Forensic Pathology

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Forensic Pathology

- Branch of medicine that applies the principles and knowledge of medical sciences to problems of field of law
- Forensic Pathologists involved with many types of deaths
  - Violent (accidents, suicides, homicide)
  - Suspicious
  - Sudden and unexpected
  - Deaths without physician in attendance
  - Deaths in an institution
    - Hospital: <24 hours
Forensic Pathology

* Major Duties
  - Cause and manner of death
  - Identify the deceased
  - Determine the time of death
  - Collect evidence from body to prove/disprove persons guilt/innocence and confirm account of death
  - Document natural disease
  - Determine contributory factors to death
  - Provide testimony if goes to trial
Forensic Pathology

- **Cause of death**
  - Injury/disease that produces physiological derangement resulting in death
    - Gunshot wound, stab, coronary atherosclerosis

- **Mechanism of death**
  - The physiological derangement produced by cause
    - Hemorrhage, septicemia, cardiac arrhythmia
Forensic Pathology

- Manner of death
  - Natural, homicide, suicide, accident, undetermined
Forensic Pathology

Coroner system
- Individual who is not a physician is elected
- Makes ruling as to cause and manner
- Not required to consult physician
- Not required to order autopsy
- Not required to agree with autopsy findings
- No training required
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Medical Examiner System

- Physician designated as “medical examiner” to determine cause and manner
- Can perform autopsies in cases that need them
- Established laboratory for use
- 60% country
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- Time of Death
  - Difficult, imprecise and often not possible
  - In virtually all cases can only give range of time (12-24 hours prior to discovery)
  - As the interval between time of death and discovery increases so does inaccuracy of estimation
Forensic Pathology

Factors Used in Estimating Time of Death

- Livor mortis
- Rigor mortis
- Body temperature
- Degree of decomposition
- Chemical changes in vitreous
- Stomach contents
- Insect activity
- Scene markers
Forensic Pathology

*Livor Mortis*

- Reddish purple coloration due to settling of blood by gravity in dependent areas of body
  - Occasionally misinterpreted as bruising
  - On firm surface appear pale
  - In individuals dying of cardiac death, may begin prior to death
- Onset $\frac{1}{2}$ to 2 hours after death
- Max coloration 8-12 hours
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Livor Mortis
  - “shift”
    * Intravascular collection of blood
    * Can move from one area to another
  - “fixed”
    * Blood has hemolyzed and begins to diffuse into extravascular spaces (decomposition)
    * Coloration will not move
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★ Rigor mortis
- Stiffening of the body after death due to postmortem muscle contraction
- Due to loss ATP from muscle
  - Development of a stable actin-myosin complex preventing muscle fiber relaxation
- Onset 2-4 hours after death
- Fully developed 6-12 hours
  - Jaw, upper extremities, lower ext.
    - Disappearance in same order
- Lost due to decomposition
Forensic Pathology

- **Rigor mortis**
  - Acceleration of development
    - Violent exercise (deplete ATP)
    - High body temperature
  - Temperate climates
    - persists 36-48 hours
  - Hot weather
    - Disappear less than 24 hours
  - Cold weather
    - Persist for several days
Forensic Pathology

- Body Temperature
  - Most commonly used method of “accurately” determining time of death
  - Based upon everyone having a “normal” temperature at time of death and assumption body cools at uniform rate
  - Both incorrect
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Body temperature
- In normal subjects: 96-100.8°F
- Diurnal variation
  - Low at 6 am
  - High at 4-6 pm
- Normal temperature slightly higher in women
- Strenuous exercise and chronic disease can raise temperature
Body temperature

- Body cooling not uniform
  - After death there is a plateau where cooling does not appear to occur
  - Body habitus influences cooling
    - Fat acts as insulator retarding heat loss
  - Infants cool quicker (mass/surface area)
Body temperature
- Ambient temperature and climate conditions influence rate of cooling
- How was deceased dressed
  - Clothes retard heat loss
- Surface body is lying on
  - Marble is a good heat conductor
  - Rug will insulate body
Forensic Pathology

