Role of Pharmacist in Emergency and Operation Room

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Outline

• Emergency room and operative room: what’s it like?
  – General characteristics of the patients

• Role of pharmacists
  – As stated in American Society of Health-System Pharmacists (ASHP)
  – As applied in Thailand situation

• Case scenario and roles of pharmacist
All services for acutely, not necessarily seriously, ill without planning
### Patient characteristics

<table>
<thead>
<tr>
<th>Level</th>
<th>Patient category (severity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Patients with critical conditions who needed immediate attention</td>
</tr>
<tr>
<td>2</td>
<td>Patients with acute emergency illness</td>
</tr>
<tr>
<td>3</td>
<td>Patients with acute illness, but not severe</td>
</tr>
<tr>
<td>4</td>
<td>Patients without emergency conditions who did not require emergency care</td>
</tr>
</tbody>
</table>

- **Mostly admission**

- **Emerg Med Int.2014;2014:576259.**
Operative room
Role of pharmacist

Emergency medicine
Role of Pharmacists

• Direct patient care roles
  – Essential
    • Direct patient care rounds
    • Medication selections, prescription process involvement
    • Medication order review
    • Medication therapy monitoring
    • Participation in procedures that utilize high risk medications
    • Resuscitation
    • Medication procurement and preparation
    • Provision of medication information
    • Documentation of associated interventions

• Administrative roles
  – Essential
    • Medication and patient safety initiatives
    • Quality-improvement activities
    • Professional leadership
    • Emergency preparedness
  – Desirable
    • Education
    • Research

ED pharmacist history

Emergency department 1950s
rate of mortality from accidental and traumatic injuries declined

Pharmacy services started 1970s

ED pharmacists needed!

Outcomes

Cost

Preventing med errors

Emerging literature

Early and goal directed therapy needed! Esp in critical situations

200,000/month

Role of pharmacist

Surgery and Anesthesiology setting,
Operative room
Surgery and Anesthesiology Pharmaceutical Services

• Surgery and anesthesiology areas
  – cystoscopy and endoscopy suites
  – cardiac catheterization laboratories or suites
  – Preoperative holding areas
  – postanesthesia care units
  – labor and delivery rooms
  – critical care areas
• “OR satellite pharmacy” and
• “OR pharmacist”
Medications used in the OR setting

- All products used in general and regional anesthesia
- Neuromuscular blockade
- Analgesia
- Preoperative management
- Hemodynamic control
- Diagnosis and manipulation during surgery
- Infection prevention
- Treatment of intraoperative emergencies
- Bleeding control
- Postoperative vomiting
Pharmaceutical Services

- Clinical services
  - Medication-use management
  - Medication-Regimen Review
  - Medication-use evaluation
  - Formulary System
  - Drug Research
  - Adverse-Drug-Reaction Monitoring and Reporting
  - Education
  - Rounds
  - Pain Management
  - Participation in Emergency Life Support
  - Pharmacokinetic Management and Consultation
  - Compliance with the Standards

- Guidelines of Neuromuscular blocking agents, anti-infectives for surgical prophylaxis
- Meds: synthetic opioids, propofol, antiemetic agents, volatile inhalation agents

Appropriateness (e.g., allergies, disease states, adherence to pharmaceutical practice guidelines), dose, route of administration, timing of administration, and cost compared with others

- Drug preparation and distribution
- Drug accountability and control
  - Supply levels checked and replenished daily
- Controlled substances
  - Methods of distribution; Records; Ordering; Storage, access, and inventory control; Reconciliation and disposal; Discrepancy reporting and disciplinary action; and 8. Performance of quality control checks

ER/OR Pharmacists (Ideal situation)

- Involved in patient’s round
- Supply levels checked and replenished daily
- Prepare medications in emergency situations
- Supply levels checked and replenished daily
Role of Pharmacist

• Pharmacists should use professional judgment in assessing their organization’s needs for pharmaceutical services in emergency department, surgery and anesthesiology
  – Different organization’s needs
  – Different number of pharmacists
  – Different medication branding

• The guidance should be adapted, as applicable, to meet those needs !!!
ER/OR Pharmacists
(Our situation)

• Involved in patient’s round
• Supply levels checked and replenished daily
• Prepare medications in emergency situations

• Supply levels checked and replenished daily
Emergency situations

- Advanced cardiac life support
  - Cardiac arrest
  - Bradycardia
  - Tachycardia

- Anaphylaxis shock

- Toxindromes

- Situation of timing associated outcomes
  - Antibiotic prophylaxis
  - Sepsis, septic shock

Epinephrine, amiodarone, dopamine, atropine

Naloxone, flumazenil
CARDIAC ARREST

Epinephrine, amiodarone
Start CPR
- Give oxygen
- Attach monitor/defibrillator

Rhythm shockable?

