Monroe-Livingston Regional EMS Protocols

Section 7

Specialty Care Transport

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7.0 Scope of Practice

The MLREMS Specialty Care Transport Paramedic provides a level of care above that of the EMT-P in order to safely provide interfacility transport of critically ill patients. These Specialty Care Transport Protocols are to be used only by credentialed MLREMS SCT Paramedics and are to be used in concert with the EMT-P scope of practice outlined in the MLREMS Standards of Care when performing an interfacility transport. These Protocols do not limit the ability of a provider to transport a patient with the physiology (pericardial effusion for example) stated in these protocols, but rather are only to be used during interfacility transports of patients with additional medications or devices not allowed under MLREMS EMT-P Standards of Care including, but not limited to:

- Patients that have more than one vasoactive medication.
- Patients that are orotracheally or nasotracheally intubated, or have a tracheostomy tube and are unstable, who require mechanical ventilation based on their condition, thus requiring staff with advanced knowledge of ventilator management.
- Patients that are being hemodynamically monitored with invasive monitoring devices, including arterial, Swan Ganz, or similar central access devices.

In addition to those medications identified in the MLREMS EMT-P Standards of Care, the credentialed SCT Paramedic may begin or continue the following additional medications which may be provided by the sending facility, or at the discretion of its Medical Director, the SCT agency:

Clopidrogel
Dobutamine
Eptifibitide
Esmolol
Fibrinolytic Agents
Fosphenytoin
Heparin
Hydrocortisone
Labetalol
Levetiracetam
Mannitol
Milrinone
Nicardipine
Nitroglycerin
Norepinephrine
Nitroprusside
Octreotide
Pantoprazol
Phenylephrine
Phenytoin
Propofol
Sodium Nitroprusside
Ticagrelor
Tirofiban
Vasopressin

This list does not preclude the SCT Paramedic from continuing other medications that are ordered/initiated by the sending facility provided that they are within the same class of medications as the SCT Paramedic's scope of practice.

The following protocols are considered standing order except if notation is made to contact medical control, which is considered Absolute On-Line with no exception for radio or phone failure. All MLREMS EMT-P Standards of Care are standing order for the Specialty Care Transport Paramedic when executing an interfacility transport except in cases identified as Absolute On-Line with no exception for radio or phone failure.

7.1 Care Expectations

The specialty care transport team will work collaboratively to achieve the following objectives:

1. Introduce yourself and the team members to the patient, family, and hospital staff.

2. Utilize full universal precautions.

3. Provide a primary and secondary assessment prior to transport on every patient transported including a history and review of interventions by the sending facility and x-ray results/lab information when applicable.

4. Treatment for life-threatening problems detected during the primary and secondary assessment must be initiated before transport unless the patient is being transported for management of that problem.

5. Establish and maintain a patent airway. If the patient is on a ventilator, maintain the ventilator settings as per the sending facility unless otherwise indicated by the clinical condition of the patient.

6. Contact the SCT Medical Control unless all the following criteria are met.

    a. The patient's condition is stable and an accurate report of the patient's condition has been given to the Specialty Care Transport Paramedic.
    b. The written protocols and any written orders currently address the immediate and foreseeable needs of the patient.
    c. There is clear evidence of discussion between the sending and receiving facilities and the receiving facility has accepted care of the patient.
    d. There is a completed hospital transfer form with the name of the accepting physician.

7. Before leaving the hospital, have the patient and family visit and, if possible, explain the patient's condition and probable course.

8. A phone report should be given to the receiving facility should any significant changes occur enroute. Before leaving the sending facility, try to obtain a contact person responsible for patient care at the receiving facility.

9. In the event of cardiac arrest of the patient during transport the Specialty Care Transport Unit will proceed to the nearest appropriate emergency department. The transporting paramedic should notify the SCT Medical Control as soon as practical. The Emergency Department should also be notified by the most appropriate means.

10. Patients carrying a "Do Not Resuscitate" order or other advanced directive (e.g. MOLST) will not be transported until limitations of treatment in the form of a written order from the sending physician have been secured. This should be discussed with the SCT Medical Control before transport.

11. The Specialty Care Paramedic will give a complete report to the staff on arrival at the receiving facility.

12. ALL PROCEDURES MUST BE DOCUMENTED.

7.2 Routine Standard of Care

These “Specialty Care Transport Protocols” are only to be used by personnel designated as a “Specialty Care Transport Paramedic” by the MLREMS Medical Director. The protocols are NOT to be used for routine Advanced Life Support care. Routine advanced life support care is directed by the “Monroe-Livingston REMAC EMS Protocols”. They are meant to act as general guidelines for rendering medical care and/or treatments and may not be inclusive for every situation. The protocols should be regarded as the prevailing norms of treatment and should be considered prudent in the delivery of medical care. Deviation from these protocols may be necessary based on patient need and must be documented.

All patients being transported by the Specialty Care Transport Team should have the following in place prior to leaving the referring facility:

- Stable airway.
- Cardiac monitor – 3-lead with 12-lead capability immediately available.
- If clinically indicated, a minimum of two intravenous lines (peripheral or central).
- Continuous pulse oximetry, cardiopulmonary monitoring including: blood pressure (invasive or noninvasive), and capnography (when clinically indicated; required for any patient on a ventilator)
- Vital signs taken a **minimum** of every 15 minutes unless a change occurs which requires immediate repetition of them.
- Vital signs taken a minimum of every 5 minutes if any vasoactive or sedating type medications are being infused.
- Confirmation that any medications being infused in the same IV line are compatible.
- Any continuous infusion requires the use of a continuous electronic infusion device.

All patients should be maximally stabilized prior to transport, including intubation and peripheral or central venous access if necessary. It is the responsibility of the sending facility to ensure that stabilization is complete. In the event the Specialty Care Transport Team does not feel the patient is stable for transport, they must communicate with both the sending facility and the SCT Medical Control before transport is initiated.

7.3 Medical Control

Specialty Care Transport Medical Control is provided by the SCT Agencies performing the transport. The SCT Technician must have a means of direct communication to SCT Medical Control Physician on-call at all times during their care of the patient. SCT Medical Control Physicians must be approved by the Agency Medical Director prior to performing any direct on-line medical control for SCT interfacility transports.

The presence of a phone icon next to a medication or procedure requires SCT Medical Control prior to initiating the order.

Specialty Care Transport Medical Control/Communication Failure:

Contact with SCT medical control will be dictated by protocol and should be available at all times. For the Specialty Care Transport unit the preferred medical control is the designated SCT Medical Control. In the event of being unable to contact the SCT Medical Control the following mechanism will be instituted.

1. Direct contact with a designated back-up MLREMS approved SCT Medical Control (if available).
2. Direct contact with standard medical control.
3. In the event of failure of all the above, treatment protocols will be regarded as standing order, however procedures requiring absolute on-line medical command should not be undertaken unless in a life threatening emergency situation.
4. In the event of a procedure requiring absolute on-line direction being undertaken without medical control, the procedure and events surrounding it will be reviewed within 24 hours by the agency Specialty Care Medical Director to determine if retroactive approval is warranted.

Orders from transferring/ receiving physicians:

During inter-hospital transport, medical crews will be asked to continue treatment initiated at the transferring hospital. These orders must be written and signed by the referring physician. If, at any time the Specialty Care Transport Crew questions orders from a referring or receiving physician, SCT Medical Control **MUST** be contacted. Likewise, anytime a transferring or receiving physician asks the Specialty Care Transport crew to carry out medical treatment for which they have not been trained, or which appears to be in conflict with established treatment protocols, SCT Medical Control **MUST** be contacted before initiating care.

Potentially Unstable Transports:

It is the requirement of the sending facility to provide sufficient interventions to stabilize the patient prior to transport. If, in the opinion of the Specialty Care Paramedic, the patient is not stable for transport, discussions with the sending facility and possibly SCT Medical Control should occur to determine how best to stabilize the patient for transport. Potential solutions include further interventions (such as intubation) at the sending facility or use of another Specialty Care Transport unit or agency with additional capabilities.

Intubation before transport is the responsibility of the sending facility and should be done by them. SCT Paramedics will not begin a transport until the sending facility has successfully managed to create a stable airway. In the event that they refuse, contact SCT Medical Control.

7.10 Aortic Emergencies

INDICATIONS

Known or suspected aortic dissection or aneurysm.

MANAGEMENT GOALS

- Reduce afterload
- Reduce HR and stroke volume to the lowest levels that allow for adequate systemic perfusion. Systolic blood pressures > 90 mmHg may be required to maintain MAP greater than 65 mmHg.
- Reduce anxiety and pain

CARE GUIDELINES

1. Routine medical care

2. Ensure two patent large bore IVs

3. If SBP remains over 120 mm Hg, consider:

   - Nicardipine (Cardene): 5mg/hr, increase by 2.5 mg/hr every 10 minutes to a maximum of 15 mg/hr. When at goal drop the infusion rate to 3mg/hr to avoid hypotension.
     OR
   - Sodium Nitroprusside (**<u>Only if Nicardipine is not available</u>**) at 0.3 mcg/kg/min, increase by 0.5 mcg/kg/min every 5 minutes up to a maximum of 3 mcg/kg/min. May increase up to 10 mcg/kg/min but for no longer than 10 minutes total (usual dose 0.5mcg/kg/min to 3 mcg/kg/min).
     OR
   - Nitroglycerin at 40-50 mcg/min (increase by 5mcg/min every 5 minutes, up to a maximum of 80mcg/min)

   Titrate either agent to a systolic blood pressure of approximately 90 mm Hg

   - If Sodium Nitroprusside or Nitroglycerin is initiated, the patient must receive beta blockade to reduce the potential for reflex tachycardia and additional strain.

