BURNS: Back to Basics
WHO
• Globally 265,000 from fires

St James Hospital
• 200 people per year (>14 years)

American Burn Association
• 486,000 – burn injuries receiving medical treatment

Victoria, Australia
• 5000 to EDs with burn injuries
Objectives

- Anatomy & Physiology of the Skin
- Pathophysiology of Burns
- Burn Shock
- Etiology of Burns
- Burns Depth (Classification)
The Skin

http://www.home-remedies-for-you.com/remedy/Burns.html
The Skin - Overview

- Integumentary System
- Largest Organ
- Thickness 1cm to 1mm
- Maintain homeostasis
The Skin - Functions

- Protection – physical barrier
- Thermoregulation
- Waterproof
- Sensory Organ
- Vitamin D Synthesis
- Absorption
The Skin

Diagram of the skin layers:
- **EPIDERMIS**
- **DERMIS**
- **SUBCUTANEOUS TISSUE**

Labels:
- Hair
- Pore
- Germinal layer of epidermis
- Sebaceous gland
- Nerve (sensory)
- Sweat gland
- Hair follicle
- Blood vessel
- Subcutaneous fat
- Fascia
- Muscle
The Skin – Principal Layers

• Epidermis
  • Outer layer
  • Body’s first line of defense
  • Composed of several layers
The Skin - Principal Layers

• Dermis
  • Inner layer
  • Composed of:
    – Collagen fibers
    – Elastin fibers
    – Mucopolysaccharide gel
  • Enclosed within the dermis:
    – Nerve endings
    – Blood vessels
    – Sweat glands
    – Hair follicles
The Skin - Principal Layers

- Subcutaneous layer.
- Beneath the subcutaneous layer are the muscles, tendons, bones, and vital organs.
Consequences of burns

- Thermoregulation
- Sweating
- Vasodilation & vasoconstriction
- Melanin
- Hair growth
- Sensation
The Eye

- Sensitive to burn injuries
- Intense heat, light, or chemical reactions can burn the thin membrane covering the eye.

![Eye Diagram](image.png)
Pathophysiology - Burns

• Burns are diffuse soft-tissue injuries created by destructive energy transfer
• Skin = barrier between the environment and the body.
• When a person is burned, this barrier is destroyed;
• High risk
  – Infection, hypothermia, hypovolaemia, and shock.
Pathophysiology

- Destructive Energy Transfer
  - Thermal
  - Radiation
  - Electrical

- Chemical Burns
Burn Shock

• Caused by 2 types of injury
  – Fluid loss across damaged skin
  – Series of fluid volume shifts within the rest of the body
• Subsequently intravascular volume oozes into the interstitial spaces as capillaries become leaky
• Cells of normal tissues take in increased amounts of water and salts from fluid around them
Burn Shock

• Involves the entire body
  – Limits distribution of oxygen and glucose
  – Hampers ability to remove waste products
• Adequate fluid resuscitation is essential
• Can occur 6-8 hrs after exposure…..?? Shock at the scene
Etiology of Burns

- Thermal
- Radiation
- Electrical
- Chemical
Thermal Burns

• Can occur when skin is exposed to temperatures higher than 44°C.
• Severity correlates directly with temperature, concentration, or amount of heat energy possessed by the object or substance and the duration of exposure.
• Sometimes known as trauma by fire
Thermal Burns

- **Flame**: most likely to be caused by an open flame
- **Scald**: hot liquids can produce scald injuries
- **Contact**: coming in contact with hot objects
- **Steam**: can produce a topical (scald) burn
- **Flash**: can be caused by explosions, electrical arc flashes, electricity control panels, and lightning strikes
Burn Depth

- A burn wound is categorised by degree of injury.
- Three pathological progressions or zones.
- Zones of burn
  - Zone of coagulation
  - Zone of stasis
  - Zone of hyperaemia
Burn Depth

• Burn depth is also categorised in terms of severity.

• The traditional labels given to burns were first-, second-, and third-degree burns, but burns classification has evolved and now includes at least five categories.
# Classification of Burns