- Postmortem vitreous potassium levels
  - Not valid
    - Levels of potassium determined by degree and rapidity of decomposition
    - Accelerate decomposition raises potassium levels
      - Time only one factor
Decomposition

- **Autolysis**
  - Aseptic breakdown of tissue caused by intracellular enzymes
    - Pancreas

- **Putrefaction**
  - Breakdown of tissue due to bacteria
  - Gastrointestinal tract main source
  - Main cause of decomposition
  - Accelerated by hot environment and sepsis
Decomposition

* Putrefaction
  - Greenish discoloration of skin in lower quadrants of abdomen
  - Green-black discoloration of face and neck
    * Swelling
    * Protrusion of eyes, tongue
    * Decomposition fluid (purge fluid) from nose and mouth
      - Reddish in color, mistaken for blood
Decomposition

- **Putrefaction**
  - Body swells due to gas formation
    - Slippage of skin with marbling and blister formation
    - Marbling is greenish black discoloration along blood vessels due to reaction of hemoglobin and hydrogen sulfide
    - Skin color changes to green then black
Decomposition

**Putrefaction**
- Hair will slip from scalp
- Internally brain becomes porridge like with other organs reduced to consistency of putty
- Rate of decomposition determined by environmental temperature
  - Hot climates: advanced decomposition in 24hrs
  - Moderate climates: 1-2 weeks
- Skeletonization: 1-2 weeks to months to years
Natural Disease

- If death has occurred as the result of a natural disease process in most cases the medical examiner is not involved
  - Ex. elderly person found dead at home
- Majority of natural deaths investigated involve cases where death has occurred suddenly or unexpectedly
  - Sudden unexpected death due to natural disease is uncommon between 1-30 y.o.
Natural Death

- Cardiovascular Disease
  - 300,000 to 400,000 deaths a year
  - Leading natural cause of death in men 20-65 yrs
  - In medical examiner cases may not have classic symptoms (chest pain, angina)
    - Abdominal pain/indigestion
    - Back, shoulder, neck pain
    - In cases where infarction goes unrecognized
      - Wall rupture may occur presenting as sudden death
Natural Death

- Coronary Artery Disease
  - 75% of all sudden deaths handled by medical examiners
    - 50% die suddenly
    - 25% die without any preceding history or warning
  - Mechanism of death usually lethal cardiac arrhythmia
    - Ventricular arrhythmia 80% cases
    - Sudden asystole 20%
Natural Death

Coronary Artery Disease
- Anatomic findings
  - Severe coronary artery atherosclerosis (most common)
    - Usually 2 vessels, occasionally only 1 (usually LAD or left main)
    - Stenosis greater than 75%
  - Myocardial scarring
  - Infrequent findings
    - Coronary artery thrombosis (<15%)
    - Acute/subacute myocardial infarct
Natural Disease

🌟 Hypertensive Cardiovascular Disease
  – Most cases of hypertensive cardiovascular disease accompanied by coronary artery atherosclerosis
  – Cardiomegaly usually present
  – Mechanism death
    ✨ Acute cardiac arrhythmia
      – Cardiomegaly alone can predispose to arrhythmia
Natural Disease

* Cardiomyopathy
  - Diseases characterized by myocardial dysfunction of known and unknown etiologies
    * Not due to arteriosclerosis, HTN, valvular disease, infection
  - 3 categories
    * Congestive or dilated cardiomyopathy
    * Hypertrophic cardiomyopathy
    * Restrictive cardiomyopathy
Natural Disease

- Central nervous system disorders
  - Less common than cardiovascular disease deaths
  - Most common
    - Epilepsy
    - Intracerebral hemorrhage
    - Non-traumatic subarachnoid hemorrhage
    - Meningitis
    - Undiagnosed brain tumor
Central Nervous System Disorder

- Epilepsy
  - Usually young and often found in bed
  - Complete autopsy generally negative
  - Toxicology reveals absent or sub-therapeutic levels of anticonvulsants
    - Therapeutic levels may also be present
  - Bite wounds to tongue only in 25%
    - Nonspecific, perimortem seizure activity can accompany other causes of death
  - Mechanism of death: cardiac arrhythmia
  - Gross and microscopic changes in brain are usually absent
**Central Nervous System Disorder**