4. If HR is over 100 bpm, consider:

   - Esmolol (Brevibloc): Bolus 500 mcg/kg over 1 minute, then start infusion at 50mcg/kg/min. May increase by 50 mcg/kg/min every 5 minutes up to a maximum of 200 mcg/kg/min

   OR

   Metoprolol (Lopressor) 5mg q 10 minutes X 3 doses up to maximum 15mg (hold for HR less than 60)

5. Consider pain management if SBP > 100 mmHg and RR > 8 rpm :

   Fentanyl 0.5-1 mcg/kg (ideal body weight) IV, may repeat every 10 minutes to a maximum of 500 mcg.
   OR
   Morphine 0.1mg/kg, may repeat with 0.05mg/kg every 10 minutes to a maximum 50 mg.

6. Consider mild sedation if patient is still anxious after adequate analgesia:

   Midazolam 1-2.5 mg IV, may repeat every 10 minutes to maximum 20 mg

7. Consider nausea/vomiting management:

   Promethazine (Phenergan) 6.25 – 12.5 mg diluted in 50 mL NS and given over 15 minutes, may repeat every 15 minutes to maximum 25 mg
   OR
   Ondansetron (Zofran) 4 mg IV, may repeat every 15 minutes up to 16 mg

7.10 Aortic Emergencies (Continued)

TREATMENT CONSIDERATIONS

- Medications should be titrated by MAP and patient consciousness. Any evidence of EKG changes necessitates a higher MAP.

7.11 Cardiogenic Shock

INDICATIONS

Hypoperfusion with systolic blood pressure < 90 mmHg and:

- PAOP >15 mmHg (if available)
  OR
- Overt signs of left ventricular failure
  - Acute pulmonary edema
  - Altered mentation
  - Cool, mottled extremities
  - Low urine output

MANAGEMENT GOALS

- Maintenance of adequate tissue perfusion, as evidenced by clinical signs & symptoms
- Improvement in cardiac output and coronary perfusion
- Target MAP of 65 mmHg or greater, target systolic pressure greater than 80 mmHg
- Maintain urine output of at least 0.5 mL/kg/hour

CARE GUIDELINES

1. Routine medical care

2. Ensure two patent large bore IVs

3. In patients experiencing cardiogenic shock *without* pulmonary congestion, administer 100 – 250 mL crystalloid fluid boluses PRN to obtain and maintain management goals. Observe patient carefully for development of pulmonary congestion.

4. If tissue perfusion is inadequate, circulating volume is adequate and the patient presents with or develops pulmonary congestion, consider initiating medical therapy:

   Systolic BP > 80 mmHg with signs of inadequate tissue perfusion:
   - Dobutamine, at 5 mcg/kg/min, may increase by 5 mcg/kg/min every 15 minutes to maximum dose of 20 mcg/kg/min (titrate slowly with concern for ectopy or status change)

   - If inadequate perfusion persists, and the maximum dose of dobutamine has been achieved, add Milrinone. Begin at 0.375 mcg/kg/min and increase by .125 mcg/kg/min every 15 min to a maximum dose 0.75 mcg/kg/min (titrate slowly with concern for ectopy or status change) Expect a slow drop in blood pressure that may necessitate adding a vasoconstrictive agent.

   Systolic BP < 80 mmHg with signs of inadequate tissue perfusion:

   - First line if HR > 60 BPM: Norepinephrine 2 mcg/min. May increase by 2mcg/min every 5 minutes. If > 80 mcg/min contact medical control (titrate slowly and watch for ectopy)

   - **<u>If Norepinephrine is not available</u>**: Dopamine 5 mcg/kg/min. May increase by 5mcg/kg/min every 5 minutes to a maximum dose 20 mcg/kg/min. (titrate slowly and watch for ectopy)

   - Consider adding Dobutamine to further increase cardiac output. Start at 5 mcg/kg/min increase by 5mcg/kg/min every 5 minutes up to 20 mcg/kg/min. Hold if HR>100 BPM (titrate slowly and watch for ectopy)

   - First line if HR <60 BPM, start Epinephrine 1 mcg/min and increase by 1 mcg/min every 15 minutes up to 20 mcg/min (0.1-0.2 mcg/kg/min). Hold if HR >100 BPM

7.11 Cardiogenic Shock (Continued)

TREATMENT CONSIDERATIONS

- The patient in cardiogenic shock must be treated aggressively.
- Obtaining pulmonary arterial occlusion pressure (PAOP) or pulmonary capillary wedge pressure (PCWP) is not indicated during transport.
- If available, review chest x-ray for presence of pulmonary edema and/or infiltrates.
- If available, review all labs and/or diagnostic material; i.e. echocardiogram, BNP, etc.
- Central venous access is desirable if possible. If vasoactive medications are being administered.
- Continuous arterial pressure monitoring is desired if possible.
- If the patient is experiencing cardiogenic shock as the result of an MI, ASA and anti-thrombin therapy should be initiated unless otherwise contraindicated.
- If Norepinephrine or Dopamine infusions are resulting in tachycardia (HR greater than 140 BPM) or tachydysrhythmias, especially if cause of cardiogenic shock is the result of AMI, wean Norepinephrine or Dopamine and begin Phenylephrine.
- Vasodilators should be used with caution. Beta Blockers should be avoided.
- Be extremely cautious with afterload and/or preload reducing agents if instituted to increase cardiac output.
- Be cautious with Dobutamine and Milrinone. **Although Dobutamine and Milrinone increase contractility, they also decrease systemic vascular resistance (SVR) which may lead to hypotension.**

7.12 Elevated Intracranial Pressure

INDICATIONS

History of brain injury (traumatic, intracranial hemorrhage, or mass) with GCS ≤ 8

MANAGEMENT GOALS

- Prevention of secondary brain injury due to hypoxia or hypotension
- Reduction of cerebral oxygen demand
- Reduction of intracranial pressure while maintaining cerebral perfusion pressure
- MAP 80 – 100 mmHg (Should the MAP be markedly elevated, consider Hypertensive Emergencies Protocol (7.13))
- $EtCO_2$ 35 - 45 mmHg

CARE GUIDELINES

1. Routine medical care

2. Consider early intubation. Maintain SpO_2 >90% and $EtCO_2$ 38 - 42mm Hg. Avoid allowing $EtCO_2$ to fall below 30 mmHg.

3. Consider analgesia:

   Fentanyl – 0.5-1 mcg/kg IV, may repeat 0.5 mcg/kg every 10 minutes to adequate analgesia, maximum of 500 mcg or hemodynamic instability

   OR

   Morphine - 0.05-0.1 mg/kg IV, may repeat with 0.05 mg/kg every 10 minutes to adequate analgesia, maximum of 50 mg or hemodynamic instability

4. Consider sedation. Level of sedation should be maintained to a Ramsay Scale score of 4-6:

   Midazolam - 1-2.5 mg IV, may repeat every 10 minutes to a maximum of 20 mg or hemodynamic instability

   OR

   Propofol – initiate at 10 mcg/kg/min, increasing rate by 5 mcg/kg/min every 5 minutes to a maximum of 30 mcg/kg/min. Administer 10 mg boluses once every 10 minutes as needed. Propofol is a potent vasodilator so expect hypotension as doses increase.

5. Consider nausea/vomiting management:

   Promethazine (Phenergan) 6.25 – 12.5 mg diluted in 50 mL NS and given over 10 minutes, may repeat every 15 minutes to maximum 25 mg

   OR

   Ondansetron (Zofran) 4 mg IV, may repeat every 15 minutes up to 16 mg

6. Consider paralysis per Intubated and Chemically Neuromuscularly Blocked Patient Protocol (7.14)

7. Consider seizure prophylaxis:

   - Fosphenytoin 20 mg (PE) /kg at a maximum rate of 150 mg/min, diluted in at least 100 ml normal saline.

8. For cerebral edema and global swelling consider:

   - Mannitol (20%-25%) 1gm/kg IV. Hypotension is an absolute contraindication in osmotic diuresis.

   - Hypertonic saline, (3%) if initiated at the sending facility, should be 30-75 ml/hr with a target serum sodium of 155 mEq/L. This should be infused through a central line but can go peripherally through a Y-site attached to free flowing fluid at 30-75 ml/hr. Do not titrate during transport.

7.12 Elevated Intracranial Pressure (Continued)

9. If an open skull fracture is suspected consider:

   Ceftriaxone (Rocephin) 2g IV, if not contraindicated.

TREATMENT CONSIDERATIONS

- Minimize external stimuli and maintain normothermia.

7.13 Hypertensive Emergencies

INDICATIONS

Blood pressure > 200/130 mmHg without symptoms or > 180/110 mmHg with:

- Acute change in mental status
- New focal neurological deficit
- Acute ischemic ECG changes
- Acute LV dysfunction
- Renal failure (increased serum creatinine or increased urinary output less than 0.5 mL/kg/hr)

MANAGEMENT GOALS

- Prevention of serious cardiac or neurologic complications
- Initiation of gradual therapy to lower blood pressure to the point that immediate life-threatening complications (acute CHF, CVA) are avoided

CARE GUIDELINES

1. Routine Medical Care

2. Attempt to identify and correct the cause of the BP elevation (pain, pre-eclampsia,overdose, etc.); consult the appropriate protocol and contacting SCT medical control.

