Differential Diagnosis in Forensic Medicine

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Case 1

- 36 year old female found in woods, partially wrapped in a sheet. Not seen for 4 days. Defects are on the extremities and groin. What would account for these wounds?
Postmortem animal activity: vultures
Interpretation of Injuries in a Forensic Setting

Premortem Injury

Postmortem Injury
Confounding Factors

- Decomposition
- Recovery of bodies from water
- Postmortem animal activity
Vultures: Curvilinear defects, Case 1

Internal organ consumption
X-ray
Exclude presence of radiopaque object
Pearls

- Don’t overinterpret injuries, especially in decomposing bodies
- Don’t exclude gunshot wounds without x-rays and/or postmortem dissection
Case 2

- A 16 year old female was found in the woods in a southern state in January. She had not been seen for a week. What is the postmortem interval (PMI)?
Case 2

Multiple choice:
A. 2 days  
B. 6 days  
C. 2 weeks  
D. 1 month

PMI = 6 days
Postmortem Interval (PMI)

- Determination unreliable
- Longer the PMI, the less precise the estimate
- Nonscientific methods:
  - Scene markers
  - Witnesses
- Use postmortem changes to support a scenario
PMI

- Rigor, livor, algor mortis
- Gastric contents
- Vitreous fluid
- Changes of decomposition:
  - Green discoloration, marbling, blisters, bloating, skin slippage, purge fluid, insect activity
Case 2

- Witness to a homicide
- Advertised on radio
- Found 6 days later
- Weather – some rain
- Temperatures averaged 49.4 F (range: 27 to 68 F)
- Fly eggs in eyes
Case 2

- Scene, clothing
Case 2

- Rigor - +1
- Livor – anterior fixed
- Gastric contents – 1 ounce green mucoid material
Case 2

- Vitreous Potassium level
  - 28 mmol/L
  - Formula: $\text{PMI} = 5.26 \times (28) - 30.9$
    - 116.38 hours
    - 4.8 days
Case 3

- 65 year old male involved in police shoot-out. Multiple gunshot wounds, including one to the sole of the foot, were present.
- Entrance or exit?

Entrance
Gunshot wound
Entrance Gunshot Wounds

- Defect in the skin
- Abrasion borders
Entrance Gunshot Wounds

- Exceptions
  - Palms, soles, re-entry wounds of axilla
- X-rays
  - Expansion of bullet fragments
  - Bone fractures
Entrance Gunshot Wounds

- May be larger than exit wounds
  - Contact to head
  - Distant to head over bony prominence
Entrance Gunshot Wounds

- Soot
- Stippling
Exit Gunshot Wounds

- Re-approximation
Exit Gunshot Wounds

- Shored abrasion borders
Pearls

- Caliber of bullet CANNOT be determined by measurement of gunshot wound

- \# entrances + \# exits + \# bullets = an even number
Pearls

- # entrances + # exits + # bullets = an even number
- Exception:
  - Artifactual exit wound
  - i.e. bone
Pearls

- \# entrances + \# exits + \# bullets = an even number
  - Exception:
    - Exit of portion of projectile
Case 4

- Adult male found with a gunshot wound to the temple. What is the most likely range of fire?
Case 4

Distant gunshot wound,
s/p medical manipulation (staples)
Pseudostippling

- Intermediate targets or ricochet bullets which fragment
- Plastic casing of handgun shot cartridges
- Postmortem insect activity
- Hemorrhage into hair follicles
- **Surgical manipulation**
Pseudostippling

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Shotgun Wounds

- Polyethylene filler in buckshot
  - Deposited on skin – 6 – 8 yards
  - Pseudostippling – 2 – 3 meters
Case 5

- 10 month old infant found unresponsive by parents in their bed. Most likely cause of death?