* Intracerebral hemorrhage
  - Can lead to sudden rapid death
  - Occurs in 10-30% of all strokes
  - Hypertension most common cause (45%)
    * Basal ganglia, thalamus, pons, cerebellum and subcortical white matter
  - Other causes
    * Amyloid angiopathy, AV malformation, tumors, bleeding diathesis, drug induced, vasculitis
  - Death is due to secondary brain stem compression/herniation or intraventricular hemorrhage
Central Nervous System Disorder

✶ Cerebral infarction (ischemic stroke)
  – Less frequent cause of sudden death and therefore is seen less frequently in medical examiners office
  – Less likely to cause death in less than 24 hours before diagnosed at hospital
Central Nervous System Disorder

- Nontraumatic subarachnoid hemorrhage
  - Ruptured berry aneurysm of cerebral vasculature (#1)
    - 90% silent until rupture
    - Multiple 15-20% cases
    - 2/3 symptomatic between ages 40-60, 1/3 symptomatic earlier
    - 80-90% found on the anterior portion of the circle of Willis
    - In fatal cases: 60% die immediately, 80% <24 hours
Respiratory System

- Sudden death due to respiratory causes is relatively infrequent
  - 10% of all sudden natural deaths
- Main pulmonary disease
  - Pulmonary thromboembolus
  - Bronchial Asthma
  - Acute Epiglottitis
Respiratory System

확장형 피사체

- Usually results when lower extremity thrombus becomes dislodged and travels to heart/lungs

확장형 피사체 원인

- Blood stasis
  - Immobility, obesity, intrapelvic tumors, pregnancy
- Venous injury
- Hypercoagulable disorder
Respiratory System

 ¶ Pulmonary Thromboembolus
  – Sudden death usually from embolus in main pulmonary artery
    ¶ If 60% pulmonary vasculature blocked the heart cannot pump blood through lungs
  – Manner of death
    ¶ Mechanical obstruction (large embolus)
    ¶ Vasoconstriction due to vasospasm if multiple smaller emboli
Respiratory System

- Pulmonary Thromboembolus
  - If PE found at autopsy attempt to locate origin
    - Pelvic veins, incisions into popliteal fossae and posterior calves
    - Usually no residual thrombi found
  - Pulmonary infarcts
    - < 10% of PE cases
Respiratory System

- Bronchial Asthma
  - Chronic bronchial asthma may be associated with sudden death in a small percentage (5%) of all cases of chronic asthma
  - May occur without prolonged attack
  - Increased frequency at night or early morning
  - Triggers
    * Allergens, infection, drugs (aspirin), psychological stress, exercise, cold air
Respiratory System

- Bronchial Asthma
  - Mechanism of death
    * Reduced air flow with ventilation-perfusion mismatch resulting in decreased oxygenation of blood/ increased CO2 and right ventricular overload
    * Decreased airflow due to allergic release of histamine/vasoactive compounds from inflammatory cells causing bronchial smooth muscle contraction
    * Also have marked intrabronchial mucus secretions
Respiratory System

* Acute Epiglottitis
  - Mechanism of death
    * Marked edema of epiglottis and upper airway mucosa leading to mechanical obstruction of airway
    * Death can be very rapid
      - Occasionally precipitated by pharyngeal examination with tongue depressor
    * Most common cause: H. influenzae
      - Other bacteria: S. pneumoniae
Deaths in Association with Pregnancy

- Deaths secondary to complications of pregnancy
  - Uncommon due to better prenatal care and more aggressive medical therapy
  - In one study of 1453 pregnancy related deaths
    - 54.9% followed live birth
    - 7.7% occurred while pregnant
    - 7.1% followed stillbirth
    - 10.7% followed ectopic pregnancy
    - 5.6% followed abortion
Deaths in Association with Pregnancy

- Most common causes of death
  - Hemorrhage (#1)
    * Ectopic most common etiology
  - Embolism
  - Pregnancy induced hypertensive complications
    * Pre-eclampsia, eclampsia
  - Infection
  - In cases of death from embolism
    * PE are more common than amniotic fluid embolism
Intraoperative Deaths