<table>
<thead>
<tr>
<th>Classification</th>
<th>Other Names</th>
<th>Example Cause</th>
<th>Appearance</th>
<th>Sensation</th>
<th>Healing Time</th>
<th>Scarring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidermal</td>
<td>Superficial, first degree</td>
<td>Ultraviolet light, very short flash</td>
<td>Dry and red, blanches with pressure, not blisters</td>
<td>May be painful</td>
<td>Less than 7 days</td>
<td>None</td>
</tr>
<tr>
<td>Superficial dermal</td>
<td>Superficial partial thickness, second degree</td>
<td>Scald (spill or splash)</td>
<td>Pale pink, fine blisters, blanches with pressure</td>
<td>Very painful</td>
<td>Less than 14 days</td>
<td>Colour match defect, low risk for hypertrophic scarring</td>
</tr>
<tr>
<td>Mid-dermal</td>
<td>Superficial partial thickness, second degree</td>
<td>Scald (spill), flame</td>
<td>Dark pink with large blisters, delayed capillary refill</td>
<td>May be painful</td>
<td>14-21 days</td>
<td>Moderate risk of hypertrophic scarring</td>
</tr>
<tr>
<td>Deep dermal</td>
<td>Deep partial thickness, second degree</td>
<td>Scald (spill) flame</td>
<td>Blotchy red, may blister, no capillary refill; children: may be dark lobster red with mottling</td>
<td>No sensation</td>
<td>Over 21 days</td>
<td>Grafting probably required, high risk of hypertrophic scarring</td>
</tr>
<tr>
<td>Full thickness</td>
<td>Third degree</td>
<td>Scald (immersion), flame, steam, high-volt electricity</td>
<td>White, waxy or charred, no blister, no capillary refill, children: may be dark lobster red with mottling</td>
<td>No sensation</td>
<td>Does not heal spontaneously</td>
<td>Grafting required if greater than 1 cm, scarring inevitable</td>
</tr>
</tbody>
</table>

Burn Depth

• Superficial burns
  – Involves the epidermis only
  – Skin is red and swollen.
  – Patients experience pain.
  – Will heal spontaneously in 3 to 7 days
Burn Depth

• Partial-thickness burns
  – Involves the epidermis and dermis
  – Usually painful
Burn Depth

• Full-thickness burns
  – Involves destruction of both layers of the skin
  – Incapable of self-regeneration
  – Skin may appear white and waxy, brown and leathery, or charred.
  – Sensory nerves are destroyed.
Inhalation Burns and Intoxication

• Can cause serious airway compromise
  – Steam/hot particulate matter associated with damage to:
    • Vocal cords and larynx
    • Lower airway
  – Superheated gases associated with damage to:
    • Upper airway
Inhalation Burns and Intoxication

• Smoke inhalation
  – Causes the majority of deaths from fires
  – Exposure to smoke from a fire may cause:
    • Thermal burns to the airway
    • Hypoxia from lack of oxygen
    • Tissue damage and toxic effects
Inhalation Burns and Intoxication

- Carbon monoxide intoxication
  - CO evolves from incomplete combustion of carbon compounds.
  - CO can displace oxygen.
  - Being exposed to relatively small concentrations will result in higher blood levels of CO.
Inhalation Burns and Intoxication

• Carbon monoxide intoxication
  – Patients usually present with an $O_2$ saturation of normal or better.
  – Never trust a pulse oximeter.

Oxygen is normal and there’s no cherry red coloring.
Let’s get them out of here. If it’s carbon monoxide, we’ve got a situation.
Summary

- Reviewed the A&P, physiology of integumentry system
- Described the pathophysiology of burns
- Explained Burn Shock and how it affects homeostasis
- Outlined the etiology and classification of burns
References


Links:
http://www.stjames.ie/Departments/WardsA-Z/B/BurnsUnit/
http://www.mayoclinic.org/diseases-conditions/burns/basics/definition/con-20035028
https://www.vicburns.org.au/about.html
http://lifeinthefastlane.com/ccc/burns/
BURNS:
Prehospital Assessment & Management
• Ability to treat burns has improved due to:
  – Better understanding of “burn shock”
  – Advances in fluid therapy and antibiotics
  – Improved ability to excise dead tissue
  – Use of biologic dressings
  – Formation of specialized teams
Objectives

• Scene Assessment
• Patient Assessment
  – Primary Survey
  – Burn Severity
  – Secondary Survey
• Prehospital Management & Treatment
  – General Management
  – Fluid Resuscitation
  – Pain Management
  – CPG’s: Adult/Paeds
  – Thermal/Chemical/Inhalation/ Electrical
Scene

• Do not run into a burning building if you are not trained and properly equipped.
• Stage yourself in a safe place to provide patient care.
Scene

• When a burned patient comes to you:
  – Extinguish the flame and cool the burn.
  – Do not permit a person on fire to run.
    • Have the patient stop, drop, and roll.
  – If smoldering cloth adheres to the skin, cut it away.
Scene

• If possible, determine the mechanism of injury (MOI).
  – Consider and examine other mechanisms associated with the burn.