**DD:**
- SIDS
- Asphyxia
- SBSI/AHT
- Toxicologic

No internal findings
Case 5

* Mechanical Asphyxiation due to Wedging
Mechanical Asphyxiation

- Wedging
  - Facial petechiae/
    congestion of
    head may be
    absent in infants
Mechanical Asphyxiation

- **Wedging**
  - Blanching in dependent areas of livor
  - Compression marks
Mechanical Asphyxiation

- Wedging
  - May fade after removal from scene
Differential Diagnosis in ‘Negative’ Infant Autopsy

- Asphyxiation
  - Overlaying
  - Wedging
  - Homicidal smothering
- Commotio Cordis
- Toxicologic deaths
- SIDS
- Other natural death with few autopsy findings
Pediatric Autopsies

- Toxicology
- Metabolic studies
- Cultures
- Vitreous electrolytes, glucose, ketones
- Medical, historical and scene information
  Radiological skeletal survey
  - No Babygram
Pediatric Pearls

- The cause of death in pediatric cases should not be determined until ALL the information is collected, including:
  - Scene
  - Case history
  - Medical history
  - Full autopsy
Case 6

- Newborn infant found in garbage can of community college. Was he born alive or dead?

Drowning: born alive
Determining Live Birth

- Radiographs
  - ‘air’ in the lungs, GI, middle ears
    - Swallowing after delivery may result in air in the GI and middle ears
    - Putrefaction and CPR may distend these organs
Lungs that have undergone full respiration will be inflated and pink.
Lungs fill pleural cavity, are spongy.
No evidence of aeration.
No froth (?drowning?)
No evidence of live birth.
Determining Live Birth

- Hydrostatic test
  - VERY limited value
    - Decomposition
    - CPR
  - Float entire thoracic organs
  - Drowning with inhalation of water – false negative
Determining Live Birth

- **Food in the stomach**
  - Indicates live birth
  - Often not present due to short survival of neonaticide victim

- **Umbilical cord**
  - 24 – 48 hours – ring of reddening around base of cord and adjacent skin
  - Detachment – 5 – 9 days after birth
Determining Live Birth

Maceration – indicates intrauterine death
Determining Live Birth

- Unanticipated births on toilet
  - Not likely to produce fracture
  - Any trauma not likely to be fatal
  - Drowning
- Froth at mouth/frothy bubbles
  - supports live birth
  - Disappears with prolonged PMI
- Water/fluid recovered from stomach may be from passive entry
Pearls

- Most perinatal deaths are natural
- Evidence of life, viability
- Refrain from over-interpretation of autopsy findings
- Decomposition will obscure assessment of findings
Case 7

- This 48 year old man was found in his apartment. What is the manner of death?

Stab Wound: Suicide
Suicidal Stab Wounds - Uncommon

- Pull aside clothing

Case 7
Suicidal Stab Wounds

Case 7
Suicidal Stab Wounds

- Most to mid and left chest
- Hesitation stab wounds

Case 7
Case 7

One fatal wound
Scene Information

Weapon
Fingerprints
Blood patterns
Homicides: Defense Wounds
Case 8

This 16 year old male was found outside his home in his yard. What is the cause and manner of death?

Thermal Injury: Self Immolation, Suicide
Suicide

- Most common methods
  - Gunshot wounds
  - Hangings
  - Overdose

- Other methods
  - CO toxicity
  - Drowning
  - Fall from height
  - Sharp force injury
  - Motor vehicle crashes
  - Suffocation
Self Immolation

- Some cultures – political or religious connection
- Rare in Western society
- Isolated or private areas

Case 8
Self Immolation

- Depression
- Suicide note/notification of intent (up to 50%)

Case 8
Self Immolation

- Male vs. female predominance
  - Male predominance in suicides, accidental fires
- Age Range wide
  (15 – 58 years – MUSC)

- Alcohol and drug use
  - Varies
  - Common in other methods of suicide
Self Immolation

- May be misinterpreted as accidental
- Cause of Fire
  - Accelerant
  - Irregular charring
  - ‘Drip’ marks

Case 8
Burns prominent anteriorly with accelerant
Self Immolation

- Preserve clothing, skin, or soil underneath victim
  - Place in sealed glass or metal container

