. if cells have greater reserves of oxygen and glucose, they will survive longer.
3. Cellular respiration converts to _____(no oxygen), resulting in less energy and a build-up of lactic acid.
4. Toxic wastes accumulate. The increased level of lactic acid lowers the pH of the cells. _____ allowing the cytoplasm to seep out of the cells.

Stage 2: _____—cell breakdown/self-digestion

- Autolysis happens in damaged or injured cells.
- Cell enzymes are released inside the cell that cause the _____and rupture of the cell membrane



Time of Death—Livor Mortis

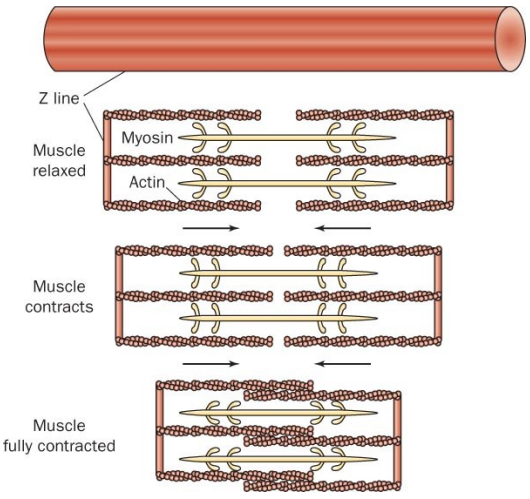
- _____
- _____—With decomposition, blood seeps down and settles in the lower parts of a body
- _____: blood cells and blood vessels decompose during autolysis hemoglobin is released from red blood cells and spills into blood vessels-the substance then pools
- Red blood cells turn _____

Time of Death—Livor Mortis

- Lividity begins about _____
- Discoloration becomes permanent after _____
- Ambient temperature affects the _____
- Lividity can determine the _____during the first eight hours
  - Areas of pressure (_____) on the body prohibit the blood from settling and lack this coloration
- Variables that affect livor mortis:
  - Temperature (_____), doesn't develop in individuals who have lost a lot of blood
- Dual lividity can show a body being moved

Time of Death—Rigor Mortis

- _____
- Without oxygen in the blood—
  - _____
  - Muscles stiffen
- Starts in the head and expands throughout
- After about _____—
  - Muscle fibers begin to dissolve
  - Softening begins
- Live muscle _____
- After death, muscle fibers become locked in a flexed position



Observation	Approx. Time Scale
The body is at its most rigid state	Just over
No visible signs of rigor	Less than
Stiffness generally disappears	After

Factors affecting rigor mortis:

- Ambient _____
- Weight of the body
- Type of clothing, or lack of it
- General health of person at time of death
- _____ at time of death
- Sun exposure

Time of Death—Algor Mortis

factor	Event	Effect	Circumstances
Temperature	**Cold**		**Slower onset an progression of rigor**
	Hot		**Faster onset and progression of rigor**
Activity before death	**Anaerobic exercise**		**Lack of oxygen to muscle, build up of lactic acid**
	sleep		**Fully oxygenated muscles exhibit rigor more slowly**
Body mass	**Obese**		**Fat stores oxygen**
	Thin		**Body loses oxygen quickly**

<u>The Chill of Death</u>

- Body heat falls after death
  - Heat loss is affected by the _____ and _____ other variables
- Time of death is expressed as a _____
- New evidence and research suggest this is the MOST limited in determining PMI
- "Rule of Thumb" PMI estimate:
  - Body feels warm and is limp (dead less than _____)
  - Body feels warm and is stiff (dead _____)
  - Body feels cold and stiff (dead _____)
- Body feels cold and is limp (dead more than _____)

<u>Time of Death—Stomach and Intestinal Contents</u>

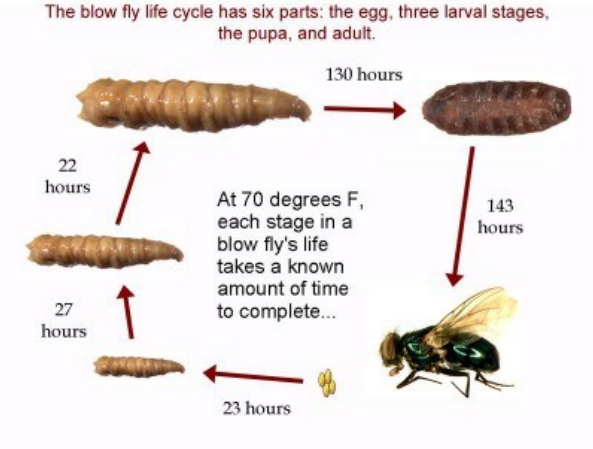
State of Contents	Timing of Death
Undigested food present in the stomach	after the last meal
Stomach is empty, but food found in small intestine	Death occurred at least _____ after a meal
Small intestine is empty; waste found in large intestine	Death occurred _____ after a meal