• Deaths during diagnostic and/or operative procedures fall into five categories
  – Deaths due to underlying disease
  – Disruption of a vital organ during a procedure
  – Air embolism during surgery
  – Anesthetic related deaths
  – Cause of death cannot be ascertained
Intraoperative Deaths

- Deaths due to underlying disease
  - Deaths occur because of the underlying disease that necessitated the procedure
  - Not due to the procedure
  - Ex. individual put on cardiac bypass pump for coronary bypass surgery whose heart when removed from the pump does not come back
Intraoperative Deaths

- Disruption of vital organ during procedure
  - Catheters being passed into right atrium, right ventricle or pulmonary artery have perforated organ
  - Perforation of coronary artery during angiography
  - Some mechanical disruption not unexpected when realize dealing with diseased friable vessels
Intraoperative Deaths

- Air embolism during surgery
  - Most commonly in surgery of the
    - CNS, laminectomy procedure

- Anesthetic related deaths
  - Examples:
    - Intubation of esophagus, administration wrong gases, drug overdose, allergic reaction to iodine based dyes
    - Malignant hypertension
      - Halogenated anesthetics and succinylcholine
Intraoperative Deaths

**Anesthetic related deaths**
- Deaths due to allergic reaction are rare
- Usually straight overdose
- Most local anesthetics are cardiotoxic and thus can cause fatal arrhythmias
  - If local anesthetic (epinephrine) is injected intravascular can cause cardiac toxicity/arrhythmia

**Cause of death can not be ascertained**
- Negative autopsy and toxicology
- Mechanism is presumed to be cardiac but underlying process(es) in death is unknown
Blunt Force Injury

- Abrasion
- Contusion
- Laceration
- Fracture of Skeletal System
Blunt Force Injury

- **Abrasion (a scrape)**
  - Removal of superficial epidermis due to friction against rough surface

- **Contusion (bruise)**
  - Hemorrhage into soft tissue due to rupture of blood vessels caused by blunt trauma
    - Skin, lung, heart, brain, muscle
    - Hematoma- large focal collection blood
Dating of Contusions

- Histology
  - Not possible

- Color changes
  - Depth and skin pigment affect appearance
    - Superficial bruises appear yellow sooner
  - Depth and location influence time of onset
    - Superficial bruises and bruises eyelids immediate
Dating of Contusions

- Evolution in color
  - Hemoglobin degradation
  - No standard terminology
    - Violet, reddish purple, bluish purple, purple
  - Rate of color change variable
    - Person to person and bruise to bruise
Blunt Force Injury

- **Laceration**
  - Tear in tissue caused by shearing or crushing force
    - Internal organs and skin
    - Blows from blunt objects, falls, vehicle impact
    - Skin-irregular with abraded contused margins
    - Most over bony prominences
  - Explore for presence of foreign material deposited by weapon or surface
Wounds due to pointed and edged weapons

- Stab wounds
- Incised wounds
- Chop wounds
Wounds due to pointed and edged weapons

- **Stab wounds**
  - Pointed instruments
  - Depth wound tract exceeds length in skin
  - Skin edges sharp without contusion/laceration
  - Most due to single edge knives
    - “V” shaped appearance
  - Secondary tract
    - Knife twisted, victim moves as knife pulled out
Wounds due to pointed and edged weapons

- Incised wounds
  - Cuts produced by sharp edged weapons or instruments
  - Wound has clean cut straight edges without abrasion/contusion
  - Longer on skin than deep
  - Hesitation marks
    - Self inflicted incised wounds
    - Superficial
Wounds due to pointed and edged weapons

- Chop wound
  - Produced by heavy instruments with cutting edge
    - Axe, machete, meat cleaver
  - May have combination incised and lacerated characteristics
    - Combination cutting and crushing
    - Most incised appearance
Asphyxial death

- Failure of cells to receive/utilize oxygen
- Non-specific “Classic” signs
  - Visceral congestion, petechiae, cyanosis
Asphyxial death