Yes
1. Start CPR
2. VF/pVT
3. Shock
4. CPR 2 min
   - IV/IO access
5. Rhythm shockable?
6. CPR 2 min
   - Epinephrine every 3-5 min
   - Consider advanced airway, capnography
7. Shock
8. CPR 2 min
   - Amiodarone
   - Treat reversible causes
9. Asystole/PEA
10. CPR 2 min
    - IV/IO access
    - Epinephrine every 3-5 min
    - Consider advanced airway, capnography
11. CPR 2 min
    - Treat reversible causes
12. Rhythm shockable?
   - If no signs of return of spontaneous circulation (ROSC), go to 10 or 11
   - If ROSC, go to Post-Cardiac Arrest Care

CPR Quality
- Push hard (at least 2 inches [5 cm]) and fast (100-120/min) and allow complete chest recoil.
- Minimize interruptions in compressions.
- Avoid excessive ventilation.
- Rotate compressor every 2 minutes, or sooner if fatigued.
- If no advanced airway, 30:2 compression-ventilation ratio.
- Quantitative waveform capnography
  - If PETCO₂ < 10 mm Hg, attempt to improve CPR quality.
  - Intra-arterial pressure
    - If relaxation phase (diastole) pressure < 20 mm Hg, attempt to improve CPR quality.

Shock Energy for Defibrillation
- Biphasic: Manufacturer recommendation (eg, initial dose of 120-200 J; if unknown, use maximum available. Second and subsequent doses should be equivalent, and higher doses may be considered.
- Monophasic: 360 J

Drug Therapy
- Epinephrine IV/IO dose:
  - 1 mg every 3-5 minutes
- Amiodarone IV/IO dose:
  - First dose: 300 mg bolus. Second dose: 150 mg.

Advanced Airway
- Endotracheal intubation or supraglottic advanced airway
- Waveform capnography or capnometry to confirm and monitor ET tube placement
- Once advanced airway in place, give 1 breath every 6 seconds (10 breaths/min) with continuous chest compressions

Return of Spontaneous Circulation (ROSC)
- Pulse and blood pressure
- Abrupt sustained increase in PETCO₂ (typically ≥ 40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

Reversible Causes
- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypo-/hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary
Amiodarone

• Cardiac arrest with shockable rhythm: amiodarone IV/IO, 1\textsuperscript{st} 300 mg, 2\textsuperscript{nd} 150 mg

• Situations
  – 3\textsuperscript{rd} dose if patients still have shockable rhythm
    • No data confirmed!

Role of Pharmacist!
Amiodarone

• Situations
  – Administration
    (as normal recommendation)
    • 300 mg in D5W 50 ml
      – exceed 2mg/ml!
      – Phlebitis might occur

• In NSS ???

Emergency situation allowed

Check individual amiodarone branding

Truven Health Analytics Inc. Micromedex [ONLINE]. 2016
Amiodarone

• Situations
  – Formulation
    • Diluent: Polysorbate 80
      – Caused severe hypotension and decreased cardiac output
      – Because of the vasodilatory and negative inotropic effects
    • A formulation of IV amiodarone without polysorbate 80 and benzyl alcohol was approved for use in the United States

– Role of Pharmacist:
  • Amiodarone 300 mg in D5W 20-30 ml IV bolus
  • Follow by fluid bolus 20 ml+ hold the hand for 10-20 sec

Epinephrine/ Adrenaline

- Cardiac arrest: 1 mg IV/ IO every 3-5 minutes
- Situations: no line access in ER
  - Route of administration
    - Central line
      - Large vein
      - Rapid dilution
      - Difficult to have central line, higher skill required
    - Peripheral line
      - Smaller veins
      - 1-2 minutes needed for systemic drug distribution
      - 20-mL bolus of IV fluid needed to facilitate the drug flow from the extremity into the central circulation