Time of Death—Insects

- Forensic entomologist
  - Collects insect evidence from on, above, and below the body
  - Records _____
- Within minutes of a death, certain insects arrive to lay their eggs on the warm body—blowflies
- As the corpse decomposes, _____

Time of Death—Blowfly Life Cycle

1. _____ after death—blowfly eggs can be found in the moist, warm areas of a corpse
2. Within _____—1st of their 3 larva stages
3. _____ day—3rd of their 3 larva stages
4. _____—larvae migrates to a dry place
5. _____— Early pupa; immobile; changes from light brown to dark brown
6. By the _____ day the pupa cases will split open and adult blowflies will emerge.



Time of Death—Insects

- The insect life cycle provides scientists with a benchmark to _____
- Insect evidence cannot provide an exact time of death—fluctuating environmental conditions
- Insect evidence provides a _____

Time of Death-Stages of Decomposition

- The physical and chemical changes experienced after death gives clues as to the _____, approximate _____, _____, and _____ of death.
- The _____ depends on the person's size, age, size of the body, and nature of the death.

Autopsy

- Performed when someone dies as a result of a crime or under certain other unusual conditions to determine the _____

Summary

- Several definitions of death
- A body decomposing through three stages— livor, rigor, and algor mortis—provides an estimated time of death
- Stomach contents and insect evidence also aid in estimating the time of death
- Environmental factors affect the estimated time of death

Investigation of Death: Autopsy

When is an Autopsy Performed?

- Whenever the cause of death is _____
- Generally speaking, the following circumstances require investigation by law:
- 1. _____ 2._____ 3._____
- Within 24 hours of entering a hospital or as a result of surgery
- A natural death when a doctor is _____or the patient is not under the care of a medical facility
- Occurs in police custody or in a correctional facility
- Results from a _____ that may pose a threat to public health

In Colorado, counties determine when autopsies are performed. Example from Weld county

- Where no physician is in attendance, or where though in attendance, the physician is unable (or unwilling) to certify the cause of death.
- All cases in which the attending physician has not been in actual attendance within 30 days prior to death.
- All cases in which _____ may be associated with the death (i.e., falls, _____ industrial accidents.)
- Any patient who has sustained a fracture; no matter how long ago
- Deaths by poison or suspected poisoning, chemicals or bacteria, industrial hazardous materials, or radiation.
- Known or suspected _____.
- Deaths where the deceased has a _____.
- All operating room deaths and deaths which occurring during a medical procedure.
- All _____ deaths due to suspicious circumstances.
- Deaths which occur within 24 hours of admission to hospital

Autopsy: "_____"

- A post-mortem examination of the body, including _____ of the corpse.
- Performed by a _____ (medical doctor)

3 Steps of a Death Investigation

1. Preliminary investigation is conducted at the _____
2. The body is transported to the _____ where the medical examiner examines the body and performs an autopsy
3. The medical examiner/coroner _____ on biological evidence collected during the autopsy

At the Death Scene

- The death investigator-Employed by the coroner's/medical examiner's office
- Responsible for;
    1. Initial assessment
    2. _____ and _____ of the body on scene
        - Position of the body, face (for identification), underside of the body (for lividity, blood, and trace evidence)
- Document signs of trauma
- Collect information regarding livor and rigor mortis, _____ to help establish time of death
- Investigators look for _____; any non-biological evidence that provides clues about time of death, (unopened mail, newspaper near the body, etc)
- Any evidence collected is properly stored and a _____ is established
- Once victim is identified, _____ and witnesses and the victim's family are interviewed
- _____ are placed over the victims _____ to protect trace evidence from being lost or preventing cross contamination

Medical Examination

The medical examination is to determine the manner, cause and mechanism of death

2 stages:

1. _____ Examination
2. _____ Examination/Autopsy

External Examination

What is examined?