• Wear appropriate personal protective equipment and follow standard precautions.
Primary Assessment

• Airway and breathing
  – Signs of airway involvement include:
    • Hoarseness
    • Cough
    • Singed nasal or facial hair
    • Facial burns
    • Carbon in the sputum
    • History of burn in an enclosed space
Primary Assessment

• Airway and breathing
  – Early ET intubation could be lifesaving.
    • Listen to lung sounds.
    • Note if signs and symptoms of edema are present.
  – Anyone suspected of having a burn to the upper airway may benefit from humidified, cool O₂.
Primary Assessment

• Circulation
  – During the first 24 to 48 hours, fluid resuscitation is emphasized to prevent burn shock.
  – Do not delay transport by making multiple attempts at vascular access.
Primary Assessment

• Assess burn severity.
  – Rule of nines
  • Divide the body into 9% segments.
  • Add portions to obtain total area affected.
Primary Assessment

• Assess burn severity
  – Rule of palms (rule of ones)
    • Use the patient’s palm to represent 1% of the body surface area.
    • Helpful when the burn covers less than 15% of the body surface area.
Primary Assessment

• Assess burn severity
  – The Lund and Browder chart

Primary Assessment

- Assess burn severity
  - The American Burn Association has published classifications.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Classification of Burns in Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burn Classification</td>
<td>Criteria</td>
</tr>
</tbody>
</table>
| Critical (severe) burns | - Full-thickness burns involving hands, feet, face, upper airway, or genitalia or circumferential burns of other areas  
- Full-thickness burns covering more than 10% of the body's total surface area  
- Partial-thickness burns covering more than 30% of the body’s total surface area  
- Burns associated with respiratory injury (smoke inhalation or inhalation injury)  
- Burns complicated by fractures  
- Burns on patients younger than 5 years or older than 55 years that would be classified as “moderate” in young adults |
| Moderate burns | - Full-thickness burns involving 2% to 10% of the body's total surface area (excluding hands, feet, face, genitalia, and upper airway)  
- Partial-thickness burns covering 15% to 30% of the body’s total surface area  
- Superficial burns covering more than 50% of the body’s total surface area |
| Minor burns | - Full-thickness burns covering less than 2% of the body's total surface area  
- Partial-thickness burns covering less than 15% of the body’s total surface area  
- Superficial burns covering less than 50% of the body’s total surface area |
Technology!!!!

• Mersey Burns App
Primary Assessment

Transport Decision (Burns Unit??)

- More than 10% of body involved
- Face, hands, feet, genitalia, perineum, or joints involved
- Full-thickness burns
- Electrical burns
- Chemical burns
- Inhalation burns
- Burns in conjunction with preexisting medical conditions
- Risk of morbidity or mortality

Tuesday 8 November 2016
Burns Units - Ireland

- National Burns Unit – St James Hospital, Dublin
- Our Lady’s Hospital for Sick Children, Crumlin
- Cork University Hospital
- University Hospital, Galway
History Taking

- Get a brief history from the patient.
- Patients with preexisting diseases may be triaged as critical even if the injury is small.
Secondary Assessment

• Pay attention to the circumstances of the burn and the possible MOI.
• Look for injuries to the eyes.
• Check for circumferential burns.
• Check and document distal pulses often.
General Management

• Only turn your attention to the burn itself when the ABCs are under control.
  – Have all resuscitative equipment ready for use.
General Management

- Patient with an acutely decompensating airway who requires field intubation
  - Includes:
    - Burn patients in cardiac or respiratory arrest
    - Responsive patients whose airways are swelling
  - Surgical airways or rescue devices may be necessary.
General Management

• Patient with deteriorating airway who might require intubation
  – Better to defer treatment to hospital teams.
  – Attempt to intubate only if the airway continues to swell and intubation will become impossible.
General Management

• Patient whose airway is patent but who has a history consistent with risk factors for airway compromise
  – Use cool, humidified O$_2$ from a high-output nebulizer or an aerosol nebulizer with saline.
  – Report the patient’s history to hospital personnel.
General Management

• Patient with no signs of or risk factors for airway compromise who is in no distress
  – Provide supplemental O₂.
Fluid Resuscitation

• Needed for patients with burns covering more than 25% of the body’s surface
  – If delayed more than 2 hours, mortality increases.
  – Our CPG if >1hr to ED
  – Begin to deliver as soon as is reasonable.
Fluid Resuscitation

• Approximate the amount of fluid needed by using the Consensus formula.
  – During the first 24 hours, the patient will need:
    • $4 \text{ mL} \times \text{body weight (in kg)} \times \% \text{ of body surface burned}$
  – Half is given during first 8 hours.
  – Half is given over the subsequent 16 hours.
Fluid Resuscitation

• Our CPGs
• Adult
  – 25%TBSA +/- or time to ED >1hr, then administer 1000mL IV/IO
  – If not consider 500mL IV/IO
• Paeds
  – > 10%TBSA+/- or time to ED >1hr, then administer IV/IO
    • 5-10yrs = 250mL
    • >10yrs = 500mL
Pain Management

• Assess pain before administering analgesia.
  – Burn patients may require higher doses.

• CPG – 2/10 pain score

• Pain medication is best given via IV route.

• Narcotics remain the drugs of choice.
Burn Shock

- Sets in during a 6- to 8-hour period
- Mortality increases if fluid resuscitation is delayed longer than 2 hours.
- Obtain vascular access and begin fluid resuscitation in the field.
Special Authorisation: Paramedics are authorised to continue the established infusion in the absence of an Advanced Paramedic or Doctor during transportation.