Epinephrine/ Adrenaline

• Cardiac arrest: 1 mg IV/ IO every 3-5 minutes
• Situations: no line access in ER
  – Route of administration
    • Central line
      – Large vein
      – Rapid dilution
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• Peripheral line

Follow by fluid bolus 20 ml+hold the hand for 10-20 sec
Epinephrine/ Adrenaline

• Situations: no line access in ER
  – Route of administration

Intraosseous provides rapid drug administration as an IV

Epinephrine/ Adrenaline

- **Situations**: no line access in ER
  - Route of administration: Endotracheal tube delivery
    - Diluents: normal saline
    - Volume
      - Adult 10 ml, Ped 5 ml, Neonatal 2 ml
      - Duration and onset: variable

**ET dose**
- Adult: 2-2.5X of 1 mg = 2-2.5 mg
- Ped: 10x of 0.01 mg/kg = 0.1 mg/kg

Epinephrine/ Adrenaline

• Cardiac arrest: 1 mg IV/ IO every 3-5 minutes
• Situations : medication preparation
  – Formulation: Delayed timing of administration?
Role of Pharmacist: Prefilled syringe preparation

The Stability and Sterility of Epinephrine Prefilled Syringe

Saowanee Kerddonfak, Wiparat Manuyakorn, Wasu Kamchaisatian, Cherapat Sasisakulporn, Wanlapa Teawsomboonkit and Suwat Benjaponpitak

SUMMARY  The commercially available auto-injector epinephrine is considerable expensive. Epinephrine prefilled syringe is an alternative treatment for anaphylaxis patients. The objective of the present study was to evaluate the stability and sterility of epinephrine prefilled syringe. Epinephrine prefilled syringe was kept in the pencil box to prevent from light exposure. The active ingredients, integrity and level of potency were measured by high-performance liquid chromatography (HPLC). The sterility was accessed by aerobic bacteria and fungi culture. The epinephrine concentration at 1, 2 and 3 months after the preparation was 101.36, 99.31 and 101.09%, respectively (acceptable range 90 - 110%). The pH was 3.17 - 3.23 (acceptable range 2.8 - 3.6). Nor-epinephrine was undetected. The cultures for bacteria and fungus were both negative. Consequently, epinephrine prefilled syringe was stable and sterile at least three month after preparation. Epinephrine prefilled syringe is an alternative low cost treatment for anaphylaxis patient.
Epinephrine/ Adrenaline

- Cardiac arrest: 1 mg IV/IO every 3-5 minutes
- Situations
  - CPR for 30 minutes
    - At least 10 amps of 1 mg required!

Stock and refill check!
Epinephrine:
other indications and med errors

• Anaphylaxis, hypersensitivity reaction
  – 0.2 to 1 mg (0.2 to 1 mL of a 1 mg/mL solution) IM in the lateral thigh/ SQ every 5 to 10 minutes as needed, or more frequently if clinically appropriate

Dose check and IM preferred!
Epinephrine: Dosing errors

- Factors contributing to dosing errors of epinephrine
  - Inadequate physician knowledge about the appropriate dose and route of epinephrine administration for anaphylaxis
  - **Lack of IM doses for anaphylaxis on emergency crash carts**
  - Complicated dose calculations involving decimals and ratios
  - Epinephrine labeled with ratios (1:1 000 and 1:10 000) associated with excessive epinephrine doses and longer delay in dosing vs gram weight/volume concentration labels
  - Lack of adequate communication between physicians and nurses

