Rosens Ch 191- EMS: Overview & Ground Transport

Basic Life Support= provision of emergency care without the use of advanced therapeutic interventions ie airway mgmt (oral/nasal airways, BMV), CPR, hemorrhage control, # and spine immobilization, and assistance with childbirth. Defibrillation with an AED is included in many BLS systems

Advanced Life Support= more comprehensive level of service by highly educated providers. Skills include advanced airway interventions, IV placement, administration of medications, cardiac monitoring, manual defibrillation, and certain invasive procedures

Single-Tiered System= every response, regardless of call type, receives the same level of personnel expertise and equipment allocation (ie all BLS or ALS)

Multi-tiered Systems= use a combination of ALS and BLS, depending on the nature of the call

First-responder System= usually police officers or firefighters (non-transport ALS or BLS provider) who quickly responds to the scene of an emergency to provide initial care (basic airway, hemorrhage control, spinal immobilization) before definitive medical care and transportation assets arrive. FR assesses the situation and determines whether additional resources are required, initiates patient care, and provides advance information to responding personnel.

AHA "Chain of Survival" to ↓ Mortality in out-of-hospital cardiac arrest

1) Early access to care
2) CPR
3) Defibrillation
4) Advanced airway management and medications

Basic ambulance equipment should include items for:

1) Emergency procedures (airway support, hemorrhage control, immobilization, childbirth)
2) Personal protection equipment
3) Patient mobilization
4) Basic rescue procedures

EMS Medical director= physician with specialized interest and knowledge of patient care activities unique to the pre-hospital environment. Typically has administrative authority to implement patient care protocols, interact with all aspects of the system, and remove a provider from practice if medical care/behaviour is substandard

Off-line (indirect) control= protocol development, education of personnel, prospective and retrospective review of patient care, and other quality improvement processes directed towards medical accountability for patient care activities

- *Protocols*: pre-established practice guidelines that define the standard of care for most illnesses/injuries encountered in the pre-hospital setting; May include standing orders for particular clinical situations (medications or procedures)

before communication with hospital personnel that are performed under the medical license of the medical director
- *Education*
- *Quality/Performance Improvement* ie retrospective review of patient care reports or direct field observation to evaluate individual and system performance and patient outcome. Competency, knowledge retention, skill performance, and time standards are measurable parameters

On-line (direct) control= real-time interaction between a physician or designee and the field provider ie radio/telephone communications or direct scene observation
- *Centralized System*: selected hospital designatedas the base hospital and is responsible for providing all direct medical control orders and notification regardless of the receiving facility
- *Decentralized System*: each hospital functions as a base station and provides direction to EMTs/paramedics transporting patients to their facility

Controversies:
- **Airway/Respiratory emergencies**
- Pre-hospital intubation: effectiveness questioned vs BMV due to rates of esophageal intubation in some systems and poor outcomes with RSI in head-injured patients
- No studies have demonstrated a benefit in the pre-hospital administration of medications for COPD, bronchospasm, or anaphylaxis (however, most systems feel these medications do not cause harm, may be helpful, and provide comfort/perceived clinical improvement for most patients)
- **Cardiovascular Emergencies**
- Pre-hospital amiodarone to terminate refractory VF has been found to result in higher survival rates to hospital arrival but not significantly effect survival to discharge
- Pre-hospital fibrinolytic agents for acute STEMI; not gained wide acceptance and may be useful only if prolonged transport times exist or if hospitals do not have catheterization/intervention facilities available
- **Trauma**
- Widely accepted that in trauma all effort should be made to reduce on-scene time
- IVF: paradigm shift to restrictive or hypotensive resuscitation for penetrating truncal injuries (vs high volume IVF for hemodynamic instability which may lead to hemodilution or disruption of a fragile clot orfurther hemorrhage by increasing MAP)
- Pneumatic anti-shock garments: shown to ↑ ortality in penetrating torso injuries; no longer recommended in urban EMS systems with short transport times

Requirements for Patient Transfers
1) Complete assessment of risks/benefits of transfer
2) Informed consent obtained from patient or family
3) Appropriate transportation (equipment and personnel) arranged
4) Treatment and stabilization performed
5) Acceptance from receiving facility ensured
6) Appropriate patient care data sent (fax or with patient)