3. If blood pressure greater than 200/130 mmHg and asymptomatic; or blood pressure greater than 180/110 mmHg and accompanied by symptoms such as tachycardia, headache, nausea/vomiting, or confusion:

   - Consider Labetalol: 10 mg slow IV push over 2 minutes, May double the previous dose and repeat every 10 minutes as needed for desired effect (maximum total dose 300 mg hold for HR < 60)

   - Consider Nicardipine (Cardene): Initiate infusion at 5mg/hr, increase by 2.5 mg/hr every 10 minutes to a maximum of 15 mg/hr. Once at goal, decrease down to 3 mg/hr and repeat titration.

   - Consider Esmolol (Brevibloc): Bolus 500 mcg/kg over 1 minute, then start infusion at 50mcg/kg/min. May increase by 50 mcg/kg/min every 10 minutes up to a maximum of 200 mcg/kg/min

   - Consider Nitroglycerin infusion: Initiate infusion at 40-50 mcg/min, may increase by 5 mcg/min every 5 minutes, up to a maximum of 80 mcg/min.

   - Consider Nitroprusside (Nipride) infusion (**Only if Nicardipine unavailable**): Initiate infusion at 0.3 mcg/kg/min, may increase by 0.5 mcg/kg/min every 5 minutes to a maximum of 3 mcg/kg/min. May increase up to 10 mcg/kg/min but for no longer than 10 minutes total (usual dose 0.5 mcg/kg/min).

TREATMENT CONSIDERATIONS

- Rapid reduction in BP is indicated in the setting of AMI, hypertensive encephalopathy, and subarachnoid hemorrhage. In all other cases, BP should be lowered no more rapidly than 10% per hour until a baseline blood pressure is reached.
- Consider adequate pain management as an initial step in patients with cephalalgia
  Morphine - 0.1 mg/kg, repeat with 0.5mcg/kg every 10 minutes to adequate analgesia or hemodynamic instability up to a maximum of 50 mg
  Or
  Fentanyl - 0.5-1 mcg/kg IV repeat with 0.5 mcg/kg every 10 minutes to adequate analgesia or hemodynamic instability up to a maximum of 500 mcg.
- If an aortic emergency is known or suspected, see Aortic Emergencies Protocol (7.10)
- If hypotension occurs, discontinue antihypertensive infusions, elevate patients' feet and administer 250 ml crystalloid fluid bolus as needed. Repeat as needed to maintain MAP of at least 65 mm Hg and contact SCT Medical Control.

7.14 Intubated and Chemically Neuromuscularly Blocked Patients

INDICATIONS

Patients who are intubated and mechanically ventilated

MANAGEMENT GOALS

- Provide for patient comfort and safety
- Optimize ventilatory parameters

CARE GUIDELINES

1. **ALL PATIENTS WHO ARE CHEMICALLY NEUROMUSCULARLY BLOCKED MUST HAVE ALSO RECEIVED AN ANALGESIC AND SEDATION BY THE SCT PARAMEDIC UNLESS SPECIFICALLY CONTRAINDICATED.**

   Analgesia:

   - Fentanyl – start with 1mcg/kg (max 100 mcg) IV once and infusion of 25-100 mcg/hr then bolus with 0.05 mcg/kg (25-50 mcg) and increase by 25-50 mcg every ten minutes (max of 3 mcg/kg/hr or 250 mcg/hr) Titrate to appropriate sedation or hemodynamic instability

   Sedation:

   - Midazolam - Start with 1-2 mg IV bolus and then infuse at 1-4mg/hr. Titrate analgesia first before sedation.
     OR
   - Propofol – Initiate infusion at 10 mcg/kg/min and titrate by increasing rate 5 mcg/kg/min every 5 minutes to a max 30 mcg/kg/min. Preferrably titrate fentanyl until a max dose is achieved, then increase the propofol according to protocol. Administer 10 mg boluses every 10 minutes as needed. Consider risk of hypotension.
   - If adequate sedation is not achieved with maximum doses of analgesics and sedating medications, contact SCT Medical Control for further recommendations.

2. Soft restraints should be used for patient safety.

3. All intubated patients may be re-dosed with neuromuscular blockers if needed to maintain ventilator synchrony or patient safety. If required Rocuronium should be dosed at 0.5 mg/kg IV (ideal body weight) every 20-40 minutes. ALL patients MUST have continuing ANALGESIC and SEDATIVE agents with continued neuromuscular blockade. If sending facility has initiated neuromuscular blockade with another agent, continue it and redose with Rocuronium if continued neuromuscular blockade is needed.

4. If unable to sedate/neuromuscularly block, ensure IV lines are in place and patent. In the event of continued failure to neuromuscularlry block, SCT Medical Control should be contacted.

7.15 Pericardial Effusion and Cardiac Tamponade

INDICATIONS

Patients with asymptomatic pericardial effusion or evidence of Cardiac Tamponade

MANAGEMENT GOALS

Render optimal care to improve outcome

CARE GUIDELINES

If evidence of symptomatic pericardial effusion:

1. Treat hypotension with repeated fluid boluses
2. Confirm equal bilateral breath sounds and chest rise with breaths

If evidence of cardiac tamponade:

1. The nearest appropriate Emergency Department should be contacted as well as SCT Medical Control.

7.16 Thoracostomy (Chest) Tubes

INDICATIONS

Patients being transported with thoracostomy tubes in place

MANAGEMENT GOALS

Render optimal care to minimize discomfort and monitor for changes in patient condition during transport

CARE GUIDELINES

- All thoracostomy tubes must be securely attached to patient before transport. This should include: confirmation of suturing to the skin, occlusive dressing to thoracostomy site, and secure taping of the thoracostomy tube to the patient.
- All thoracostomy tubes should be connected to a commercially available Pleur-Evac or a Heimlich valve.
- If suction was being applied to the Pleur-Evac at the sending facility, it will be maintained during the transport at the same setting.
- In the event of a sudden deterioration in the patient's status, all thoracostomy tubes will be placed to suction.
- Thoracostomy tubes should be re-examined every 15 minutes during transport to ensure proper function.
- In the event that a thoracostomy tube becomes dislodged, no attempt will be made to reposition. The thoracostomy tube should be put to suction and the patient observed for signs of tension pneumothorax.
- If tension pneumothorax should develop, initiate appropriate care with needle decompression and contact Specialty Care Transport Medical Control.
- Provide appropriate analgesia as needed.
- If the patient becomes hypotensive and tension pneumothorax is not suspected, refer to MLREMS Hypotension and Shock Protocol (2.18)

7.17 Titration of Vasoactive Medications

INDICATIONS

Patients being transported with intravenous vasoactive medications

MANAGEMENT GOALS

Provide for safe titration and use of intravenous vasoactive medication during transport

CARE GUIDELINES

1. All vasoactive medications must be controlled utilizing a Continuous Electronic Infusion Device (commonly referred to as a medication pump).

2. Whenever possible, vasoactive medications should be given through a central access device (central line, PICC line, etc). If this is not possible, the vasoactive medication should be infused through the Y-site of free flowing peripheral IV of normal saline (0.9% NS).

3. The primary carrier IV of normal saline (0.9% NS) should have a flow rate of 125 ml/hr and should not be titrated. This can be achieved with either a flow restricting device or as a channel on the Continuous Electronic Infusion Device. A stopcock or “Y-site” should be used for each infused medication proximally to the flow restrictor.

4. NO medications should ever be bloused through the IV line infusing vasoactive medications.

5. Whenever possible, initial administration of vasoactive substances should begin in the sending facility. Addition of vasoactive medications during transport should be made after SCT Medical Control consultation.

6. Unless otherwise specified by the sending facility or SCT Medical Control, vasoactive medications should generally be titrated to achieve a Mean Arterial Pressure of 65 mmHg or greater.

7. Titration of vasoactive substance should be performed utilizing an understanding of the medication’s pharmacokinetics, with typical half-life determining the period of observation to determine medication effect.

7.18 Transvenous (Temporary) Pacemaker

INDICATIONS

Patients being transported with a transvenous (temporary) pacemaker

MANAGEMENT GOALS

Provide for safe transfer of patients with a transvenous (temporary) pacemaker

CARE GUIDELINES

- Check to assure the insertion site dressing is clean and dry and the pacing electrode position is anchored securely with tape.
- Secure the pacing generator and place the plastic cover over the pacemaker controls.
- Manage complications, should they develop, according to the following:

1. **Failure to capture** –due to electrode displacement or a high stimulation threshold
   - Check and tighten all connections.
   - Increase the pacemaker output/mA.
   - Turn the patient to a left lateral recumbent position.
   - Call Specialty Care Transport Medical Control immediately and report if effective capture is not regained after the above interventions.
   - Place the external pacer on the patient and pace if needed for symptomatic bradycardia following the MLREMS Bradycardia Protocol (3.4; 4.4).
   - Turn off any internal pacer if one is present.

2. **Failure to pace with no spike present** –caused by a broken or loose connection, electrode fracture, inhibition of pacemaker output, battery or circuit failure.
   - Check and tighten all connections.
   - Check for any equipment that might cause electrical interference and remove if possible.
   - Replace the battery and/or pacing generator.
   - Call Specialty Care Transport Medical Control immediately and report if effective pacing is not regained after the above interventions.
   - Place the external pacer on the patient and pace if needed for symptomatic bradycardia following the MLREMS Bradycardia Protocol (3.4; 4.4).
   - Turn off any internal pacer if one is present.