Burns – Paediatric (≤ 15 years)

Burn or Scald

Cease contact with heat source

Should soak for another 10 minutes during packaging and transfer. Caution with hypothermia

Inhalation and/or facial injury

Yes

Airway management

No

Consider humidified oxygen therapy

Remove burned clothing & jewellery (unless stuck)

Brush off powder & irrigate chemical burns. Follow local expert direction

Commence local cooling of burn area

Dressing/coversing of burn area

No

Go to Pain Mgt CPG

No

Yes

Pain > 2/10

Isolated superficial injury (excluding Hand)

No

Caution with the very young, circumfructal & electrical burns

Yes

TBSA burn > 5%

ECG & SpO2 monitoring

No

Yes

≥ 10% TBSA and/or time from injury to ED > 1 hour

NaCl (0.9%) IV Infusion

Follow local protocol

5 to 10 years = 250 mL

> 10 years = 500 mL

Special Authorisation: Paramedics are authorised to continue the established infusion in the absence of an Advanced Paramedic or Doctor during transportation

Monitor body temperature


Thermal Burns

• While assessing burns, consider:
  – Pain
  – Swelling
  – Skin color
  – Capillary refill time
  – Moisture and blisters
  – Appearance of wound edges
  – Foreign bodies, debris, contaminants
  – Bleeding
  – Circulatory adequacy
  – Concomitant soft-tissue injury
Thermal Burns

• Superficial burns
  – If patient is reached within the first hour, immerse the burn in cool water or apply cold compresses.
  – Transport the patient in a comfortable position.
Thermal Burns

• Partial-thickness
  – Cool burn with water or apply wet dressings.
  – Elevate extremities.
  – Establish IV fluids.
  – Administer pain medication.
Thermal Burns

- Full-thickness
  - Assess pain and administer pain medication.
  - Dry dressings are often used.
  - Begin fluid resuscitation
Chemical Burns of the Skin

• Assessment
  – Ensure your own safety.
  – Follow with decontamination of the patient.
Chemical Burns of the Skin

- **Management**
  - Flush with copious amounts of water.
  - Rapidly remove the patient’s clothing.
  - Wash skin folds.
  - Once washing is complete, wash again.
Inhalation Burns

• Assessment
  – Signs of upper airway swelling:
    • Stridor
  – Signs of lower airway involvement:
    • Wheezing and desaturation
    • Pulmonary edema
Inhalation Burns

• Management
  – Maintain an acceptable $O_2$ saturation level.
  – Monitor for signs of airway compromise.
Electrical Burns and Associated Injuries

• Electrical burns may produce internal injuries with little external evidence.

• May result in two injury sites:
  – Entrance wound
  – Exit wound
Electrical Burns and Associated Injuries

• Electrical burns have a strong possibility of severe internal injury.
  – Two common causes of death from electrical injury are asphyxia and cardiac arrest.
  – Electricity can disrupt the nervous system.
• Lightening Related Injuries

• Radiation Burns
Long-Term Consequences

• Patient
  – Average of 1 day of inpatient treatment for each 1% of TBSA
  – May be left with problems with:
    • Thermoregulation
    • Motor function
    • Sensory function
Long-Term Consequences

• Provider
  – Caring for patients with severe burn emergencies can be horrifying.
  – Proper training, confidence, and courage can have a large impact.
Summary

- Outlined prehospital burns patient assessment
- Described the management of a burns patient prehospital
- PHECC Education & Training Standard
- Paramedic CPG 4/5/6.6.1, Version 2, 07/11
- Paramedic CPG 4/5/6.7.53, Version 3, 12/13
References


Head and Maxillofacial Injuries
Skull and Facial Bones

• The brain
  – Requires maximum protection from injury
  – Housed within soft and hard wrappings
The Scalp

• Scalp layers
  – Skin and hair
  – Subcutaneous tissue
  – Galea aponeurotica
  – Loose connective tissue (alveolar tissue)
  – Periosteum
The Skull

- 28 bones in three anatomical groups
  - Auditory ossicles
  - Cranium
  - Face
Cranial Vault

- Eight bones
  - Parietal
  - Temporal
  - Frontal
  - Occipital
  - Sphenoid
  - Ethmoid
Floor of Cranial Vault

- Compartments
  - Anterior fossa
    - Crista galli
    - Cribriform plate
  - Middle fossa
  - Posterior fossa
Base of the Skull

- Occipital condyles
- Palatine bone
- Hard palate
- Zygomatic arch

Diagram:
- Maxilla
- Palatine bone
- Zygomatic arch
- Occipital condyle
- Carotid canal
- Foramen magnum
- Jugular foramen
- External occipital protuberance
Facial Bones (1 of 2)

- 14 bones form the structure of the face without contributing to the cranial vault
  - Maxillae
  - Vomer
  - Inferior nasal concha
  - Zygoma
  - Palatine bone
  - Nasal bone
  - Lacrimal bones
Facial Bones (2 of 2)