Tintinalli Ch 1- EMS

15 Elements of an EMS System:

1) **Personnel**: ambulance personnel, volunteers, etc
2) **Training**: education of citizens and paramedics/first responders
3) **Communications**: 911 (emergency calls), ambulance dispatch
4) **Transportation**: ground/air transport
5) **Facilities:** Hospitals; may bypass closest site to reach specialty services ie trauma
6) **Critical Care Units**: need to identify care not available in all community hospitals and develop criteria for transfer ie trauma, NICU, burns, SCI, Neuro Sx, CCU, ICU
7) **Public Safety Agencies**: police/fire departments; Provide first-response services and assistance in hazardous circumstances
8) **Consumer participation**: lay public first aid training and use of universal telephone number system, political and financial public support
9) **Access to Care**: all individuals deserve timely access to the system when necessary
10) **Transfer of care** (between medical facilities)
11) **Standardization of patients' records**: allows for quick/easy interpretation by receiving physicians and nurses
12) **Public information and Education**: community benefits of EMS, prepare the public to provide first aid, ensure knowledge on how to access the EMS system, ensure patients understand they may not be delivered to the hospital of their choice
13) **Independent Review and Evaluation**
14) **Disaster Linkage**: preparedness drills/planning
15) **Mutual aid agreements**: co-operation with neighboring jurisdictions ensures uninterrupted care available when local agencies overwhelmed/unable
16) **Research**

EMS System= entire system in place to provide care to emergency patients from the initial call to definitive care

Priority dispatch= process by which emergency medical dispatchers collect information to direct the most appropriate EMS response

Pre-arrival instruction= provision of basic instructions to help care for the patient prior to the arrival of EMS personnel

Functions of the EMS communication System:

1) Public access
2) Prompt dispatch of the appropriate vehicles and personnel
3) Timely hospital notification
4) On-line medical control

Tintinalli Ch 2- Prehospital Equipment & Adjuncts

EMS specific equipment is better adapted to field use vs hospital equipment in:

1) Size
2) Weight
3) Durability

Four questions for EMS equipment:

1) Does it do the job?
2) Is it safe?
3) Des it do the job and is it safe in the field environment?
4) Does it do the job and is it safe in the field environment in the hands of field personnel?

Equipment Necessary for an EMS System

1) Vehicles
2) Communications
3) Electronic Patient Record
4) Universal precautions
5) Personal Protective Equipment (PPE)
6) Resuscitation Equipment (defibrillators, airway/ventilation adjuncts, vascular access)
7) Spinal Immobilization
8) Extremity Immobilization
9) Pharmaceutical Equipment

I. Vehicles

1) Ground ambulances
    a) Type I: standard truck chassis with a separate modular box to carry personnel, patient, and equipment; No access between driver and patient care compartments

    b) Type II: enlarged van type vehicle

    c) Type III: van chassis with an integrated modular box on the back for medical care and equipment

2) Helicopters
3) Fixed-wing aircraft
4) First-response vehicles (FD, PD)

II. Communications:

1) Two way radios

- ***Trunking***: in urban centers, communications pathways are managed by a central processor between end users allowing large numbers of users to share a relatively small number of radio frequencies

2) Cellular phones

III. Electronic Patient Record

- standardized data sets and a process for collecting data are essential for research and quality assurance

IV. Universal Precautions

- masks, goggles, gloves, occasionally gowns

V. Personal Protective Equipment (PPE)

- For exposure to hazardous material, biologic, or chemical weapons of mass destruction
- Minimum PPE: filtered (N95) mask, goggles, gloves, protective clothing (nonabsorbent & puncture-resistant)

VI. Resuscitation Equipment

● ***Manual Defibrillators/AEDS***

- AEDs should have recording capabilities so that the cardiac arrest can be reviewed for medical oversight and QA

● ***Airway/Ventilation Adjuncts***

- Basic: Oral/Nasal airways, bag-valve mask, portable suction
- Other adjunts: LMA, Combitube/King, LMA
- Advanced: ETTs of varying sizes, laryngoscope blades + handles, stylets, lubricant, Magills, bougies, +/- meds for RSI

● **Vascular access equipment**

- Tourniquets, cleaning agent, IV catheters, IV fluid bags, IV tubing

- Medical director must provide guidelines for when/how to institute vascular access to allow appropriate interventions at the appropriate time

VII. Spinal Immobilization

- Spinal boards + Cervical collars
- If an athlete is injured with a football helmet + shoulder pads that are propertly fitted their head should be held in neutral position by these and removal in the field is not recommended, patient is to be immobilized and transported on the rigid backboard with helmet and shoulder pads in place
- Motorcycle helmets do not fit snugly and should be removed in the field

VIII. Extremity Immobilization

- improves patient comfort and increases ease of transport

Rosen's Ch- 192/ Tintinalli Ch-3: Air Medical Transport

Aviation Physiology:

Boyle's Law: volume of a unit of gas is inversely proportional to the pressure on it ; ie. as altitude increases (& atmospheric pressure ↓) the volume of the gas expands

PV= k; V α 1/P

where: *P* denotes the pressure of the system, *V* is the volume of the gas, *k* is a constant value representative of the pressure and volume of the system.