3. **Failure to sense** – occurs when the pacemaker does not sense an intrinsic beat.
   - Check and tighten all connections.
   - Increase the sensitivity of the pacing unit.
   - Place the patient in a position where adequate sensing was last observed. A left lateral recumbent position is usually best.
   - Increase the pacing rate to override the intrinsic rhythm if possible
   - Turn the pacemaker off if it is not needed, but do not disconnect from the electrode wires.
   - Call Specialty Care Transport Medical Control immediately and report if effective pacing is not regained after the above interventions.
   - Place the external pacer on the patient and pace if needed for symptomatic bradycardia following the MLREMS Bradycardia Protocol (3.4; 4.4).
   - Turn off any internal pacer if one is present.

7.18 Transvenous (Temporary) Pacemaker (Continued)

4. Over-sensing –occurs when the pacemaker sensitivity is set too high. (It should be suspected when pauses are seen intermittently on the ECG or when the paced rate falls below that set on the pacemaker generator. The pacemaker-induced problem may be mistaken for electrode fracture or impending generator failure. Over-sensing leads to under-pacing.)

- Decrease the sensitivity on the pacemaker.
- Replace the pacemaker generator if the problem continues.
- Call Specialty Care Transport Medical Control immediately and report if effective pacing is not regained after the above interventions.
- Place the external pacer on the patient and pace if needed for symptomatic bradycardia following the MLREMS Bradycardia Protocol (3.4; 4.4).
- Turn off any internal pacer if one is present.

7.19 SIRS/Sepsis

INDICATIONS

Suspected or documented infection and at least two of the following:

- Temperature > 101°F (38.3°C) or < 96.8°F (36°C)
- Tachycardia HR >90 bpm
- Tachypnea RR > 20 rpm or $PaCO_2$ < 32 mmHg
- Increased WBC count >12,000 c/mm^3, < 4,000 c/mm^3 or >10% bands

MANAGEMENT GOALS

- Maintain airway patency and oxygenation / ventilation status to goal of SpO_2 92% or greater
- Maintain intravascular fluid volume status to goal of MAP of 65 mmHg or higher

CARE GUIDELINES

1. Routine medical care

2. Ensure that the appropriate initial fluid resuscitation (30mL/kg) occurred prior to transport. If not administer fluids to achieve the initial target of 30 mL/kg as needed.

3. Aggressive fluid maintenance is absolutely necessary, even if patient is normotensive. Maintain a maintenance infusion of 125mL/hr.

4. Bolus 10 mL/kg every of 0.9% NS 10 minutes until a MAP of 65 mmHg is achieved.

If target MAP has not been reached after 30 mL/kg of 0.9%NS, and patient is still hypotensive, continue 0.9%NS boluses and consider adding the following:

- Norepinephrine 4-80 mcg/min (primary agent, with target goal of MAP >65 mmHg)

    - If Norepinephrine maximum is reached or HR increased to >140 BPM, contact SCT medical control and consider starting Phenylephrine at 25 mcg/min. Increase 25 mcg/min every 5 minutes to a maxof 200 mcg/min or adequate MAP.
    - Dobutamine 5-20 mcg/kg/min if cardiac output remains poor **(secondary agent** for CI <3.0 L/min/m^2 and ScvO2 >70% with HCT >30)
    - If a third agent is required =, contact SCT Medical Control and consider epinephrine at 1 mcg/min (0.05 mcg/kg/min) or vasopressin 0.01-0.04 units /min.

If the patient has failed to respond to vasopressor therapy, consider:

Hydrocortisone 100 mg IV/IM/IO

TREATMENT CONSIDERATIONS

- Maintain urine output of 0.5mL/kg/hour
- Maintain anti-infective therapy as begun at the sending facility; consider a broad spectrum antibiotic infusion.

7.20 STEMI / Acute MI Management

INDICATIONS

Patients presenting to outlying Hospital Emergency Departments lacking interventional cardiac capabilities, with ST elevation ≥ 1mm in 2 contiguous leads, new LBBB with symptoms less than 12 hours in duration or LBBB with ST/T wave abnormalities which meet diagnostic criteria for MI (e.g., Sgarbossa).

MANAGEMENT GOALS

- Provide for patient comfort and safety
- Optimize transport times to meet AHA guidelines for "door to balloon" time of 90 minutes or less.

CARE GUIDELINES

1. Routine medical care.

2. Serial 12 lead EKG's during transport; Do not delay transport to obtain.

3. Ensure two patent IVs.

4. If not already administered or started by sending facility:

   Aspirin, 324 mg chewed PO x 1

   AND

   Clopidogrel (Plavix), 300 mg PO x 1 or Ticagrelor 180 mg PO x 1

5. Consider anticoagulation/antiplatelet administration:

   Eptifibatide (Integrilin), 180 mcg/kg IV bolus x 2,10 minutes apart then 2 mcg/kg/hr infusion, (If GFR or CrCL < 50 ml/min then reduce infusion to 1 mcg/kg/hr; if GFR or CrCl < 30 ml/min do not administer).

   Heparin 60 units/kg IV bolus x 1, (Maximum of 4,000 units), followed by 12 units/kg/hr infusion, (Maximum of 1,000 units/hr)

6. Consider Nitrates if SBP > 110 mmHg:

   Nitroglycerine 0.4mg SL q 5 minutes prn pain

   OR

   - Consider Nitroglycerin infusion: Initiate infusion at 40 – 50 mcg/min, may increase by 5 mcg/min every 10 minutes up to a maximum of 80 mcg/min while maintaining SBP > 110 mmHg.

7. Consider beta blockade if HR >80 and SBP >110 mmHg:

   - Metoprolol (Lopressor) 5 mg every 5 minutes X 3 doses up to maximum 15 mg to goal HR <80

8. Consider pain management if SBP > 110 mmHg and RR > 8:

   Morphine 0.1 mg/kg IV bolus, repeat at 0.05 mg/kg every 10 minutes to adequate analgesia or hemodynamic instability

9. Consider nausea/vomiting management:

   Promethazine 6.25 mg – 12.5 mg diluted in 50 ml normal saline, given over 15 minutes, may repeat every 15 minutes to max of 25 mg.

   OR

   Ondansetron 4 mg IV push. May repeat every 15 minutes, maximum dose of 16 mg.

7.20 STEMI / Acute MI Management (Continued)

10. Should patients condition deteriorate to the point of cardiogenic shock, treat per section 7-11. Contact SCT Medical Control and the receiving facility to advise them of the patients change in condition.

7.21 Ventilator Management

INDICATIONS

Patients who are mechanically ventilated

MANAGEMENT GOALS

- Provide for patient comfort and safety
- Optimize ventilatory parameters

CARE GUIDELINES

1. Connect ventilator hose to the gas supply.

2. Turn on gas supply and check cylinder contents.

3. Set ventilation parameters to suit the patient. Refer to referring or receiving physician orders.

4. The following Specialty Care Transport unit standard (adult) ventilator settings will be initiated unless other physician orders/patient condition dictate:
   a. FIO_2 titrated to maintain SpO_2 > 90%
   b. Respiratory rate=10-12
   c. Tidal Volume=4-8 mL/kg
   d. PEEP=5
   e. Mode = A/C [Volume Control]

5. Briefly occlude the patient connection port of the patient-valve with thumb and check that the peak inflation-pressure reading on the manometer is appropriate for the patient.

6. Connect the patient valve to the endotracheal tube.

7. Monitor the inflation pressure manometer to ensure correct ventilation

8. Make appropriate adjustments per patient's clinical condition. $ETCO_2$ should be maintained at 38-42 mmHg. $ETCO_2$ must be monitored by waveform capnography at all times.

9. Ensure patient compliance with the ventilator and the recommended settings prior to leaving the facility.

10. Adjustments beyond the following parameters require Specialty Care Transport Medical Control or physician order.
    a. Respiratory rate <8 or >16
    b. PEEP >10
    c. ETCO2 <38 or > 42 mmHg

11. Provide sedation and analgesia per SCT 7.14.

7.22 Ventricular Assist Devices – Total Artificial Heart (TAH)

INDICATIONS

Patients who have implanted Syncardia® Total Artificial Heart (TAH)

MANAGEMENT GOALS

Provide for patient comfort and safety
Ensure device functionality
Optimize patient perfusion

CARE GUIDELINES

1. Routine Medical Care
2. TAH Patients will have BP and HR obtainable by conventional means, but no electrical activity
   - Target SBP < 130 mmHg
   - Pulse rate set and normal, between 120-135bpm
   - Normal fill volume is variable, 50-60 ml/beat and displayed on the unit
3. Assess device functionality and operation
   - Defined by:
     - Device power
     - Fault alarms from driver unit
   - If driver is not operating, the patient has no pulse or blood pressure, or fault alarming; change to backup driver or hand pump
     - Hand pump at a rate of 120 bpm where 1 beat is equivalent to '1 down and up'
4. Ensure patent IV access
5. If blood pressure is > 130 mmHg consider
   - Nitrates:
     Nitroglycerin 0.4mg SL q 5 minutes
     OR
     Nitroglycerin infusion, 10 mcg/min may increase by 5mcg/min every 10 minutes to a maximum of 50 mcg/min SBP < 130mmHg
   - If SBP elevation persists:
     Consider Labetalol 10mg slow IV push over 2 minutes. May double the previous dose and repeat every 10 minutes as needed for desired effect (maximum total dose 300 mg hold for HR<60 BPM.
6. Assess for hypervolemia:
   - If fill volumes are > 60ml and patient has complaints of respiratory distress administer IV furosemide 40mg
7. Assess for hypovolemia:
   - If patient has blood pressure < 90mmHg or fill volumes < 45ml with evidence of distributive shock, blood loss, or dehydration:
     250ml bolus IV 0.9% Normal Saline or Lactated Ringers; May repeat if necessary

ADDITIONAL CONSIDERATIONS

- TAH patients are on multi-agent anticoagulation
- Insufficient cardiac support may be due to:
  - Hypervolemia, not hypotension and hypovolemia; Kevlar chambers can accommodate no more then 70ml at a time.
  - Degradation or damage to the drivelines. Examine drivelines for venting air. Repair kit is in patient support kit
- Transport patient with both drivers, hand pump, all batteries, and power cords
- Contact receiving hospital
  - Strong Hospital Artificial Heart Program – 1-800-892-4964
  - Syncardia ®Emergency number 1-866-771-9437

7.23 Post Thrombolytic Administration

INDICATIONS

Patients who have had a thrombolytic administered prior to transfer for the conditions of Acute Coronary Syndrome (ACS), Pulmonary Embolus (PE), or Stroke (CVA).