• Function
  – Protect the eyes, nose, and tongue
  – Provide attachment points for the muscles that allow chewing
  – Lend shape to the cheeks
The Orbits

• Cone-shaped fossa
• Enclose and protect the eyes
• Contains:
  – Blood vessels
  – Nerves
  – Fat
• Extremely thin and break easily
• Blowout fracture
Mandible and Temporomandibular Joint

• Mandible
  – large moveable bone forming the lower jaw and containing the lower teeth

• Temporomandibular joint (TMJ)
  – allows movement of the mandible
The Brain

• Cranial vault
  – Brain: 80%
  – Cerebral blood: 12%
  – Cerebrospinal fluid: 8%
• The brain accounts for 2% of total body weight.
  – Most metabolically active and perfusion-sensitive organ in the body
  – Totally dependent on a constant source of both fuels (oxygen and glucose) via cerebral blood flow
Major Brain Regions

- Cerebrum
- Diencephalon
- Cerebellum
- Brainstem
- Meninges
Brainstem: Meninges

• Protective layers around central nervous system
  – Dura mater: the outermost layer; a strong, fibrous wrapping that covers the entire brain
  – Arachnoid: delicate, transparent membrane (blood vessels resemble a spider’s web)
  – Pia mater: third meningeal layer; thin, translucent, highly vascular membrane that firmly adheres to the surface of the brain
# Nerves

**Cranial Nerves—Learning-Laboratory.com**

Cram CNs into your cranium!

<table>
<thead>
<tr>
<th>CN#</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Olfactory</td>
<td>Sense of smell</td>
</tr>
<tr>
<td>II</td>
<td>Optic</td>
<td>Sense of sight</td>
</tr>
<tr>
<td>III</td>
<td>Oculomotor</td>
<td>Extraocular eye movements, lid elevation, pupil contraction, lens shape</td>
</tr>
<tr>
<td>IV</td>
<td>Trochlear</td>
<td>Downward and inward eye movement</td>
</tr>
<tr>
<td>V</td>
<td>Trigeminal</td>
<td>Mastication, touch, pain, and temperature</td>
</tr>
<tr>
<td>VI</td>
<td>Abducens</td>
<td>Eyeball movement</td>
</tr>
<tr>
<td>VII</td>
<td>Facial</td>
<td>Facial expression, lip articulation, taste on anterior tongue, secretion of saliva &amp; tears</td>
</tr>
<tr>
<td>VIII</td>
<td>Vestibulocochlear (Acoustic)</td>
<td>Hearing, equilibrium</td>
</tr>
<tr>
<td>IX</td>
<td>Glossopharyngeal</td>
<td>Taste on posterior tongue, gag reflex, swallowing and phonation of the pharynx</td>
</tr>
<tr>
<td>X</td>
<td>Vagus</td>
<td>Visceral muscle movement (heart, lungs, intestines, etc)</td>
</tr>
<tr>
<td>XI</td>
<td>Spinal Accessory</td>
<td>Trapezius and sternocledomastoid movement</td>
</tr>
<tr>
<td>XII</td>
<td>Hypoglossal</td>
<td>Speech movements of the tongue, swallowing</td>
</tr>
</tbody>
</table>
The Eye

- Globe (eyeball)
- Oculomotor nerve
  - 3rd cranial nerve
- Optic nerve
  - 2nd cranial nerve
Structures of the Eye

- Sclera
- Cornea
- Conjunctiva
- Iris
- Pupil
The Ear

- External ear
  - Pinna, external auditory canal, eardrum
- Middle ear
  - Tympanic membrane, ossicles
- Inner ear
  - Cochlea, semicircular canals
The Mouth: Nerves (1 of 2)

- Hypoglossal (12th cranial)
  - Motor function of the tongue
- Glossopharyngeal (9th cranial)
  - Taste sensation of the posterior tongue
  - Salivary gland function
The Mouth: Nerves (2 of 2)

• Trigeminal (5th cranial)
  – Motor chewing function

• Facial (7th cranial)
  – Motor activity of all muscles providing facial expression
  – Sensation of taste to anterior 2/3 of the tongue
  – Cutaneous sensations of the tongue and palate
Patient Assessment (1 of 4)

- Scene Assessment
  - Initial step of any assessment should be a determination of scene safety.

- Primary Assessment
  - Severity of the injury
  - Patient’s level of consciousness
  - General impression
  - Catastrophic haemorrhage
  - Airway and breathing
Patient Assessment

• Primary Assessment (cont.)
  – Circulation
  – Disability
  – Expose/Environment
  – Transport Priority

• History Taking
  – SAMPLE
  – Exact Time of initial injury
Patient Assessment (3 of 4)

- Secondary Assessment
  - Level of Consciousness (LOC)
  - Glasgow Scale
- Pupillary Assessment
  - Frequently monitor the size, equality, and reactivity of the patient’s pupils.
  - Nerves that control dilation and constriction are very sensitive to ICP.