# Epinephrine: Dosing errors

<table>
<thead>
<tr>
<th>Reports</th>
<th>Patient(s)</th>
<th>IV epinephrine dosing (dilution)</th>
<th>Cardiovascular event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horak et al, 1983[25]</td>
<td>23 year-old female, penicillin-induced anaphylaxis</td>
<td>0.3 mg</td>
<td>Severe myocardial ischemia</td>
</tr>
<tr>
<td>Butte et al, 1999[26]</td>
<td>11 year-old male, croup with severe respiratory distress</td>
<td>0.5 mL (by nebulizer diluted in 3 mL 0.9% saline)</td>
<td>Increased heart rate, ventricular tachycardia, myocardial infarction</td>
</tr>
<tr>
<td>Johnston et al, 2003[27]</td>
<td>40 year-old female with reaction to pseudoephedrine and diphenhydramine taken for acute sinusitis (no hypotension or respiratory compromise)</td>
<td>1 mL (1:1 000)</td>
<td>Pulseless ventricular tachycardia</td>
</tr>
<tr>
<td>Anchor et al, 2004[28]</td>
<td>1. 60 year-old female, NSAID-induced angioedema</td>
<td>1. 0.3 mL (1:1 000)</td>
<td>1. Intermittent ventricular tachycardia</td>
</tr>
<tr>
<td></td>
<td>2. 76 year-old male, idiopathic anaphylaxis</td>
<td>2. 0.2 mL (1:1 000)</td>
<td>2. Immediate blood pressure spike, tachycardia, and nonspecific ST changes by ECG</td>
</tr>
<tr>
<td>Arfi et al, 2005[29]</td>
<td>14 year-old male, IVIG-induced anaphylaxis</td>
<td>0.01 mL/kg (1:1 000)</td>
<td>Acute myocardial ischemia</td>
</tr>
<tr>
<td>Putland et al, 2006[30]</td>
<td>220 cases with severe asthma (retrospective)</td>
<td>Average epinephrine infusion rate was 1.5 μg/min (range=0.5 to 13.3 μg/min) Total dose range=15 to 99 551 μg Duration of infusion, 10 min to 11.4 days (median 19.5 h)</td>
<td>1. Supraventricular tachycardia (n=2; both SVT) 2. Hypotension requiring treatment (n=4) 3. Objective evidence of myocardial ischemia, elevated troponin (n=2) 4. Sinus tachycardia (n=23) 5. Chest pain without ECG or marker changes (n=2)</td>
</tr>
<tr>
<td>Shaver et al, 2006[31]</td>
<td>29 year-old female, penicillin-induced anaphylaxis</td>
<td>0.1 mg (1:10 000)</td>
<td>Acute myocardial infarction</td>
</tr>
<tr>
<td>Izgi et al, 2010[32]</td>
<td>37 year-old female, amoxicillin-induced anaphylaxis</td>
<td>1\textsuperscript{st} dose: 0.5 mg (1:10 000) 2\textsuperscript{nd} dose: 0.5 mg (1:10 000) 3\textsuperscript{rd} dose (undiluted): 1 mg (1:10 000)</td>
<td>Severe myocardial ischemia</td>
</tr>
</tbody>
</table>
Summary: Medication use

- **Epinephrine IV/IO**
  - 1 mg q 3-5 mins
  - Optional: ET 2-2.5 mg

- **Vasopressin**

- **Amiodarone IV/IO**
  - 300 mg (1\textsuperscript{st})
  - 150 mg (2\textsuperscript{nd})
  - Next dose: no data
Summary: medication use during cardiac arrest

- Epinephrine/adrenaline
  - Epinephrine 1 mg dilute in NSS up to 10 ml IV/IO
- Amiodarone
  - 150-300 mg dilute in D5W 20 ml IV/IO
- Others
  - no alternative vasopressors (norepinephrine, phenylephrine) with proven survival benefit compared with epinephrine
- Administration
  - Flush with NSS 20 ml, elevate the extremity if peripheral line administration
ACLS 2015

Start CPR
- Give oxygen
- Attach monitor/defibrillator

Rhythm shockable?
Yes
- VF/pVT
- CPR 2 min
  - IV/IO access
- Rhythm shockable?
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Reversible Causes
- Hypovolemia
- Hypoxia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary
Sodium bicarbonate

• Correction of metabolic acidosis
  – CPR guideline
    • 1976: recommended
    • mid-1980s: widely used
    • 1991: fell progressively to almost no use
    • 2010 guideline
      – “Routine use of sodium bicarbonate is not recommended for patients in cardiac arrest” (class III recommendation, based on level of evidence B)
  • 2015 guideline
    – Were not reviewed or revised in the last update published in 2015

• Severe cardiotoxicity or cardiac arrest from hyperkalemia or tricyclic antidepressant overdose (class IIb recommendation, Level of evidence C)
  – Dose: 1 mL/kg boluses as needed

Sodium bicarbonate

• Cardiac arrest, Due To Hyperkalemia
  – Sodium bicarbonate 50 mEq IV over 5 minutes
  – Repeat administration may be required, as effects are temporary

