Mobile Imaging

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‘Mobile’ vs. ‘Portable’
- Taking the x-ray to the patient
  - Hospital patients too ill to travel
  - Nursing home patients
  - Patient with restriction due to isolation precautions
  - Surgical patients
- Terminology – Mobile vs. Portable

Self-Propelled Unit
- Battery driven – self propelled
- Power source to charge – 110/220 V
- 10 – 15 exposures with full charge
- 2.5 – 5 mph
- 7% incline travel
- Forward & reverse
- After fully discharged can take up to 8 hours to charge

Protective Features
- Automatic parking brakes
- Bumper braking
- Locks control movement

Digital Units
- DR
  - Cassettefree
- Cable or wireless
- CR
  - PSP technology

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Capacitor Discharge Unit
- Not motor driven - lighter
- Uses standard 110 V 15 amp or 220 V 10 amp power
- Stores electric charges when plugged in – discharges energy across tube during exposure

Mobile C-arm
- Mobile fluoroscopy
- Image intensifier & x-ray tube
- Used in OR
- Versatile & flexible
- Charging via outlet

Features of C-Arm
- Used with TV monitor & Control cart
  - Fluoroscopy control
  - Control unit or foot pedal
  - Hands free control with foot pedal

TV Monitor
- Left & right monitors
  - Left : Active monitor – live imaging
  - Right: Image hold monitor – reference

Tube on Top
- Regular use - The image intensifier positioned to the top
  - Reduce dose to head & neck of staff
  - Reduce OID – better image resolution reduced scatter
- Image orientation is critical to avoid confusion

Aseptic
- Medical
  - Clean
- Surgical
  - Sterile
Surgical Aseptic
- C-arm cannot be exposed to the surgical site
- Draping of image intensifier
- Draping of patient
- Using shower curtain

Technical Factors
- KVP, mAs & time – adjusted for individual patient
- KVP controls
  - Penetrating power
  - Image contrast (analog- limited control in digital)
- mAs
  - Image density (analog- limited control in digital where brightness can be adjusted)
  - Radiation dose
- Time – Critical in controlling motion

15% Rule
- As the KVP increases and mAs decreases to compensate, the entrance skin exposure (ESE) to a patient decreases dramatically.

| KVP vs Entrance Skin Exposure (ESE) |  |
|---|---|---|
| KVP | mAs | ESE (mR) |
| 70  | 48  | 122 |
| 90  | 34  | 67  |
| 100 | 71  | 48  |
| 121 | 3.6 | 40  |
| 141 | 3.6 | 34  |

Technical Factors
- Increase KVP = increase scatter/lower contrast
- Increase KVP = wider latitude with lower mAs therefore lower patient dose

Grid Use
- To control scatter
  - If KVP exceeds 80
  - If part is thicker than 10 cm (4 inches)
  - Exception in chest imaging

Feature of Grids
- Grid ratio = height of grid strip/thickness of the interspace
  - High ratio more effective in reducing scatter but need higher factors
- Grid frequency = # of grid strips per cm
  - High grid frequency shows less grid line on the image
### Common Grid Ratios
- 6:1 common
- 8:1 up to 90 kVp
- 12:1 Bucky grid

**Considerations:**
- Increasing kVp will save on patient dose but increase scatter
- Increase mAs will increase dose to patient

### Common Grid Frequencies
- Grid frequency will be a factor when using stationary grids
- Grids with higher frequency = thinner strips
- High grid frequency will reduce the distraction of grid line

### Types of Grids
- **Parallel Grids**
  - Stationary
  - Moving Grid (Bucky)
- **Focused Grids**
  - Stationary
  - Moving
- **Crossed Grids**

### Grid Cut-Off
- Loss of exposure on the image when CR is angled against the lead strips

**Causes**
- Off Center Grid
- Off Level Grid
- Off Focus Grid

### Off-Level Grids
- Angle along long axis of grid only
- Angling > 3-4° will result in grid cutoff

### Off Center
- CR not centered along the center axis of grid
- Critical when using a focus grid
- Called lateral decentering
Off-Focus
- Using the wrong SID
- Also a problem with focused grids
- Increasing SID = increasing grid cut-off

Alternative to Grid Use
- 10-15 cm (4-6 inches) OID
- mAs increase approx 10% for every cm of air gap
- Similar to using 8:1 grid

Air Gap Technique
- Not as effective at higher kVp where the scattered radiation has more forward direction

Anode Heel Effect
- Reduced intensity of the beam at the anode side of the x-ray tube
- Short SID
- Larger field sizes
- Small anode angles