MANAGEMENT GOALS

Provide for patient comfort and safety
Ensure completion of thrombotic medication
Close and frequent monitoring of patients physical and neurologic condition.

CARE GUIDELINES

1. Monitor patient's vital signs and neurologic exam at a minimum of every 15 minutes during the infusion as well as after the infusion during transport (i.e. NIHSS).
    a. If the patient's neurologic exam decompensates, stop the infusion and contact the receiving facility and SCT medical control.
    b. Infusion should not be restarted until evaluated by the receiving facility.

2. Monitor for major/minor bleeding
    a. Major bleeding i.e. intracranial, retroperitoneal, gastrointestinal, urinary
    b. Minor bleeding i.e. gums, venipuncture sites, hematuria, hemoptysis, hematomas, ecchymosis
    c. If bleeding complications occur contact the receiving hospital and SCT Medical Control and consider stopping the infusion.

3. Monitor patients vitals every 15 minutes
    a. Special attention to blood pressure keeping the systolic <185 mmHg and diastolic <110 mmHg
        i. Nicardipine initiate at 5 mg/hr, increase the dose by 2.5 mg/hr every 10 minutes to a maximum of 15 mg/hr. Once at goal decrease can decrease down to 3 mg/hr and repeat titration. If BP drops below 140/80 mmHg immediately discontinue medication.
        OR
        ii. Labetalol 10 mg slow IV push over 2 minutes. May double the previous dose and repeat every 10 minutes as needed (max dose 300 mg and hold for HR < 60.

        iii. Contact SCT Medical Control in the setting acute hypertension that has not responded to treatment. i.e. blood pressure that is continually elevated SBP>185 mmHg or DBP>110 mmHg despite 2 doses or titrations.

ADDITIONAL CONSIDERATIONS

Any decompensation in neurologic condition that occurs during transport needs to be immediately reported to SCT Medical Control and the receiving facility. If the infusion is running at this time it should be stopped immediately. The infusion will not be restarted prior to evaluation at the receiving facility.

Specialty Care Transport

Medication Data Sheets

7.31 Clopidogrel (Plavix)

a) Pharmacology

(1) Receptors binds to P2Y12 adenosine diphosphate receptor reducing platelet activation/aggregation

b) Pharmacokinetics

(1) Onset of action: 2-6 hours (following loading dose)
(2) Half-life: 8 hours

c) Indications

(1) Antiplatelet agent used in acute MI

d) Contraindications

(1) Hypersensitivity
(2) Active bleeding
(3) Trauma patient

e) Adverse Effects

(1) Severe bleeding

f) Precautions

(1) Recent bleeding

g) Dose

(1) 300 mg PO
(2) Do not repeat

7.32 Dobutamine

a) Pharmacology

(1) Pure synthetic beta adrenergic agonist, potent inotrope, mild chronotrope, increases cardiac output

b) Pharmacokinetics

(1) Fast onset: Almost immediate
(2) Half life: 1-2 minutes

c) Indications

(1) Acute decompensated heart failure
(2) Decreased cardiac output
(3) Cardiogenic shock

d) Contraindications

(1) Tachydysrhythmias
(2) Hypertrophic subaortic stenosis (left ventricular outflow obstruction)

e) Adverse Effects

(1) Hypotension
(2) Cardiac dysrhythmias
(3) Coronary arteriosclerosis, worsening
(4) Dyspnea
(5) Nausea
(6) Infusion site reaction

f) Precautions

(1) Can lead to ventricular tachycardia or ventricular fibrillation
(2) Can precipitate ACS or AMI
(3) Hypovolemia

g) Dose

(1) Maintenance infusion: 5-20mcg/kg/min
(2) In the event of tachydysrhythmias, reduce dose by 5mcg/kg/min (or to a minimum of 2mcg/kg/min)

7.33 Eptifibatide (Integrilin)

a) Pharmacology

(1) Reversibly binds to platelet glycoprotein IIb/IIIa receptors, reducing platelet aggregation

b) Pharmacokinetics

(1) Onset of action: 1 hour
(2) Half-life: 2.5 hours

c) Indications

(1) Acute coronary syndrome and percutaneous coronary intervention with or without stenting

d) Contraindications

(1) Hypersensitivity
(2) Active abnormal bleeding within the previous 30 days
(3) Recent trauma or surgery within the previous 6 weeks
(3) Hypertension (SBP > 200 mm Hg or DPB > 100 mm Hg)
(4) Recent CVA within 30 days or history of hemorrhagic stroke
(5) Dependency on hemodialysis

e) Adverse Effects

(1) Severe bleeding

f) Precautions

(1) Monitor vital signs
(2) Do not administer if GFR <30 mL/min

g) Dose

(1) CrCl > 50 mL/hr: bolus180 mcg/kg IV(maximum 22.6 mg) x 2 10 minutes apart. Maintenance infusion: 2 mcg/kg/min (maximum 15 mg/hr)
(2) CrCl < 50 mL/hr: bolus 180 mcg/kg x 1 (maximum 22.6 mg), maintenance infusion 1 mcg/kg/min (maximum 7.5 mg/hr)

7.34 Esmolol (Brevibloc)

a) Pharmacology

(1) Esmolol is a short acting beta-adrenergic antagonist with Beta-1cardioselectivity

b) Pharmacokinetics

(1) Fast onset: 2-10 minutes
(2) Duration of effect: 10-30 minutes, prolonged following high cumulative doses and/or extended duration of use
(3) Metabolism: In blood via red blood cell esterases

c) Indications

(1) Tachycardia and/or hypertension
(2) Reduction of heart rate and sheering forces associated with aortic aneurysm
(3) Rapid atrial fibrillation/flutter

d) Contraindications

(1) Sinus bradycardia, heart block greater than 1st degree, uncompensated congestive heart failure, cardiogenic shock, or allergy to beta-blockers, hypertension/tachycardia induced by cocaine

e) Adverse effects

(1) Hypotension
(2) Bradycardia
(3) Heart block
(4) Exacerbated heart failure
(5) Peripheral ischemia
(6) Dizziness
(7) Agitation
(8) Nausea/vomiting

f) Precautions

(1) Use of beta adrenergic antagonists must be weighed against potential adverse effects, especially in patients with reactive airway disease, diabetes mellitus, hypoglycemia or renal failure

g) Dose

(1) Loading dose of 500 mcg/kg over 1 minute, followed by 50 mcg/kg/min. Can increase infusion by 50 mcg/kg/min every 5 minutes up to a maximum of 200 mcg/kg/min.

f) Special Notes

(1) Esmolol is incompatible with furosemide, amphotericin B, and procainamide. Esmolol may cause increased serum digoxin levels and enhance AV node block.
(2) It may be mixed in D5W or NS to a concentration of 10 mg/ml (2.5 grams in 250 ml).

Esmolol (Brevibloc) 2.5 gram/250 ml (10mg/mL) D5W or NS only					
Patient Weight		Drip Rate			
Lb	**kg**	**50 mcg/kg**	**100mcg/kg**	**150 mcg/kg**	**200 mcg/kg**
110	50	15mL/hr	30mL/hr	45mL/hr	60mL/hr
132	60	18mL/hr	36mL/hr	54mL/hr	72mL/hr
154	70	21mL/hr	42mL/hr	63mL/hr	84mL/hr
176	80	24mL/hr	48mL/hr	72mL/hr	96mL/hr
198	90	27mL/hr	54mL/hr	81mL/hr	108mL/hr
220	100	30mL/hr	60mL/hr	90mL/hr	120mL/hr

7.35 Fibrinolytic Agents

a) Pharmacology

(1) To promote lysis of the clot allowing return of blood flow to the infarct related vessel

b) Pharmacokinetics

(1) Dose varies (depends on specific agent and indication)
(2) Half-life: 10-130 minutes (depends on specific agent used)

c) Indications

(1) Acute myocardial infarction
(2) Acute stroke (within 3-4.5 hours of onset)
(3) Pulmonary embolus
(4) Intraarterial thrombosis (usually low continuous dose, no titration)

d) Contraindications

(1) Active internal bleeding (i.e. GI Bleed) or acute trauma
(2) Previous or current hemorrhagic stroke on pretreatment head CT
(3) Known intracranial neoplasm, AV malformation, or aneurysm
(4) Uncontrolled hypertension; blood pressure >185/110 mmHg
(5) Intracranial or intraspinous surgery, serious head trauma, or previous stroke (< 3 months)
(6) Suspected aortic dissection
(7) Pregnancy
(8) Anticoagulant use that has produced any of the following: INR > 1.7; prothrombin time (PT) > 15 seconds; activated partial thromboplastin time (aPTT) > than the upper limit of normal
(9) Platelet count <100,000/mm^3
(10) History of ischemic stroke or TIA in past 6 months (for acute MI indication)

e) Adverse Effects

(1) Bleeding
(2) Hypersensitivity reactions
(3) Angioedema
If bleeding or severe angioedema – stop infusion after contact Specialty Care Transport Medical Control

f) Precautions

(1) Stroke within the previous 6 months
(2) Myocardial infarction within the previous 3 months
(3) Serious trauma or major surgery within the last 14 days
(4) Recent gastrointestinal or urinary tract hemorrhage within the previous 21 days
(5) Postmyocardial infarction pericarditis
(6) Recent pregnancy (up to 10 days postpartum)
(7) Active peptic ulcer disease
(8) Subclavian line (non-compressible site) or recent arterial puncture at a non-compressible site within the past 7 days
(9) CPR within the last 10 days
(10) Abnormal blood glucose level (<50 or >400 mg/dL)

g) Dose

(1) The dose varies based upon the type of agent used and specific indication. If a patient is receiving thrombolytics during transport, ensure that proper physician orders have been written detailing dosing and timing of doses.