* Petechiae
  - Pinpoint hemorrhage produced by rupture of small vessels
  - Sudden over distension/rupture vessels due to abrupt increase intravascular pressure
    * Visceral pleura, epicardium
  - Strangulation
    * Conjunctivae, sclera
  - Vomiting, coughing, acute heart failure
Asphyxial death

- Suffocation
- Strangulation
Asphyxial death

- Suffocation
  - Failure oxygen to reach blood
    - Smothering, choking, mechanical asphyxia
  - Smothering
    - Mechanical obstruction of external airways
      - Plastic bag, gags, pillows
  - Choking
    - Obstruction within air passages
Asphyxial death

- Mechanical asphyxia
  - Pressure outside body prevents respiration
    - Heavy weight presses down on chest/upper abdomen
      - Under car repairing it
    - Trapped in a restricted space resulting in restriction of ability to breath
      - Alcohol/ drugs
      - Falls down a well and is wedged between walls
Asphyxial death

- Strangulation
  - Closure of blood vessels and air passages of neck as a result of external pressure on neck
  - Hanging
  - Ligature strangulation
  - Manual strangulation
Strangulation

- In all forms the cause of death is cerebral hypoxia secondary to compression vessels supplying blood to brain
  - Carotid arteries
    - Direct pressure to front of neck
    - 11 lb pressure needed
    - Unconsciousness in 10 seconds
  - Vertebral arteries
    - Severe lateral flexion or rotation neck (hanging)
    - 66 lb pressure needed
Strangulation

• Hanging
  – Asphyxia secondary to compression or constricture of neck structures by constricting band tightened by weight of body
  – Virtually all suicides
  – Death due to compression blood vessels
    • Can also obstruct airway but not necessary
    • Rarely fracture neck
Strangulation

Hanging

- Furrow on neck
  - Does not completely encircle neck but slants upward toward knot (point of suspension)
  - Point of suspension side > back > front neck
- Face is pale
- Tongue is protruding and black
- Blood pools in dependent areas
  - Punctate hemorrhages (Tardieu spots)
Strangulation

kreśl Hanging

– Internal structures neck
  ✴ 50% no injuries
  ✴ 10-15% fracture of thyroid or hyoid bone
  ✴ 25% petechiae
    – Absence due to complete obstruction arterial system
Strangulation

Ligature
- Pressure on neck applied by constricting band that is tightened by force other than body weight
- Virtually all homicides
- Mechanism death same as hanging
Strangulation

*Ligature*
- No complete occlusion of vasculature
  - Blood from vertebral arteries
  - Compression venous system
- Face and neck markedly congested
- Confluent scleral/ conjunctival hem.
- 86% fine petechiae periorbital
- Ligature mark usually encircle neck in horizontal plane
- Rarely injury to internal neck structures
Strangulation

- Manual Strangulation
  - Pressure from a hand, forearm, other limb against neck compressing internal structures
  - Virtually all homicide
  - Mechanism death same
  - Occlusion airway minor role if any
Strangulation

« Manual Strangulation
  – Face congested and cyanotic
  – Petechiae conjunctivae and sclerae
  – Marks of violence
    ✳ Abrasions, contusion, fingernail marks
  – Internal neck
    ✳ Extensive musculature hemorrhage
    ✳ Fracture hyoid/ thyroid in older patients
Sudden Infant Death Syndrome

- Sudden unexpected death of an apparently healthy infant
- Less than 1 yr age
- Examination scene, review of history and complete postmortem examination fails to reveal cause of death
- Diagnosis of exclusion
SIDS

- 4-5000 deaths year in US
- Decreasing incidence
  - 1992: 1.2/1000
  - 1996: 0.74/1000
- Heterogenous group of disease processes
SIDS

- Most occur 2-4 months age
  - 92% less than 6 months
- Death below 1 month probably not due to same condition(s)
  - Inability to adapt to new environment
- While child is asleep
  - Peak midnight and breakfast
- Premature infants at greater risk
SIDS