- ***Squeeze injuries*** (barotitis/barosinusitis) occur on descent due to contraction of air trapped within the sinus/middle ear cavities, which cannot be equalized with ambient pressure, resulting mucosal and neurovascular tissue being pulled inward
- ***Reverse squeeze injuries*** occur on ascent due to ↑ air volume in trapped spaces with ↓ in barometric pressure causing the exertion of pressure on adjacent bony, neurovascular, or parencymal structures

Charles' Law: as the temperature ↑ the volume of a gas ↑

$$\frac{V_1}{T_1} = \frac{V2}{T_2} \; ; \; V \alpha T$$

Dalton's Law: total barometric pressure at any given altitude equals the sum of partial pressures of gases in the mixture

$$P_t = P_1 + P_2 + P_3 + \ldots + P_n$$

- Clinically manifested as a ↓ in partial arterial oxygen tension with ↑ altitude (O_2 still constitutes 21% of atmospheric pressure but since ↑ altitude= ↓ pressure each breath brings fewer O_2 molecules to the lungs

Henry's Law: mass of gas absorbed by a liquid is directly proportional to the partial pressure of the gas above the liquid

- sudden decompression at high altitude may result in dysbarism

Clinical Considerations for Air medical transport

1) Temperature fluctuations
2) Dehydration
3) Noise
4) Vibration
5) Risk of ascent injuries: conversion of simple pneumothorax into tension, rupture of hollow viscus due to expansion of intestinal gas
6) Alterations in IV flow rates, pressure in air splits/ETT cuffs

Types of Air Medical missions

1) Primary responses: aircraft serves as the sole means of patient transport to a receiving facility
2) Secondary responses: aircraft transports patients from outlying hospitals to facilities offering higher levels of care

Transport by Helicopters (Rotor-Wing Aircraft)- generally 1000-3500 ft above ground

5 Advantages:

1) Travel "as the crow flies" reducing travel times by 75% vs ground transport
2) Large service area
3) Can access locations that may be inaccessible to other modes of travel
4) Avoids traffic delays and ground obstacles
5) Does not require an airport to land

5 Disadvantages:

1) Noise
2) Turbulence (interference with pt evaluation/monitoring/mgmt)
3) Weather may limit availability (pilots should be blinded to the nature of the call during mission planning)
4) Cramped patient compartments (may compromise optimal care)
5) Weight limitations

List 5 Safety Precautions/Rules for Rotor-wing transport

1) Aircraft should always be approached from the front where the pilot can see approaching personnel
2) When rotors are turning, non-flight team personnel should approach the aircraft only with escort from a flight team member
3) Never approach from the rear as the tail rotor is virtually invisible
4) Landing zone should be at least 100 x 100ft
5) Ground personnel should be well clear during landings/takeoffs

Transport by Airplanes (Fixed-wing aircraft)

5 Advantages:

1) Increased range abilities
2) Greater speed than rotor-wing/ground transport
3) Increased capacity for patient/crew/equipment compared to rotor-wing
4) Less cabin noise and turbulence than rotor-wing
5) Pressurization of cabin can combat the impact of physiologic gas laws

4 Disadvantages:

1) Requires an airport to land
2) Runway must be of appropriate length or condition
3) Requires refueling facilities
4) Transports require multiple vehicles (also requires ground transport from airport to hospital)

Role of the Air Medical Director

1) Supervising air medical services (final authority over all clinical aspects): off-line and on-line
2) Ensuring all personnel have adequate training and qualifications
3) Ensure appropriate equipment/supplies are available
4) Ensure the correct vehicle selected or transports
5) Evaluating air medical transport teams
6) Quality assurance

List Criteria for Air Medical Transport

1) Distance to the closest appropriate facility is too great for safe and timely transport by ground ambulance
2) Patient's clinical condition requires that the time spent in transport be as short as possible
3) Pt's condition is time critical, requiring specific or timely treatment not available at the referring hospital
4) Potential for transport delay associated with ground transport is likely to worsen the patient's clinical condition

5) Patient requires critical care life support during transport that was not available from the local ground ambulance service
6) Patient is located in an area inaccessible to regular ground traffic, impending ambulance egress or access
7) Local ground units are not available for long-distance transport
8) Use of local ground transport services would leave the local area with out adequate EMS coverage