<table>
<thead>
<tr>
<th>GLASGOW COMA SCALE</th>
<th>Eye Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spontaneous</td>
</tr>
<tr>
<td></td>
<td>To Voice</td>
</tr>
<tr>
<td></td>
<td>To Pain</td>
</tr>
<tr>
<td></td>
<td>None</td>
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<table>
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<th>Verbal Response</th>
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<tbody>
<tr>
<td>Oriented</td>
<td>5</td>
</tr>
<tr>
<td>Confused</td>
<td>4</td>
</tr>
<tr>
<td>Inappropriate Words</td>
<td>3</td>
</tr>
<tr>
<td>Incomprehensible Words</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Motor Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obeys Command</td>
<td>6</td>
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<tr>
<td>Localises Pain</td>
<td>5</td>
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<tr>
<td>Withdraws (pain)</td>
<td>4</td>
</tr>
<tr>
<td>Flexion (pain)</td>
<td>3</td>
</tr>
<tr>
<td>Extension (pain)</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>

Glasgow Coma Score Total 15
• Assessing Intracranial Pressure (ICP)
  – severity of increase can be estimated based on the patient’s clinical presentation.
  – Critical treatment decisions

• Reassessment
  – Vital signs
  – Repeat the physical examination
  – Reprioritise patient as necessary
Management of Head Injuries (1 of 2)

• Traumatic insult to the head that may result in injury to soft tissue, bony structures, or the brain
• More than 50% of all traumatic deaths result from a head injury.
• Road traffic collisions are the most common mechanism of injury.
  – Also in victims of assault, when elderly people fall, sports-related incidents, and a variety of incidents involving children
Management of Head Injuries (2 of 2)

- Two general types
  - Closed (most common type): usually associated with blunt trauma; skull fractures, focal brain injuries, or diffuse brain injuries and ICP
  - Open: dura mater and cranial contents are penetrated, and brain tissue is open to the environment
- Gunshot wounds have a high mortality rate with almost always a significant neurological deficit and a decreased quality of life
Scalp Lacerations

- Minor or very serious
  - Rich blood supply
  - Quickly lead to significant blood loss
- Hypovolaemia
- Often result from direct blows to the head
  - Indicates deeper, more severe injury
Skull Fractures

• Significance
  – Directly related to the type of fracture, the amount of force applied, and the area of the head that suffered the blow
  – Most commonly seen following road traffic collisions and significant falls
  – May be associated with soft-tissue scalp injuries

• Potential complications
  – Intracranial haemorrhage
  – Cerebral damage
  – Cranial nerve damage
Linear Skull Fractures

- Linear skull fractures
  - Nondisplaced skull fractures
  - 80% of all fractures.
  - 50% occur in the temporal-parietal region of the skull.
  - Radiographic evaluation is required to diagnose
  - If the brain is uninjured and the scalp is intact, linear fractures are relatively benign.
  - Open: risk of infection
  - Potential injury to the middle meningeal artery (extradural bleeding)
Depressed Skull Fractures

- Result from high-energy direct trauma to a small surface area of the head with a blunt object.
- Frontal and parietal regions are most susceptible (bones relatively thin).
- Bony fragments may be driven into the brain.
- Overlying scalp may be intact.
- Often present with neurological signs.
Basilar Skull Fractures (1 of 2)

- Associated with high-energy trauma with diffuse impact to the head
- Generally result from extension of a linear fracture to the base of the skull
- Difficult to diagnose with radiography
Basilar Skull Fractures (2 of 2)

• Signs: CSF drainage from the ears, periorbital bruising (panda eyes), or bruising behind the ear over the mastoid process (Battle’s sign)

Courtesy of AAOS
Open Skull Fractures

- Severe forces applied to the head
- Associated with trauma to multiple body systems
- Brain tissue may be exposed to the environment.
- High mortality rate
Traumatic Brain Injury

- Primary (direct) brain injury
- Secondary (indirect) brain injury
- Coup-contrecoup injury
- Swelling
  - Initially because of cerebral vasodilation
  - Increase of cerebral water (cerebral oedema)
Accumulations of blood within the skull or swelling of the brain can lead to an increase of pressure within the cranial vault.

- Squeezes the brain against bony prominences within the cranium.
• Increase in ICP
  – Decreases cerebral perfusion pressure and cerebral blood flow
  – Critical minimum threshold (60 mm Hg)
  – The body responds to a decrease in CPP by increasing mean arterial pressure (autoregulation), causing further increase in ICP.
  – CPP cannot be calculated in the prehospital setting.
  – Cerebral herniation can occur.
  – Early signs and symptoms
  – Ominous signs
Diffuse Brain Injury (1 of 3)

• Cerebral concussion
  – Brain is jarred around in the skull.
  – Caused by rapid acceleration-deceleration forces.
  – Results in transient dysfunction of the cerebral cortex
  – Resolution is usually spontaneous and rapid
  – Signs range from transient confusion and disorientation to confusion for several minutes.
  – Loss of consciousness may occur.
  – Retrograde or anterograde amnesia
Diffuse Brain Injury (2 of 3)