• Severe cyclic antidepressant cardiotoxicity
  – Sodium bicarbonate solution 1 meq/kg bolus IV dose may be administered as needed to achieve hemodynamic stability and QRS narrowing
  – Monitor serum sodium levels and pH avoiding severe hypernatremia (ie, sodium above 155 mEq/mL) or alkalemia (ie, pH above 7.55)
Sodium bicarbonate

- Osmolarity: 7.5% soln (~1790 mosm/L)
- Administration
  - Do not administer via endotracheal route as alkaline solutions such as sodium bicarbonate may injure airway
  - Intravenous route
    - Hypertonic solutions of sodium bicarbonate must be diluted to isotonicity (1.5%) with sterile water, sodium chloride, dextrose 5%, or other standard electrolyte solutions before administration
    - Undiluted hypertonic sodium bicarbonate may be given by IV injection during cardiac arrest
    - Avoid simultaneous administration of sodium bicarbonate and catecholamines through the same IV catheter or tubing as the sodium bicarbonate solution will inactivate the catecholamine

Sodium bicarbonate

- Osmolarity: 7.5% soln (~1790 mosm/L), hypertonicity, alkalinity
- Adverse events
  - Injection site extravasation and vein damage, skin ulcer, tissue necrosis
  - Hyperkalemia, metabolic alkalosis

Atropine, dopamine, epinephrine

BRADYCARDIA
1. Assess appropriateness for clinical condition. Heart rate typically <50/min if bradyarrhythmia.

2. Identify and treat underlying cause
   - Maintain patent airway; assist breathing as necessary
   - Oxygen (if hypoxemic)
   - Cardiac monitor to identify rhythm; monitor blood pressure and oximetry
   - IV access
   - 12-Lead ECG if available; don’t delay therapy

3. Persistent bradyarrhythmia causing:
   - Hypotension?
   - Acutely altered mental status?
   - Signs of shock?
   - Ischemic chest discomfort?
   - Acute heart failure?

4. Monitor and observe
   - No

5. Atropine
   - If atropine ineffective:
     - Transcutaneous pacing
     - Dopamine infusion
     - Epinephrine infusion

6. Consider:
   - Expert consultation
   - Transvenous pacing

Doses/Details
- **Atropine IV Dose:**
  - First dose: 0.5 mg bolus
  - Repeat every 3-5 minutes
  - Maximum: 3 mg
- **Dopamine IV Infusion:**
  - 2-10 mcg/kg per minute
- **Epinephrine IV Infusion:**
  - 2-10 mcg per minute
Atropine

- Bradycardia: 0.5 mg IV every 3 to 5 minutes to a maximum total dose of 3 mg = 6 amps
- Thailand situation
  - 0.6 mg IV every 3 to 5 minutes to a maximum total dose of 3 mg = 5 amps!!
- If atropine ineffective
  - Pacing, dopamine, epinephrine infusion
Atropine

- **Bradycardia:** 0.6 mg IV every 3 to 5 minutes to a maximum total dose of 3 mg = 5 amps!!

- **Reversal of neuromuscular blockade**
  - Atropine 0.01 -0.03 mg/kg IV (0.6-1.8 mg) combined with neostigmine 0.04-0.05 mg/kg was effective for reversal of neuromuscular blockade

- **Organophosphate intoxications**
  - 1–3 mg IV as a bolus, depending on severity
  - Doubling doses of atropine if response is still absent
  - Give atropine boluses until the heart rate is more than 80 beats per minute, the systolic blood pressure is more than 80 mm Hg
  - Total doses of up to 9-11 g have been used during the course of treatment (30 to 40 days) in very severe poisonings


Dose and administration
Bradycardia

- Atropine
  - IV push 5 amps
- Dopamine IV infusion
- Epinephrine IV infusion
## Pharmacological effects