- Males greater than females
- Race not a factor
- No known genetic etiology
- Temperature decrease - increase SIDS
- Occur in families at random
  - 1st death SIDS, 2nd undetermined, 3rd need intensive investigation
Child Homicide

- 1999: 280 children between 1-4 years murdered in US
  - Infanticide: killing of child 1st year
    - Usually parent
  - Neonaticide: killing of child within 24 hours of birth
    - Usually mother
      - Young, unmarried
    - Usually smothering
  - After few days of life
    - Perpetrators more varied
    - Death usually due to blunt trauma head/abdomen
Child homicide

- Classic battered child
  - Neglected/ starved
- Impulse or “Angry” homicide
  - Punished child
  - Most child homicides
- “Gentle” homicide (smothering)
  - Munchausen Syndrome by Proxy
Child homicide

- Battered baby syndrome
  - Repeated intentional acts of trauma to a young child inflicted at slightest provocation
  - Deprivation food/ water
  - Presents to physician with acute injury and evidence old injuries
  - Delay in bringing child to hospital
Child homicide

• Battered baby syndrome
  – Significant discrepancy between hx and clinical findings
  – Explanations of trauma vague/ inconsistent
  – Head injuries from falling out of arms, chair, bed
  – Burns: put hand in boiling water, climbed into tub, sibling
  – Starvation: “fussy eater”
  – Often severe diaper rash
    • “very tender skin”, “allergic to everything”
Child homicide

- Battered baby syndrome
  - Autopsy
    - Multiple bruises various ages
    - Pattern bruises
    - Long incisions down back, buttocks, extremities to reveal soft tissue hemorrhage
    - Most die head trauma +/- fracture
    - Retinal hemorrhage
    - Punched in abdomen
      - Liver laceration, spleen rupture, tear mesentery
Child homicide

- “Angry” or “Impulse” homicide
  - Most cases
  - Sudden violent act brought on by trivial provocation
  - Child picked up and thrown/ slammed
  - May be well cared for
Child homicide

- “Gentle” homicide
  - Smothering most commonly missed method
  - Minor force necessary therefore no evidence trauma
    - Autopsy unremarkable
    - Small percentage of SIDS (<10%)
Child homicide

- Munchausen’s Syndrome by Proxy
  - Usually mother
  - Child brought to physician for induced signs and symptoms of illnesses
    - Multiple hospital admissions
    - Extensive evaluations/procedures
      - Hypoglycemia with insulin
      - Prick finger and put blood in urine
Child homicide

- Munchausen’s Syndrome by Proxy
  - Smothers child and then resuscitates or brings to ER semi-moribund
    - Hx apnea, cyanosis, loss of consciousness
  - Continues to recur
  - Extensive negative workup
Shaken Baby Syndrome

- Retinal, subdural and/or subarachnoid hemorrhage caused by violent shaking
  - Whiplash action of child’s relatively heavy head in association with weak neck muscles
  - Immature partially membranous skull
  - Large subarachnoid space
  - Soft immature brain
Shaken Baby Syndrome

- Acceleration-deceleration traction stresses due to head whipping back and forth
- Original reports
  - Diagnosis made clinically
  - Autopsies not always performed
Shaken Baby Syndrome

- More cases
  - Injuries to scalp and skull (contusions and fractures)
    - Impact trauma
  - Biomechanical study
    - Model 1 month old infant with accelerometer
    - Can not shake hard enough
      - Amount of shaking necessary would break neck
      - No cases of syndrome with broken neck
    - Injuries due to impact of head
  - Pediatrician vs Forensics
Wound Ballistics

- Severity of wound
  - Amount of tissue shredded
  - Amount of Kinetic Energy lost by bullet in body
  - KE = \( \frac{1}{2}mv^2 \)
    - Need to transfer KE to tissue to create maximum damage
Wound Ballistics

- Bullet enters tissue
  - Imparts radial motion to tissue creating temporary cavity much larger than permanent
    - 5-10 ms
    - High velocity projectiles can cause injury far from path of bullet
    - Handgun temporary cavity not important
Handgun wounds