- Clothing, boots/shoes, belongings in pockets should be _____ carefully for storage/packaging
- Surface of body
    1. Signs of _____/x-ray
    2. _____ samples
    3. _____ scrapings
    4. Fingerprints
- _____ evidence collection: Hairs, blood, plant debris, etc.
- _____evidence collection: Glass, soil, artificial fibers, etc

Internal Examination/Autopsy

Estimation of time of death:

- Algor, Livor and Rigor Mortis
- _____ contents
- _____ (from death scene investigation)
- Stages of Decomposition
    1. Fresh
    2. _____
    3. _____ Decay
    4. _____ Decay
    5. Dry/remains
- Fluids Collected
    - _____: Collected from femoral artery
    - _____: Collected from bladder
    - _____ Humor: Collected from inside of eye
    - _____-Spinal Fluid
    - Stomach/Intestinal contents

Stages of Decomposition

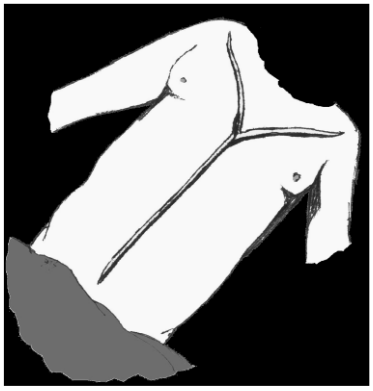
1. Fresh: Livor, algor, rigor mortis, _____, stoppage, _____ arrive
2. Bloat: accumulation of _____ from microbes, hemoglobin breaks down to form other _____ (marbling), maggots hatch, distinctive odors
3. Active Decay: loss of mass (maggots feeding/purging of fluids, _____ and _____, strong odors
4. Advanced Decay: reduced insect activity, _____
5. Dry/remains: resurgence of plant growth, remains=_____

Types of Autopsy

- _____: determine cause and manner of death and identify the decedent
- _____: diagnose a particular disease or for research.
    1. Can clarify or confirm medical diagnoses
- _____: performed by students of anatomy for study
- _____: performed using MRI's and CT scans

Autopsy

Trunk dissection; →



- _____ incision
- From the shoulders to the pelvic bone
- This incision is _____

Opening the Chest

- Skin & muscle, are pulled from the _____
- Chest Plate is extracted

Removal and Dissection of the Organs

Many methods of removal serve different purposes

- _____ method is an in-situ and en bloc examination of organs intact (still connected to one another)
- _____ method is an organ by organ removal.
    1. Not great for forensic autopsy-connections are lost between organs
- _____ method is the En Masse removal of all the viscera (thoracic, cervical, abdominal, pelvic organs) then dissected in organ blocks
    1. Preserves vascular supply and connections between organs.
- _____ method is "En Bloc" removal of organs that are physiologically connected to another, (thoracic, coeliac, urogenital)

After Organ Removal

Upon removal each organ is:

- _____ & _____
- _____ in cross sections
- Examined
- Sampled for microscopic & chemical analysis

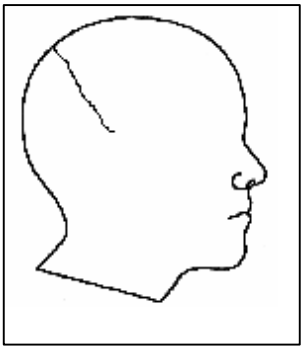
"Running the Gut"