Alteplase (Ischemic Stroke) - 0.9 mg/kg IV (max dose 90 mg), 10% administered over 1 minute and 90% over 60 minutes

Alteplase (PE): 100 mg IV over 2 hours (for low weight or elderly patients, may administer 50 mg)

Alteplase (MI): 15 mg bolus over 1-2 minutes, then 0.75 mg/kg (up to 50 mg) x 30 minutes, then 0.5 mg/kg (up to 35 mg) x 60 minutes (maximum100 mg over 90 minutes)

Tenecteplase: One time bolus ≤ 60 kg = 30 mg; 61-70 kg = 35 mg; 71-80 kg = 40 mg; 81-90 kg = 45 mg; ≥ 90 kg=50 mg

7.36 Fosphenytoin

a) Pharmacology

(1) Pro-drug of phenytoin, stabilizes neuronal membranes and decreases seizure activity by altering sodium ions in the motor cortex

b) Pharmacokinetics

(1) Onset: 15 minutes

c) Indications

(1) Seizures and seizure prophylaxis

d) Contraindications

(1) Hypersensitivity
(2) SA or AV heart blocks
(3) Stokes-Adams syndrome
(4) Bradycardia/hypotension
(5) Tricyclic Antidepressant toxicity

e) Adverse Effects

(1) Cardiac dysrhythmias
(2) Hypotension

f) Precautions

(1) Can lead to AV heart block

g) Dose

(1) Fosphenytoin is dosed as PE (Phenytoin Equivalents) – 1:1 conversion with phenytoin
(2) Slow IV Infusion: 20 mg (PE)/kg IV in 100 mL of NS of D5W over 15 minutes

7.37 Heparin

a) Pharmacology

(1) Reversibly binds to antithrombin III inactivating thrombin

b) Pharmacokinetics

(1) Onset of action: immediate
(2) Half-life: 1-2 hours

c) Indications

(1) Acute Coronary Syndrome

d) Contraindications

(1) Hypersensitivity or known heparin inducted thrombocytopenia
(2) Severe thrombocytopenia
(3) Uncontrolled bleeding except when from disseminated intravascular coagulation (DIC)
(4) Recent trauma or surgery

e) Adverse Effects

(1) Severe bleeding

f) Precautions

(1) Monitor vital signs, coagulation tests, and platelet count

g) Dose

(1) IV Bolus: 60 units/kg IV (Maximum 4000 units)
(2) Maintenance infusion: 12 units/kg/hr IV (Maximum of 1000 units/hr)

7.38 Hydrocortisone Sodium Succinate (Solu-Cortef)

a) Pharmacology

(1) Glucocorticoid , corticosteroid

b) Pharmakokinetics

(1) Intravenously or intramuscularly administered
(2) Half-life 4-6 hours
(3) Elimination 12 hours

c) Indications

(1) Primary of secondary adrenal insufficiency
(2) Refractory Hypotension

d) Contraindications

(1) Known hypersensitivity
(2) Idiopathic Thrombocytopenic Purpura (ITP)

e) Adverse Effects

(1) Hypertension
(2) Cardiovascular collapse
(3) Hyperglycemia
(4) Arrhythmia

f) Dose

(1) Adults – 100 mg IV/IM/IO as a single dose
(2) Peds – 2 mg/kg (maximum 100 mg) IV/IM/IO as a single dose

7.39 Labetalol

a) Pharmacology

(1) Pure synthetic alpha-1 and beta-1,2 antagonist

b) Pharmacokinetics

(1) Onset of action: 5-10 minutes
(2) Duration of action: 2-4 hours

c) Indications

(1) Acute hypertension

d) Contraindications

(1) Hypersensitivity
(2) AV Heart block
(3) Hypotension
(4) Bronchospasm

e) Adverse Effects

(1) Hypotension
(2) Bradycardia
(3) AV heart Block
(4) Heart failure
(5) Bronchospasm
(6) Dizziness

f) Precautions

(1) Increase dose cautiously based on effect from previous dose

g) Dose

(1) 10 mg IV over 2 minutes
(2) May repeat and double the previous dose every 10 minutes if indicated – Maximum total dose 300 mg

7.40 Levetiracetam (Keppra)

a) Pharmacology

(1) Precise mechanism is unknown however thought to involve one or more of the following central pharmacologic effects: inhibition of voltage-gates N-type dependent calcium channels, facilitation of GABA-ergic inhibitory transmission through displacement of negative modulators; reduction of delayed rectifier potassium current; or binding to synaptic proteins which modulate neurotransmitter release.

b) Pharmacokinetics

(1) Onset of action: 1-4 hours
(2) Half-life: 6-8 hours

c) Indications

(1) Seizures and seizure prophylaxis

d) Contraindications

(1) Hypersensitivity

e) Adverse Effects

(1) Hypertension
(2) Vomiting

f) Precautions

(1) May cause CNS depression

g) Dose

(1) May load with 20 mg/kg IV over 15 minutes (load not always necessary)
(2) Typical adult dose: 500-1500 mg PO/IV twice daily

h) Special Notes

(1) Levetiracetam is compatible with both D5W and Normal Saline.

7.41 Mannitol

a) Pharmacology
(1) Osmotic diuretic

b) Pharmacokinetics
(1) Onset of action: 15-30 minutes
(2) Duration of action: 1.5-6 hours

c) Indications
(1) Cerebral edema,
(2) Increased ICP

d) Contraindications
(1) Hypersensitivity
(2) Pulmonary edema
(3) Hypotension
(4) Severe Renal Disease

e) Adverse Effects
(1) Heart failure
(2) Pulmonary edema
(3) Renal failure

f) Precautions
(1) Hypotension

g) Dose
(1) Bolus 1 g/kg IV

7.42 Milrinone (Primacor)

a) Pharmacology

(1) Milrinone is a phosphodiesterase III enzyme inhibitor which enhances the contractility of the ventricles by inhibiting the breakdown of cAMP, thereby increasing the levels of available Ca++ in cardiac sarcomeres.
(2) Milrinone also has shown diastolic relaxation properties (positive lucitropy) which may aid in ventricular filling

b) Pharmacokinetics

(1) Highly bound to plasma
(2) Elimination half-life of approximately 2.5 hours
(3) ~85% excreted unchanged in the urine, hepatic metabolism

c) Indications

(1) Acute decompensated heart failure
(2) Decreased cardiac output
(3) Cardiogenic shock

d) Contraindications

(1) Hypotensive
(2) Known hypersensitivity

e) Adverse Effects

(1) Hypotension
(2) Ventricular arrhythmias
(3) Headache
(4) Myocardial infarction
(5) Anaphylaxis, bronchospasm

f) Precautions

(1) May aggravate symptoms of idiopathic hypertrophic subaortic stenosis (IHSS)
(2) SVT and VT have been observed, as well as increased ectopy and non-sustained VT
(3) Shortening of AV node conduction time, may increase ventricular response in a-fib/a-flutter
(4) If prior vigorous diuretic therapy was used, caution should be observed due to potential for significant decreases in ventricular filling pressures. HR, BP and clinical symptomatology should be closely monitored.
(5) Not recommended in acute myocardial infarction
(6) Dosage reduction in patient's with renal impairment
(7) Milrinone-induced improvement in cardiac-output with resultant diuresis may necessitate a reduction in the dose of diuretics
(8) Potassium loss from excessive diuresis may predispose digitalized patients to arrhythmia. Hypokalemia should be corrected prior to, or during the use of Milrinone

g) Dose

(1) Milrinone may be mixed with D5W or NS. Add 1 vial (20mg/20mL) to 80 ml of D5W or NS for a final concentration of 20mg/100mL (200mcg/mL)
(2) Maintenance infusion between 0.375 and 0.75 mcg/kg/min, do not bolus, causes hypotension.
(3) See Dosing Table Next Page

h) Special Notes

(1) Milrinone is not compatible with furosemide or procainamide

7.42 Milrinone (Primacor) (Continued)

Milrinone 20 mg in 100 mL (200mcg/mL)				
Pt weight (kg)	**Pt weight (lb)**	**0.375 mcg/kg/min (ml/hr)**	**0.5 mcg/kg/min (mL/hr)**	**0.75 mcg/kg/min (mL/hr)**
40	88	4.5	6	9
45	99	5.1	6.8	10.1
50	110	5.6	7.5	11.3
55	121	6.2	8.2	12.4
60	132	6.8	9	13.5
65	143	7.3	9.8	14.6
70	154	7.9	10.5	15.8
75	165	8.4	11.2	16.9
80	176	9	12	18
85	187	9.6	12.7	19.1
90	198	10.1	13.5	20.3
95	209	10.7	14.2	21.4
100	220	11.3	15	22.5
105	231	11.8	15.7	23.6
110	242	12.4	16.5	24.8
115	253	12.9	17.2	25.9
120	264	13.5	18	27
125	275	14	18.7	28.1
130	286	14.6	19.5	29.2
135	297	15.2	20.2	30.4