Case 8
Self Immolation

- Carbon Monoxide
  - High to minimal levels

- Reflex closure of airway
  (hot air blast)

- Flash fire:
  consumption of oxygen

- Predisposing conditions
  (elderly, heart disease)
Fire Deaths

- Accidental vs. Homicide vs. Suicide
  - CO
    - Fatal premortem trauma absent in suicides, accidents
      - (internal organs frequently preserved)
  - X-rays required
Fire Deaths

- Bondage
Case 9

- A 14 year old male is recovered from the river 3 days after falling off a boat. What is the most likely cause of his injuries?
*Drowning and chop wounds from boat propeller*
Chop Injuries

- Heavy instruments with a cutting edge
  - Cutting and blunt force trauma
  - Incised wound with underlying comminuted fractures/deep groove in bone
Boat Propellers

- Multiple, parallel and curvilinear injuries

Case 9
BACKWARD RAKED BLADES
CONCAVE CUTS

BOAT DIRECTION
Reconstruction of propeller injuries

Distance between chop wounds

Case 9
Other Boat Injuries
Scuba Equipment
Death in water

- Marine activity
- Abrasions to knees, arms, head

- Decomposition slowed until removal from water
  - Rigor may be accelerated due to energy expenditure
Drowning

- Leaching of blood in premortem injuries
  - Dissection of wound tracts
Case 10

- A 35 year old female was driving a car which veered off the road and struck a traffic sign (20 mph). What is the most likely cause and manner of death?

Subarachnoid hemorrhage
Case 10

Ruptured Berry Aneurysm: Natural
Traffic Fatalities

- **Purpose of autopsy:**
  - Alive/Nontraumatic COD?
  - Driver vs. passenger?
  - Injury reconstruction?
  - Toxicology?
  - Airbag injury?
  - Fire/Carbon monoxide exposure?
Natural Events Precipitating MVC

- Cardiovascular
  - Myocardial infarction
  - Coronary anomalies
  - Aortic dissection
  - Valvular diseases
- Cerebrovascular events
- Pulmonary thromboemboli
- Seizures
- Asthma
- Anaphylaxis
Natural Events

- Vehicle decelerated
- Minimal vehicle damage
- Minimal/nonfatal injuries to decedent
- Scene reconstruction
Head Injuries

- Impaction on interior
- Intrusion of passenger compartment
- Ejection (full or partial)
- Airbag deployment
Intracranial Hemorrhage

- Epidural, Subdural hemorrhage ~ traumatic
- Subarachnoid hemorrhage
  - Extension of traumatic hemorrhage
  - Rupture of berry aneurysm*
  - Rupture of hypertensive intracerebral hemorrhage
  - Vascular malformation rupture
  - Hematologic disorders
  - Tumors

*Most common cause of significant, nontraumatic SAH
Cerebrovascular Disease vs. Trauma

- Hypertensive hemorrhage
  - Basal ganglia, thalamus, pons, cerebellum
  - Most common cause of primary cerebral parenchymal hemorrhage
Cerebrovascular Disease vs. Trauma

- Hemorrhagic Infarcts
  - Emboli
  - Neoplasms
  - Infections
  - Hypercoagulable state/hemorrhagic diathesis

- Trauma is associated with contusion of outer cortex
Motor Vehicle Crashes

- Mechanical and Positional asphyxiation
Case 11

- An 89 year old female is found dead in bed at a nursing home. She had a history of dementia and psoriasis. What is the cause of her periorbital cutaneous findings?

**Thrombocytopenia due to Methotrexate toxicity**
Petechiae

- Decomposition
- Vomiting
- Coughing/gagging
- CPR
- Asthma
- Infection
- Mechanical Asphyxiation
- Strangulation
- *Disorders of coagulation*
Other Considerations

- Liver disease
- Over-anticoagulation

- Coagulation studies (ie. PT/aPTT) cannot be performed on postmortem blood