Standard SID
- 100 cm (40 inches)
- 180 cm (72 inches)
- Ensure consistency
- Reduce magnification
- Reduce patient dose
- Reduce motion artifacts

Consistency
- Ensure accurate diagnosis
- Method
  - Technical factors
  - Contrast
  - Positioning
  - Check previous imaging
**Radiation Protection**
- Tech’s responsibility
- Time/Distance/Shielding
  - 183 cm (6 feet) distance
    - Notify staff before exposure
    - Protect adjacent patients
    - Remove visitors
    - Protect patient
- Practice ALARA
- Shield for tech & patient/s
  - 0.5 mm lead equivalent

**Other Factors**
- Direction of the CR
- Minimum mAs & time
- Avoid repeats
- Double check position before exposure
- Grid use
- Collimate
- High kVp & low mAs
- SID

**Standard Precautions**
- Used whenever there is a possible of contact with blood, body fluids, secretions, mucous membranes and non-intact skin.
- Apply standard precautions to all patients. Standard precautions include handing soiled or contaminated linen or substances.

**Protective Equipment**
- Gloves
- Fluid repellant gowns
- Face masks
- Protective eyewear
- Filtered mask/ Resuscitation masks

**Hand Hygiene**
- Use hand rub if no visible soiled
  - Alcohol based not antibiotic
- Use hand wash if visible soiled
  - Soap & water no antibiotic soap
- Before & after all procedures
- After removing gloves
- Keep hands lower than elbow after wash
- Minimum 40-60 sec
Gloves
- Wear gloves for all vascular procedures
- If possibility of contact with blood, secretions, excretions, mucous membranes, non-intact skin, or contaminated items
- Wash hands after removing gloves

Avoiding Need Sticks
- Avoid recapping if possible
- Recap using one-handed "scoop" method if necessary or use recapping device
- Dispose all sharp in special sharps container
- Do not try to remove a needle from a sharp container
- Do not over fill the container

Biopspills
- Spillage of any chemical substance eg drug, medication or liquid
- Wear gloves and appropriate personal protective equipment
- Blot spill and discard towels or linen in designated medical waste container.
- Clean contaminated area with bleach solution or hospital grade disinfectant

Method of Infection Transmission
- Contact
  - Direct
  - Indirect
- Airborne
- Droplet
- Vehicle
- Vector

Airborne Transmission
- Organisms remain suspended in air for extended periods
- Negative-pressure room
- Patient leaving room must wear mask

Techs Defense
- Filtered mask – N95
- Gloves
Droplet Precautions
- Large droplets travel about 3 feet (about 1 m)
- Contact with nasal or mouth mucosa infectious
- Patient must wear mask on leaving room

Tech Defense
- Mask
- Gloves

Contact Transmission
- Direct contact
  - Body surface to body surface
- Indirect contact
  - Intermediate contact with fomite

Tech Defense
- Mask
- Impervious gown
- Gloves
- Shoe cover
- All equipment cleaned after leaving room

Vehicle Transmission
- Microorganism transmitted by contaminated item eg food

Vector Transmission
- Microorganism transmitted by living organism eg mosquito
Transmission Based Precautions
- Necessary if the patient has infected pathogen or communicable disease or if the patient is at risk for infection (immunosuppressed)
- Double protection for both patient and health care practitioner.
- Some infections and conditions will fall into more than one category
- Transmission precautions are used in addition to the STANDARD PRECAUTIONS
  - AIRBORNE
  - DROPLET
  - CONTACT

Medical Aseptic
- Keeping a clean environment
- IP covered and cleaned before and after patient use

Comfort vs. Protection
- Sheet/pillow covers vs impermeable covering

Pre-Exam Checks
- Battery level
- Accessory equipment
- Isolation precautions
- Patient restrictions

In Room Checks
- Patient ID
- Visitor/ adjacent patient
- Furniture
- Medical equipment
- Life support

Patient Modification
- Needs determined by patient condition
- Initial and continuous assessment
Restraints
- Control movement of extremities
- Keep patient in position
- Prevent patient form falling
- Prevent self-injury

Restraint Precautions
- Reapply carefully
  - Never to movable part
- Never leave patient unattended
- Allow mobility as needed
- Pad area - Restraint must be removed every 2 hours

Knots

Types of Restraints
- Limb holders
  - Ankle or wrist immobilizers
- Vest immobilizers

Trauma Patient
- Determine level of conscious
- Make periodic reassessment
- Limit patient movement – spine injury
- Do not disturb/remove
  - Impaled objects
  - Bandages
  - Antishock garment
  - Medical device