• Diffuse axonal injury (DAI)
  – Associated with or similar to a concussion
  – More severe diffuse brain injury
  – Poor prognosis
  – Involves stretching, shearing, or tearing of nerve fibres with subsequent axonal damage
  – Most often results from high-speed, rapid acceleration-deceleration forces
  – Severity depends on the degree of axonal damage.
  – Mild, moderate, or severe
# Diffuse Brain Injury

## Table 32-4 Diffuse Axonal Injury (DAI)

<table>
<thead>
<tr>
<th>Pathophysiology</th>
<th>Incidence</th>
<th>Signs and Symptoms</th>
<th>Prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mild DAI</strong></td>
<td><strong>Incidence</strong></td>
<td><strong>Signs and Symptoms</strong></td>
<td><strong>Prognosis</strong></td>
</tr>
<tr>
<td>Temporary neuronal</td>
<td>Usually the result of blunt head trauma;</td>
<td>Loss of consciousness (brief, if present); confusion, disorientation, amnesia</td>
<td>Minimal or no permanent neurological impairment</td>
</tr>
<tr>
<td>dysfunction; minimal</td>
<td>concussion is an example</td>
<td>(retrograde and/or anterograde)</td>
<td></td>
</tr>
<tr>
<td>axonal damage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Moderate DAI</strong></td>
<td><strong>Incidence</strong></td>
<td><strong>Signs and Symptoms</strong></td>
<td><strong>Prognosis</strong></td>
</tr>
<tr>
<td>Axonal damage and</td>
<td>20% of all severe head injuries; 45% of all</td>
<td>Immediate loss of consciousness: secondary to involvement of the cerebral cortex or</td>
<td></td>
</tr>
<tr>
<td>minute petechial</td>
<td>diffuse axonal injuries</td>
<td>reticular activating system of the brainstem; residual effects: persistent</td>
<td>Survival likely, but permanent neurological</td>
</tr>
<tr>
<td>bruising of brain tissue;</td>
<td></td>
<td>confusion and disorientation; cognitive impairment (e.g., inability to concentrate);</td>
<td></td>
</tr>
<tr>
<td>often associated with a</td>
<td></td>
<td>frequent periods of anxiety; uncharacteristic mood swings; sensory/motor deficits</td>
<td>impairment common</td>
</tr>
<tr>
<td>basilar skull fracture</td>
<td></td>
<td>(such as altered sense of taste or smell)</td>
<td></td>
</tr>
<tr>
<td><strong>Severe DAI</strong></td>
<td><strong>Incidence</strong></td>
<td><strong>Signs and Symptoms</strong></td>
<td><strong>Prognosis</strong></td>
</tr>
<tr>
<td>Severe mechanical</td>
<td>16% of all severe head injuries; 36% of all</td>
<td>Immediate and prolonged loss of consciousness; posturing and other signs of</td>
<td>Survival unlikely; most patients who survive</td>
</tr>
<tr>
<td>disruption of many</td>
<td>diffuse axonal injuries</td>
<td>increased ICP</td>
<td>never regain consciousness but remain in a</td>
</tr>
<tr>
<td>axons in both cerebral</td>
<td></td>
<td></td>
<td>persistent vegetative state</td>
</tr>
<tr>
<td>hemispheres with</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>extension into the</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>brainstem; formerly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>called “brainstem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>injury”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Focal Brain Injury (1 of 2)

- Cerebral contusion
  - Brain tissue is bruised and damaged in a local area.
  - Greater neurological deficits
  - Acceleration-deceleration forces and direct blunt head trauma
  - Frontal lobe is most commonly affected.
  - The reaction of the injured tissue will be to swell, leading to increased ICP.
Intracranial haemorrhage
- ICP increases
- Bleeding can occur between the skull and dura mater, beneath the dura mater but outside the brain, within the parenchyma of the brain itself, or into the CSF.
  - Extradural haematoma
  - Subdural haematoma
  - Intracerebral haematoma
  - Subarachnoid haemorrhage
Maxillofacial Fractures (1 of 6)

• Commonly occur when the facial bones absorb the energy of a strong impact
  – A force of up to 150 g is required to fracture the maxilla
  – Likely to produce closed head injuries and cervical spine injuries as well
  – The first clue is bruising.
  – A black-and-blue mark on the face
  – Deep facial laceration
Maxillofacial Fractures (2 of 6)

• Nasal fractures
  – Not as structurally sound as other bones of the face
  – Most common facial fracture
  – Characterised by swelling, tenderness, and crepitus
  – Deformity usually appears as a lateral displacement.
  – Epistaxis
Maxillofacial Fractures (3 of 6)