7.43 Nicardipine (Cardene)

a) Pharmacology

(1) Calcium channel blocker

b) Pharmacokinetics

(1) Onset of action: 10 minutes
(2) Half-life: 8 hours

c) Indications

(1) Acute hypertension

d) Contraindications

(1) Hypersensitity
(2) Advanced aortic stenosis

e) Adverse Effects

(1) Hypotension
(2) Flushing
(3) Peripheral edema
(4) Palpitations
(5) ECG changes

f) Precautions

(1) Monitor vital signs

g) Dose

(1) Maintenance infusion: 5 mg/hr
(2) May increase dose 2.5 mg/hr q10 minutes – maximum dose of 15 mg/hr. Once at goal blood pressure, decrease the rate to 3 mg/hr to prevent accumulation of the drug and hypotension due to the long half-life of the medication.

7.44 Nitroglycerin

a) Pharmacology

(1) Nitrate/vasodilator – Stimulates cGMP production – vascular smooth muscle relaxant
(2) More effect on the peripheral veins than arteries

b) Pharmacokinetics

(1) Fast onset: Almost immediate
(2) Half-life: 1-3 minutes

c) Indications

(1) Acute hypertension
(2) AMI

d) Contraindications

(1) Hypersentivity
(2) Pericardial tamponade
(3) Pericarditis
(4) Phosphodiesterase-5 inhibitors (Sildenafil, tadalafil, vardenafil) usage

e) Adverse Effects

(1) Hypotension
(2) Bradycardia
(3) Flushing
(4) Dizziness
(5) Nausea and vomiting

f) Precautions

(1) Monitor vital signs

g) Dose

(1) Maintenance infusion: Depending on indication, may start at 10-50 mcg/min
(2) Can be increased 5 mcg/min q5 minutes

7.45 Norepinephrine (Levophed)

a) Pharmacology

(1) Alpha adrenergic and to a lesser effect Beta adrenergic agonist, used to increase peripheral resistance, blood pressure, and to a lesser effect heart rate

b) Pharmacokinetics

(1) Rapid onset
(2) Half life: 2-5 minutes

c) Indications

(1) Hypotension due to sepsis/hypovolemia (often in conjunction with intravenous fluid therapy)

d) Contraindications

(1) Mesenteric or peripheral vascular disease (ischemia)

e) Adverse Effects

(1) Bradyarrhythmias
(2) Peripheral ischemia
(3) Headache
(4) Extravasation causing skin necrosis

f) Precautions

(1) Avoid hypertension
(2) Central lines should be used for infusions due to risk of extravasation

g) Dose

(1) Maintenance infusion: 2-80mcg/min

Norepinephrine 4mg in 250 mL (16mcg/mL)	
2 mcg/min	8 mL/hr
3 mcg/min	11 mL/hr
4 mcg/min	15 mL/hr
5 mcg/min	19 mL/hr
6 mcg/min	22 mL/hr
7 mcg/min	26 mL/hr
8 mcg/min	30 mL/hr
9 mcg/min	34 mL/hr
10 mcg/min	38 mL/hr
11 mcg/min	41 mL/hr
12 mcg/min	45 mL/hr
13 mcg/min	49 mL/hr
14 mcg/min	53 mL/hr
15 mcg/min	56 mL/hr
16 mcg/min	60 mL/hr
17 mcg/min	64 mL/hr
18 mcg/min	68 mL/hr
19 mcg/min	71 mL/hr
20 mcg/min	75 mL/hr

7.46 Octreotide (Sandostatin)

a) Pharmacology

(1) Octreotide is a longer acting, synthetic form of the hormone somatostatin.

(2) For its use in variceal bleeding, octreotide constricts splanchnic blood vessels and inhibits the release of GI hormones, including serotonin, vasoactive intestinal peptide (VIP), gastrin, secretin and pancreatic polypeptide.

b) Pharmacokinetics

(1) Onset of action: ~10 minutes

(2) Duration of action: 1.5-2 hours

(3) Metabolized by the liver and excreted by the kidneys. Liver disease reduces metabolism and kidney failure reduces elimination to 3-4 hours.

c) Indications

(1) Octreotide is indicated as an adjunct in the treatment of upper GI bleed, especially those associated with esophageal varices.

(2) Octreotide is indicated in patients who have undergone pancreatic surgery, have pancreatic sepsis, acute pancreatitis or pancreatic fistula

d) Contraindications

(1) Relatively contraindicated in bradycardia

(2) Known allergy or sensitivity

e) Adverse effects

(1) Octreotide may cause depression of gall bladder function

(2) Octreotide may cause hypoglycemia or hyperglycemia

(3) Octreotide may precipitate acute pancreatitis

(4) Redness, flushing, abdominal pain, nausea/vomiting headache, fever, fatigue have been associated with octreotide

f) Precautions

(1) Concomitant use with beta blockers due to bradydysrhythmia risk.

(2) Blood glucose monitoring should be undertaken on any patient taking diabetic medications, including sulfonylureas or insulin

g) Dose

(1) Initial bolus of 25-50 mcg, followed by continuous infusion of 25-50 mcg/hr.

h) Special Notes

(1) Octreotide is compatible with both D5W and Normal Saline.

Mix 1200 mcg Octreotide in 250 mL (concentration 4.8 mcg/mL)	
Dose	Infusion Rate
50 mcg/hr	10 mL/hr
100 mcg/hr	20 mL/hr
150 mcg/hr	30 mL/hr
200 mcg/hr	40 mL/hr
250 mcg/hr	50 mL/hr

7.47 Pantoprazole (Protonix)

a) Pharmacology
(1) Suppresses gastric acid secretion by inhibiting the parietal cell H^+/K^+ ATP pump

b) Pharmacokinetics
(1) Onset of action: ~30 minutes
(2) Half-life: 1 hour

c) Indications
(1) Treatment and prevention of peptic ulcer bleeding
(2) Management of GERD, erosive esophagitis, and hypersecretory disorders

d) Contraindications
(1) Hypersensitivity

e) Adverse effects
(1) Headache

f) Precautions
(1) Infusion related reactions (thrombophlebitis and hypersensitivity reactions including anaphylaxis Stevens-Johnson syndrome, and toxic epidermal necrolysis)

g) Dose
(1) Initial bolus 40-80 mg IV
(2) May be continued as a continuous infusion at 8 mg/hr IV or intermittent bolus doses as 40 mg IV twice daily

h) Special Notes
(1) Pantoprazole is compatible with both D5W and Normal Saline.

7.48 Phenylephrine (Neosynephrine)

a) Pharmacology

(1) Pure alpha adrenergic agonist used to increase peripheral resistance and blood pressure

b) Pharmacokinetics

(1) Onset of action: immediate
(2) Half life approximately 2-3 hours; duration 15-30 minutes

c) Indications

(1) Hypotension due to sepsis/hypovolemia (often in conjunction with intravenous fluid therapy)

d) Contraindications

(1) Mesenteric or peripheral vascular disease (ischemia)
(2) Ventricular tachycardia

e) Adverse Effects

(1) Reflex bradycardia
(2) Severe peripheral and visceral vasoconstriction
(3) Extravasation leading to skin necrosis

f) Precautions

(1) Avoid hypertension
(2) Use with caution in patients with heart block, hyperthyroidism, bradycardia, myocardial disease, severe CAD
(3) Central lines should be used for infusions due to risk of extravasation

g) Dose

(1) Initial dose 25 mcg/min, increase dose by 25 mcg/min every 5 minutes to a max of 200 mcg/min.