The _____ of the stomach, intestines, and bowels must be inspected as well

Removing the Brain

The Scalp is cut _____

across the _____ of the head



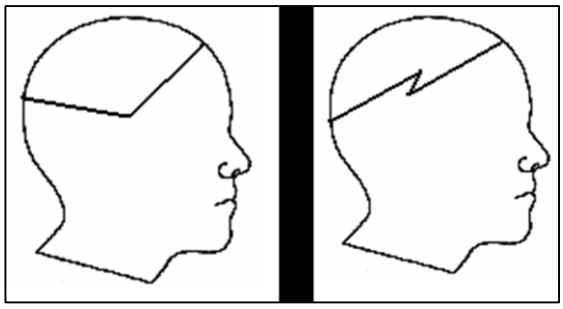
Exposing the Skull

Next the scalp is pulled forward and back to

_____

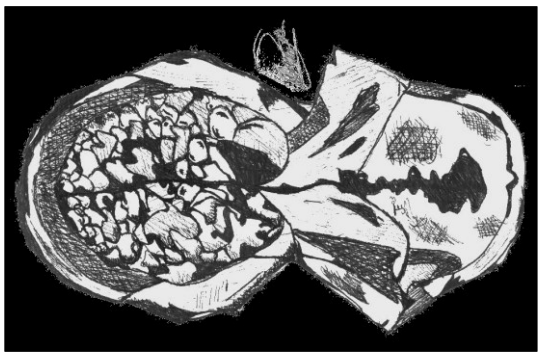
Exposing the Brain

Two methods of cutting the skull cap



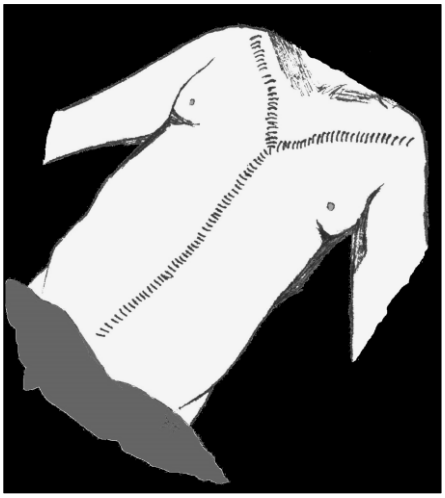
Removal of the Brain

- Spinal Cord is cut - The soft _____ is removed
- Brain is so _____ it must be placed In formaldehyde for about a _____ before an in depth examination



Close Up

- _____ is replaced
- Skin pulled back in place
- Body Organs _____ be replaced
- Incisions are sown up with the use of a _____ stitch



Laboratory Analysis

1. _____: the science related to the detection of drugs, alcohol, and poisons using bodily fluids such as blood, vitreous humor, and urine.
2. _____: the study of _____. Slides are made of organ tissue to analyze using a microscope. Disease/abnormalities can be detected.
3. _____: the study of _____ associated with the nervous system
4. _____: the study of blood, semen, and other body fluids with reference to legal matters

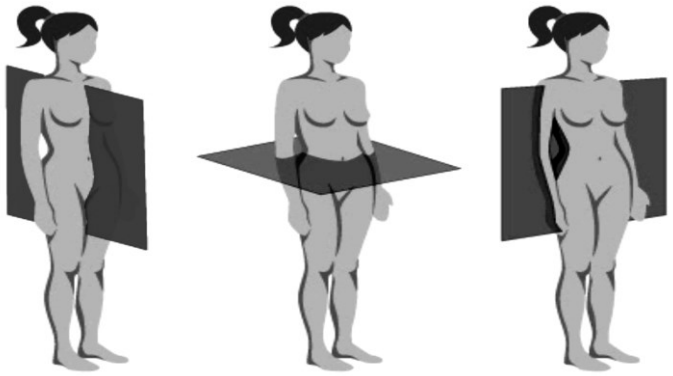
The Autopsy Report

1. _____: Case number, victim info, date/time of death, etc
2. _____ Examination : Full description of body & clothing, evidence of disease/trauma
3. Evidence of Injury: Description of any injuries and record of all _____
4. Internal Examination: Weights and descriptions of all major organ systems and _____, findings from toxicology/histology
5. Medical Examiner's _____: Cause and manner or death, results and outcomes of tests and examinations

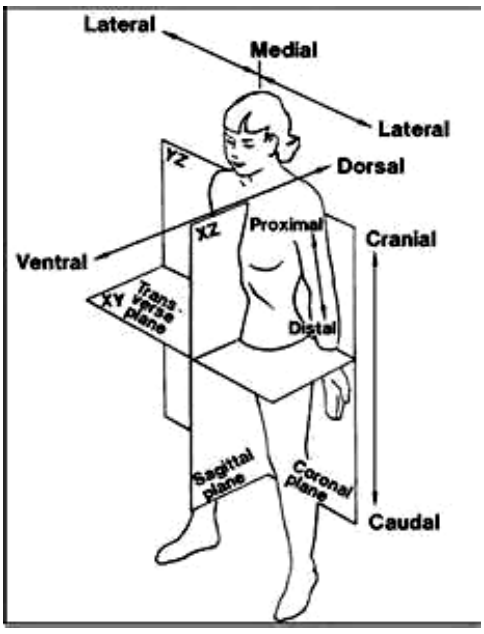
Investigation of Injury Notes

Anatomical Positions: Planes

_____ _____ _____



Anatomical Position



Right and left is the _____

Cranial v. caudal

_____ vs._____

Ventral v. dorsal

_____ vs._____

Lateral v. medial

Description: _____

_____

_____

Proximal v. distal

Description:_____

Physical Trauma

- The _____ of the injuries depend on:
- The amount _____ applied to the body
- The weapon's _____
- The part of the body affected

Force

Force is a _____ applied to an object

- Describes _____ the weapon hit the victim

Force = _____ x _____ or F=ma

Acceleration is the change in velocity over a period of time.