Limited Mobility
- Determine extent of mobility
- Never move part or patient without assessment
- Determine past injury, surgical procedures
Agitated / Confused
- Request assistance as needed
- Do not isolate yourself in room
- Keep exit clear
- Request permission before touching
- Keep steady calming conversation

Obese
- Request assistance as needed
- Verify weight limits on equipment
- Avoid excessive kVp

Complicated Fractures
- Precautions
- Traction
- Spinal fracture
- Multiple broken bone
- Head injury
- Open fixation

On Life Support
- Document all line or leads
- Work around medical equipment
- Care when moving patient
- Monitor any restraints – Remove with caution

Breathing Tubes
- Tracheostomy tubes & endotracheal tubes attached to respirators

Endotracheal Tube
- The distal tip should be 1 to 2 inches (3 to 5 cm) superior to the tracheal bifurcation (carina)
Endotracheal Tube

- Poor Placement
- Good Placement

Lines & Leads

- EKG
- Holter monitor

EKG

- ECG or EKG monitors the electrical activity of the heart
- Easily reattached

EKG Lines

Feeding Tubes

- Patient unable to eat or drink
- Unable to swallow
- Unable to chew

Enteral nutrition (EN) tube to the stomach or intestine
Parenteral nutrition (PN) tube fluid given intravenously
Enteral Nutrition (EN)
- Nasogastric
- PEG
- RIG
- PEJ
- Pulling out or disconnecting can seriously affect patient’s condition

Nasogastric (NG)
- From nostril, to stomach
- Insertion very uncomfortable
- Can be pulled out or dislodged

NG Tube
- Creating opening from abdominal wall to stomach
- Clothing can hide tubing
- Tube held in place with stitches or small inflated balloon under the skin or flange around the tube just under the skin

Gastrostomy Feeding
- From the abdominal wall to small bowel (jejunum)
- Nutrition given intravenously
- Central line
- PICC line

Percutaneous Endoscopic Jejunostomy (PEJ) feeding
- From the abdominal wall to small bowel (jejunum)

Parenteral Nutrition (PN)
PICC Line

Central Line

Central Line

Thoracostomy Tubes
- In place to drain the pleural cavity for re-expansion of the lungs

Chest Tube

Trauma Terminology
- Contusion
- Sprain
- Subluxation
- Dislocation
- Fracture
- Apposition
- Angulation
  - Varus
  - Valgus
Types of Fractures
- Chip
- Colle’s
- Comminuted
- Compound
- Depressed
- Epiphyseal
- Greenstick
- Impacted
- Incomplete
- Linear
- Oblique
- Occult
- Pathologic
- Simple
- Spiral
- Spontaneous
- Stellate
- Stress
- Subcapital
- Torsion
- Torus

Closed Reduction
- Closed reduction
  - Often in the ED performed by the physician

Open Reduction
- Typically an OR procedure
  - Using screws, plates or rods to realign fracture fragments

Named Fractures
- Barton’s
  - intraarticular
- Baseball (mallet)
- Bennett
  - longitudinal
- Boxer’s
- Colles’
- Hangman’s
- Hutchinson’s
  - Chauffeur’s
- Monteggia’s
- Pott’s complete
- Smith’s

Post Imaging Checks
- Return room to original condition
- Verify patient is comfortable
- Check status of visitors

Specific Imaging Considerations
- Special considerations
  - Depending on the specific body part & the needs of the patient
Shielding

Chest Imaging
- Patient upright
- Check restriction
- Document restrictions
- Moving the scapula
- Check medical equipment, lines

Chest Imaging
- Direction of x-ray beam
- SID

Lordotic Looking Chest

Head too Low

Grid Cut-off
Forshortened Chest

Artifacts

Artifacts

Pleural Effusion

Multiple lines and leads

Rotated
### Abdomen
- Avoid grid cut-off
- Include the symphysis

### Extremities
- Two projection at 90-degrees
- Cross-table imaging
- Imaging to include the entire orthopedic appliance
- Caution – medical equipment
- Utilize anode heel effect

### Spine
- Must include C7/T1
- Do not remove collar without physician consent
- Swimmer method to visualize C7/C1

### Special Care Units
- Fragile immune system
- Image before general medical or surgical patients
- Clean unit before entering

### Nursery
- Minimize stress
- Never leave unit in pathway
- Dangers from
  - Handling
  - Temperature change
  - Infection

### Precautions for NICU
- Hypothermia
- Infection
- Handling
Summary

- Develop a system
- Communicate even if patient is unresponsive
- Be aware of other people, furniture and equipment

Thank You!