7.49 Phenytoin (Dilantin)

a) Pharmacology

(1) Stabilizes neuronal membranes and decreases seizure activity by altering sodium ions in the motor cortex

b) Pharmacokinetics

(1) Onset of action: 0.5-1 hour

c) Indications

(1) Seizures and seizure prophylaxis

d) Contraindications

(1) Hypersensitivity
(2) SA or AV heart block
(3) Stokes-Adams syndrome
(4) Bradycardia/hypotension
(5) Tricyclic Antidepressant toxicity

e) Adverse Effects

(1) Hypotension
(2) Cardiac Dysrhythmias
(3) Infusion site reaction

f) Precautions

(1) Can lead to AV heart block
(2) Do not infuse with any other medications or fluids

g) Dose

(1) Slow IV Infusion: 20 mg/kg IV in at least 250 mL of NS (only, NO Dextrose) infused at a rate of less than 25 mg/min
(2) Typical adult dose: 1000 mg (in 250 ml)

7.50 Propofol (Diprivan)

a) Pharmacology

(1) Propofol is an anesthetic/sedative/hypnotic that is neither a barbiturate nor a benzodiazepine.
(2) It produces anesthesia through a number of interrelated mechanisms, including enhancement of GABA-A, sodium channel blockade and through activation of the endocannabinoid system (a retrograde neuronal signaling system to maintain higher levels of GABA)

b) Pharmacokinetics

(1) Onset of Action: 30-40 sec; rapid distribution due to high lipophilicity
(2) Duration of action: 2-4 minutes
(3) Elimination half-life is 30-60 minutes
(4) Propofol is metabolized in the liver by glucuronide conjugation and is excreted via the kidneys

c) Indications

(1) Sedation of ventilated patient in a critical care/ICU setting
(2) Induction and maintenance of anesthesia
(3) Procedural sedation

d) Contraindications

(1) Allergy to eggs or egg products, soy or soy products.
(2) Hypotensive, especially those who are volume depleted.

e) Adverse effects

(1) Hypotension, bradycardia, arrhythmias, hyperlipidemia, bronchospasm, laryngospasm , anaphylaxis, green urine, injection site burning

f) Precautions

(1) Maintenance of sedation with propofol decreases systemic vascular resistance and decreases cardiac output
(2) Propofol should be used with extreme caution in patients with known ventricular failure or extremes of HR
(3) Hypocapnia (from hyperventilation) while using propofol for maintenance of sedation is associated with an increased risk of hypoperfusion to the brain
(4) Rapid oxygen desaturation may occur following a bolus of propofol
(5) Bolus injections of propofol are associated with an increase in undesirable cardiorespiratory effects in older patients. Consider ½ dose until pt stability and response established
(6) Discard infusion bottle after 12 hours or 6 hours if mixed as an admixture in D5W due to poor sterility of the lipid emulsion past these time points

g) Dose

(1) Initial dose is 10-20 mcg/kg/min as a slow infusion. Rapid bolus injections should be avoided due to the increased incidence of hypotension (May use 10 mg bolus doses every 10 minutes as necessary).
(2) Maintenance infusion 10-50 mcg/kg/min

h) Special Notes

(1) Propofol is incompatible with many antibiotics and vasoactive agents. It should be infused via its own IV line.
(2) Propofol is compatible with fentanyl. These 2 agents can be given together through the Y-site.

Propofol (Diprivan) Infusion Chart Propofol concentration 10mg/mL					
Pt weight (kg)	**10 mcg/kg/min**	**20 mcg/kg/min**	**30 mcg/kg/min**	**40 mcg/kg/min**	**50mcg/kg/min**
50	3 mL/hr	6 mL/hr	9 mL/hr	12 mL/hr	15 mL/hr
60	3.6 mL/hr	7.2 mL/hr	10.8 mL/hr	14.4 mL/hr	18 mL/hr
70	4.2 mL/hr	8.4 mL/hr	12.6 mL/hr	16.8 mL/hr	21 mL/hr
80	4.8 mL/hr	9.6 mL/hr	14.4 mL/hr	19.2 mL/hr	24 mL/hr
90	5.4 mL/hr	10.8 mL/hr	16.2 mL/hr	21.6 mL/hr	27 mL/hr
100	6 mL/hr	12 mL/hr	18 mL/hr	24 mL/hr	30 mL/hr

7.51 Sodium Nitroprusside (Nipride, Nitropress)

a) Pharmacology

(1) Vasodilator – direct action on venous and arteriolar smooth muscle

b) Pharmacokinetics

(1) Fast onset: Almost immediate
(2) Duration of action: 1-10 minutes

c) Indications

(1) Acute hypertension
(2) Blood pressure control in aortic aneurism

d) Contraindications

(1) Hypersentivity
(2) Aortic deformity
(3) Heart failure

e) Adverse Effects

(1) Hypotension
(2) Tachycardia
(3) Cyanide toxicity and metabolic acidosis

f) Precautions

(1) Monitor vital signs
(2) May cause rapid decrease in BP

g) Dose

(1) Maintenance infusion: 0.3 mcg/kg/min
(2) Can be increased 0.5 mcg/kg/min q5 minutes to a maximum of 3 mcg/kg/min. May be increased to 10mcg/kg/min if absolutely necessary, however should not be continued for longer than 10 minutes.

7.52 Ticagrelor (Brilinta)

a) Pharmacology

(1) Interacts with the platelet $P2Y_{12}$ adenosine diphosphate receptor to prevent signal transduction and platelet activation/aggregation

b) Pharmacokinetics

(1) Onset of action: 30 minutes to 2 hours (following loading dose)
(2) Half-life: 7 hours

c) Indications

(1) Antiplatelet agent used in acute MI

d) Contraindications

(1) Hypersensitivity
(2) Active bleeding
(3) Trauma patient

e) Adverse Effects

(1) Severe bleeding

f) Precautions

(1) Recent bleeding

g) Dose

(1) 180 mg PO load x 1 then 90 mg PO twice daily
(2) Do not repeat load

7.53 Tirofiban (Aggrastat)

a) Pharmacology

(1) Reversibly binds to platelet glycoprotein IIb/IIIa receptors, reducing platelet aggregation

b) Pharmacokinetics

(1) Onset of action: 10 minutes
(2) Half-life: 2 hours

c) Indications

(1) Acute coronary syndrome and percutaneous coronary intervention with or without stenting

d) Contraindications

(1) Hypersensitivity
(2) History of thrombocytopenia following prior exposure to tirofiban
(3) Active internal bleeding or a history of bleeding diathesis
(4) Major surgical procedure
(5) Severe trauma or surgery within the previous 30 days

e) Adverse Effects

(1) Severe bleeding
(2) Headache

f) Precautions

(1) Monitor vital signs

g) Dose

(1) CrCl > 60 mL/hr: loading dose 25 mcg/kg (max 3,825 mcg) administered over 5 minutes or less; maintenance infusion 0.15 mcg/kg/min (max 23 mcg/min) continued for up to 18-48 hours
(2) CrCl $\leq$ 60 mL/hr: loading dose 25 mcg/kg (max 3,825 mcg) administered over 5 minutes or less; maintenance infusion 0.075 mcg/kg/min (max 11.5 mcg/min) continued for up to 18-48 hours

7.54 Vasopressin (Pitressin)

a) Pharmacology

(1) Synthetic V1 smooth muscle vasoconstrictor
(2) Used as an adjust vasopressor and catecholamine sparing agent in refractory sepsis patients on norepinephrine

b) Pharmacokinetics

(1) Fast onset: Almost immediate
(2) Half-life: 20 minutes

c) Indications

(1) Refractory sepsis (patients receiving high dose norepinephrine with continued hypotension)

d) Contraindications

(1) Hypersensitivity

e) Adverse Effects

(1) Cardiac dysrhythmias
(2) Coronary infarct, worsening
(3) Bradycardia
(4) Hypertension
(5) Bronchospasm

f) Precautions

(1) Monitor vital signs

g) Dose

(1) Maintenance infusion: 0.01-0.04 units/min

Appendix

Ideal Body Weight Table for Ventilator Tidal Volume Calculation

Male

Height (in)	IBW (Kg)	4mL /kg	5mL /kg	6mL /kg	7mL /kg	8mL /kg
46	26	103	129	155	180	206
47	28	110	138	166	193	221
48	29	118	147	177	206	236
49	31	125	157	188	219	250
50	33	133	166	199	232	265
51	35	140	175	210	245	280
52	37	147	184	221	258	295
53	39	155	194	232	271	310
54	41	162	203	243	284	324
55	42	170	212	254	297	339
56	44	177	221	266	310	354
57	46	184	231	277	323	369
58	48	192	240	288	336	384
59	50	199	249	299	349	398
60	52	207	258	310	362	413
61	54	214	268	321	375	428
62	55	221	277	332	387	443
63	57	229	286	343	400	458
64	59	236	295	354	413	472
65	61	244	305	365	426	487
66	63	251	314	377	439	502
67	65	258	323	388	452	517
68	66	266	332	399	465	532
69	68	273	342	410	478	546
70	70	281	351	421	491	561
71	72	288	360	432	504	576
72	74	295	369	443	517	591
73	76	303	379	454	530	606
74	78	310	388	465	543	620
75	79	318	397	476	556	635
76	81	325	406	488	569	650
77	83	332	416	499	582	665
78	85	340	425	510	595	680
79	87	347	434	521	608	694
80	89	355	443	532	621	709

Female

Height (in)	IBW (Kg)	4mL /kg	5mL /kg	6mL /kg	7mL /kg	8mL /kg
46	26	102	128	153	179	205
47	27	109	136	163	191	218
48	29	115	144	173	202	231
49	31	122	153	183	214	244
50	32	129	161	193	225	257
51	34	135	169	203	237	271
52	35	142	177	213	248	284
53	37	148	186	223	260	297
54	39	155	194	233	271	310
55	40	162	202	243	283	323
56	42	168	210	252	294	337
57	44	175	219	262	306	350
58	45	181	227	272	318	363
59	47	188	235	282	329	376
60	49	195	243	292	341	389
61	50	201	252	302	352	403
62	52	208	260	312	364	416
63	54	214	268	322	375	429
64	55	221	276	332	387	442
65	57	228	285	342	398	455
66	59	234	293	351	410	469
67	60	241	301	361	422	482
68	62	247	309	371	433	495
69	64	254	318	381	445	508
70	65	261	326	391	456	521
71	67	267	334	401	468	535
72	68	274	342	411	479	548
73	70	280	351	421	491	561
74	72	287	359	431	502	574
75	73	294	367	441	514	587
76	75	300	375	450	525	601
77	77	307	384	460	537	614
78	78	313	392	470	549	627
79	80	320	400	480	560	640
80	82	327	408	490	572	653