Therefore, an object moving quicker _____

Practice problem

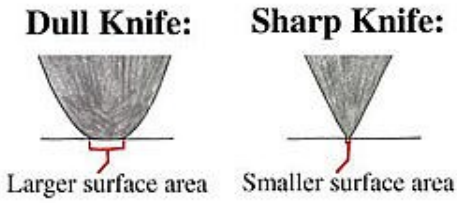
If a 1000kg car traveling at $10m/s^2$ or (45mph with 2 seconds to stop), what would be the force of the impact if it crashed into a wall?

F=ma → F= _____ x _____ so, F= _____

What if the speed was increased to 90mph?

_____

Surface area and pressure



If the same amount of force is exerted over a larger surface area, the injury _____.

Pressure= amount of force per unit area.

Pressure= _____

The force of a palm pushing against a wall _____ than the force of a closed fist

(_____ surface area = _____ pressure/force)

Surface area, Pressure, and force

A weapon with a larger surface area will inflict a _____ (if same force is applied)

What would have more force:

A narrow metal rod vs. a flat wooden board?

Answer: _____ = _____= _____

What would be more prone to severe trauma:

The skull vs. the back?

Answer: _____ = _____ =

_____=_____

Blunt Force Trauma

An injury resulting from an impact with a _____

Categories of blunt force trauma:

1. _____ 2. _____ 3. _____

Abrasion

A _____ injury to the superficial layers (epidermis) of the skin resulting from friction against a _____. Usually not deep, heal quickly

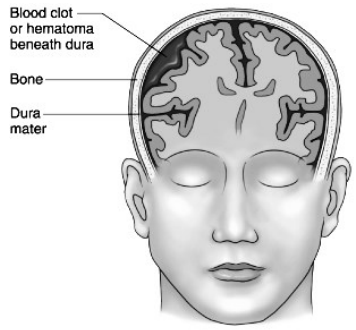
While alive: _____ Post-mortem: _____

Abrasions can be:

- Brush-force is parallel to skin
- Impact-force is perpendicular to skin
- Patterned-brush abrasion that causes an imprint on skin

Contusion (bruise)

Hemorrhage into the dermis, subcutaneous tissues, deep soft tissues, and internal organs resulting from a _____



Hematoma: swelling as a result of _____

Patterned contusion: the bruise looks similar to the object that produces it

Ecchymosis

Discoloration caused by the escape of blood into the tissues

_____ trauma-related, particularly in the elderly

Laceration

A _____ of the tissue resulting from compression or stretching associated with impact from a _____ object or surface

- _____ may occur where the skin splits but the _____ do not form a 'bridge' across the wound

Avulsion

Refers to a _____ of a body structure

Commonly used to describe _____, exposing underlying tissues.

Sharp Force Trauma

An injury produced by a pointed or _____, and characterized by a relatively _____ separation of tissues

Types: 1. _____ 2. _____ 3. _____

Stab/Puncture Wounds

Direction of force relatively _____ to skin surface

_____ of wound generally _____ than length on skin surface

Depth of wound can be greater than the length of blade that caused it.

Why? _____

Incised/Cut wounds

Sharp instrument is _____ the skin surface

_____ of wound is _____ than length on skin surface

Chop wounds

Combination of _____ and _____ injury

Can result in _____

Axes, hatchets, propellers, lawn mower blades

Gun Shot Injuries

Contact wound: Gun is _____ victim

Near contact wound: Gun is _____ victim

Intermediate-range wound: Gun is _____ feet away.

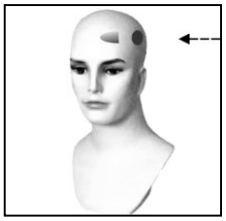
- Results in _____ (stippling)

Distant wound: Gun is _____ away

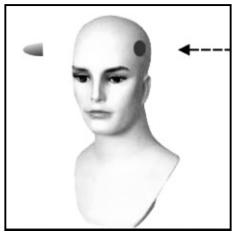
Entrance	**Exit**

Gunshot injuries

_____: entrance, but no exit



_____: entrance and exit



Patterned Injuries

An injury (generally an abrasion or contusion) that _____ some of the features of the

_____

Potential misinterpretations

- Mongolian spots- found on babies, _____
- Periorbital ecchymosis- _____ occurring around eyes
- _____ pupura