- Mandibular fractures and dislocations
  - Second only to nasal fractures in frequency
  - Massive blunt force trauma to the lower third of the face
  - Fracture is most commonly located at the angle of the jaw.
  - Malocclusion: misalignment of the teeth
  - Mandibular dislocations are most often the result of yawning extravagantly or otherwise opening the mouth very widely.
Maxillofacial Fractures (4 of 6)

• Maxillary fractures
  – Massive blunt facial trauma (road traffic collision, falls, and assaults)
  – Produce massive facial swelling
  – Le Fort I fracture
  – Le Fort II fracture
  – Le Fort III fracture
Maxillofacial Fractures (5 of 6)

• Orbital fractures
  – May complain of double vision and lose sensation above the eyebrow or over the cheek secondary to associated nerve damage
  – Inferior orbit fractures are the most common and can cause paralysis of upward gaze.
Maxillofacial Fractures (6 of 6)

• Zygomatic fractures (cheek bone)
  – Blunt trauma secondary to motor vehicle crashes and assaults
  – Side of the patient’s face appears flattened
  – Loss of sensation over the cheek, nose, and upper lip
  – Paralysis of upward gaze may be present.
  – Orbital fractures, ocular injury, and epistaxis.
Assessment of Face Injuries (1 of 2)

- It is not important to distinguish among the various maxillofacial fractures in the prehospital setting
  - Requires radiographic evaluation in the accident and emergency department
  - Rapid patient assessment, management of life-threatening conditions, full spinal precautions and prompt transport
### Table 32-5 Summary of Maxillofacial Fractures

<table>
<thead>
<tr>
<th>Injury</th>
<th>Signs and Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple facial bone fractures</td>
<td>- Massive facial swelling</td>
</tr>
<tr>
<td></td>
<td>- Dental malocclusion</td>
</tr>
<tr>
<td></td>
<td>- Palpable deformities</td>
</tr>
<tr>
<td></td>
<td>- Anterior or posterior epistaxis</td>
</tr>
<tr>
<td>Zygomatic and orbital fractures</td>
<td>- Loss of sensation below the orbit</td>
</tr>
<tr>
<td></td>
<td>- Flattening of the patient’s cheek</td>
</tr>
<tr>
<td></td>
<td>- Paralysis of upward gaze</td>
</tr>
<tr>
<td>Nasal fractures</td>
<td>- Crepitus and instability</td>
</tr>
<tr>
<td></td>
<td>- Swelling, tenderness, lateral displacement</td>
</tr>
<tr>
<td></td>
<td>- Anterior or posterior epistaxis</td>
</tr>
<tr>
<td>Maxillary (Le Fort) fractures</td>
<td>- Mobility of the facial skeleton</td>
</tr>
<tr>
<td></td>
<td>- Dental malocclusion</td>
</tr>
<tr>
<td></td>
<td>- Facial swelling</td>
</tr>
<tr>
<td>Mandibular fractures</td>
<td>- Dental malocclusion</td>
</tr>
<tr>
<td></td>
<td>- Mandibular instability</td>
</tr>
</tbody>
</table>
Management of Face Injuries

- Begins with protecting the cervical spine
- Open the airway
- Treat as you would any other soft-tissue injury
- Epistaxis following facial trauma can be severe
- Swelling and bruising
Blunt Eye Injuries

- Range from swelling and bruising to rupture of the globe
  - Hyphaema
  - Orbital blowout fractures
  - Retinal detachment
Assessment of Eye Injuries

• Variety of symptoms
  – Vision loss that doesn’t improve
  – Double vision
  – Severe eye pain
  – Foreign body sensation
  – Obvious ocular damage
Evaluate Visible Ocular Structures and Functions (1 of 2)

• Orbital rim: bruising, swelling, lacerations, and tenderness
• Eyelids: bruising, swelling, and lacerations
• Corneas: foreign bodies
• Conjunctivae: redness, pus, inflammation, and foreign bodies
Evaluate Visible Ocular Structures and Functions (2 of 2)

• Globes: redness, abnormal pigmentation, and lacerations
• Pupils: size, shape, equality, and reaction to light
• Eye movement in all directions: paralysis of gaze or uncoordinated eye movements
• Visual acuity: test each eye separately.
Oral and Dental Injuries (1 of 2)

- Soft-tissue Injuries
  - Lacerations and avulsions in and around the mouth
    - Associate with a risk of intraoral haemorrhage and subsequent airway compromise
  - Fractured or avulsed teeth and lacerations of the tongue
    - May cause profuse bleeding into the upper airway
  - Patients may swallow blood.
    - Bleeding may not be grossly evident.
Oral and Dental Injuries (2 of 2)

• Dental Injuries
  – Fractured and avulsed teeth
  – Common following facial trauma
  – May be associated with mechanisms that cause severe maxillofacial trauma
  – Always assess the patient’s mouth following a facial injury.
  – Teeth fragments can become an airway obstruction.
Summary

• Anatomy of the head and face
• Assessment and management of general injuries
• Assessment and management of specific injuries