- Discharge gun
  - Bullet
  - Flame 1400 F
  - Gas
  - Soot
  - Powder: burning and unburnt
  - Metal vaporized from bullet and jacket
  - Primer compounds
  - Copper and nickel vaporized from cartridge case
Distance

- Contact
- Near contact
- Intermediate
- Distant
Type of wounds

- **Contact**
  - Muzzle is in contact with body
  - There is
    - Scorching of the wound edges
    - Soot deposited on wound margin
    - Soot driven into wound tract
  - There May be
    - Muzzle impression
    - Soot on skin adjacent to wound
Type of wounds

- **Contact**
  - Over bone
    - Stellate entrance wound
    - Soot deposited around bone entrance
    - Soot may be deposited on inner surface of skull
  - Clothing may absorb soot and powder
    - Soot still inside wound tract
Type of Wounds

**Near Contact**
- Transition between contact and intermediate
- Entrance surrounded by wide band of seared blackened skin
Type of Wounds

Intermediate
– “powder tattooing”
  – Punctate abrasions of skin due to impact of unburnt and burning grains of powder in skin
    – Not burns
  – Range depends on gunpowder, barrel length, caliber
  – Size and density powder tattoo can determine range
Type of Wounds

- Intermediate
  - Soot present up to 12 inches for handguns
    - Can wipe off, not powder tattooing
  - Tattooing for handguns
    - Flake powder: 2 feet
    - Flattened ball: 3 feet
    - Ball powder: 4 feet
Type of Wounds

- Distant
  - No soot or tattooing
  - Cannot determine exact range
  - Entrance wound
    - Abrasion ring
    - Small, circular or oval, regular (except for contact over bone)
    - Can not tell caliber by entrance wound
Type of Wounds

- Exit wounds
  - Larger and more irregular than entrance
    - Bullet tumbling
    - Bullet deformation
  - No abrasion ring
Type of Wounds

• Bullet wound of skull
  – Entrance
    • Punched out with sharp edges
    • Opposite surface beveled
  – Exit
    • Beveled or cratered outward
High Velocity Rifle Wounds

- Higher velocity
  - More kinetic energy = more wounding
- External injuries to torso appear no different from handgun
  - Severe internal injury
  - Temporary cavity may fracture bone, injure vessels and organs far from bullet
High Velocity Rifle
Wounds

amous same wound characteristics
– Entrance may lack abrasion ring
  “micro-tears”
– Tattooing
  Cylindrical powder: 1 ½ feet
  Ball powder: 3 feet
– Soft point hunting bullets
  Shed lead as go through body
  “lead snowstorm”
Suicides

♀ Facts about suicides by guns
  – 5-6% right handed individuals shoot themselves with left hand
  – Multiple bullet wounds do not rule out suicide
    ♀ Woman 9 times in chest
    ♀ Man 5 times in head
  – Fatal “accidental” shooting while “cleaning” gun usually suicide
Suicides

- Facts about suicides by guns
  - Suicide notes present only 25% cases
  - Backsplatter of blood on firing hand occurs about 33-35%
  - Gun found clutched in hand in 20% long arms and 25% handguns
  - Occasionally individuals shoot themselves in back of head
Shotgun wounds

- Entrance wounds
  - Contact to 12 inches
    - Single round entrance ¾ to 1 inch diameter
    - Abrasion ring
    - Powder tattooing
      - Less dense than pistol
      - Ball powder: 3 feet
      - Flake powder: 2-2 ½ feet
Shotgun wounds

- Entrance
  - 12 inches to 3 feet
    - Circular wound with scalloped margins
  - 4 feet
    - Large central scalloped entrance
    - Few satellite pellet holes
  - Beyond 10-12 feet great variation in spread
Shotgun wounds

- The Wad
  - Either paper or plastic
  - Lies between shot pellet and powder
  - Close range
    - Propelled into body
    - Between 1-3 feet petal marking
    - Beyond 10 feet wad not enter
Shotgun wounds

Range determination

- Duplicating on paper the size of the shotgun pattern described at autopsy
  - Must use same weapon and ammunition
  - Range formulas do not work
- Size shot pattern dependent on range, choke of gun and type of ammunition