<table>
<thead>
<tr>
<th>Agent</th>
<th>( \alpha_1 )</th>
<th>( \beta_1 )</th>
<th>( \beta_2 )</th>
<th>( D )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dobutamine (0.5–4 mg/mL ( D_3W ) or NS)</td>
<td>+</td>
<td>+++</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>2–10 mcg/kg/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;10–20 mcg/kg/min</td>
<td>++</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dopamine (0.8–3.2 mg/mL ( D_3W ) or NS)</td>
<td>0</td>
<td>+</td>
<td>0</td>
<td>++++</td>
</tr>
<tr>
<td>1–3 mcg/kg/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3–10 mcg/kg/min</td>
<td>0/+</td>
<td></td>
<td></td>
<td>++++</td>
</tr>
<tr>
<td>&gt;10–20 mcg/kg/min</td>
<td>+++</td>
<td></td>
<td></td>
<td>++++</td>
</tr>
<tr>
<td>Epinephrine (0.008–0.016 mg/mL ( D_3W ) or NS)</td>
<td>++</td>
<td></td>
<td>+++</td>
<td>0</td>
</tr>
<tr>
<td>0.01–0.05 mcg/kg/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.05–3 mcg/kg/min</td>
<td>+++</td>
<td></td>
<td>+++</td>
<td>0</td>
</tr>
<tr>
<td>Norepinephrine (0.016–0.064 mg/mL ( D_3W ))</td>
<td>+++</td>
<td></td>
<td>+++</td>
<td>+/+</td>
</tr>
<tr>
<td>0.02–3 mcg/kg/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phenylephrine (0.1–0.4 mg/mL ( D_3W ) or NS)</td>
<td>+++</td>
<td></td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>0.5–9 mcg/kg/min</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Epinephrine/ adrenaline

- Adrenaline 1 amp = 1mg/ml (1:1000)
- Dilute ด้วย NSS 9 ml = 0.1 mg/ml
- 5 µd/min = ml/hr = 5 ml/hr

แปลงหน่วยจาก ml/hr เป็น µg/hr

= 0.1x5x1000 = 500 µg/hr

แปลงหน่วยจาก µg/hr เป็น µg/min โดย ÷ 60

dose (mcg/min) = 1000 = 8.3 mcg/min

Check dose recommendation
2-10 mcg/min
Amiodarone, adenosine

TACHYCARDIA
Adult Tachycardia (With Pulse)

1. Assess appropriateness for clinical condition. Heart rate typically ≥150/min if tachyarrhythmia.

2. Identify and treat underlying cause
   - Maintain patent airway; assist breathing as necessary
   - Oxygen (if hypoxemic)
   - Cardiac monitor to identify rhythm; monitor blood pressure and oximetry

3. Persistent tachyarrhythmia causing:
   - Hypotension?
   - Acutely altered mental status?
   - Signs of shock?
   - Ischemic chest discomfort?
   - Acute heart failure?

4. Synchronized cardioversion
   - Consider sedation
   - If regular narrow complex, consider adenosine

5. Wide QRS? ≥0.12 second
   - Yes
     - Consider antiarrhythmic infusion
     - Consider expert consultation
   - No
     - IV access and 12-lead ECG if available
     - Vagal maneuvers
     - Adenosine (if regular)
     - β-Blocker or calcium channel blocker
     - Consider expert consultation

6. Doses/Details
   - Synchronized Cardioversion
     - Initial recommended doses:
       - Narrow regular: 50-100 J
       - Narrow irregular: 120-200 J biphasic or 200 J monophasic
       - Wide regular: 100 J
       - Wide irregular: defibrillation dose (NOT synchronized)
   - Adenosine IV Dose:
     - First dose: 6 mg rapid IV push; follow with NS flush.
     - Second dose: 12 mg if required.
   - Antiarrhythmic Infusions for Stable Wide-QRS Tachycardia
     - Procainamide IV Dose:
       - 20-50 mg/min until arrhythmia suppressed, hypotension ensues, QRS duration increases >50%, or maximum dose 17 mg/kg given.
       - Maintenance infusion: 1-4 mg/min.
       - Avoid if prolonged QT or CHF.
     - Amiodarone IV Dose:
       - First dose: 150 mg over 10 minutes.
       - Repeat as needed if VT recurs.
       - Follow by maintenance infusion of 1 mg/min for first 6 hours.
   - Sotalol IV Dose:
     - 100 mg (1.5 mg/kg) over 5 minutes.
     - Avoid if prolonged QT.

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Adenosine

- 6 mg IV (1-2 s) followed by 20 mL saline flush, increase to 12 mg (every 1-2 mins as needed for 2 doses) **MAX 12 mg/dose**
  - Onset
    - Initial Response: 20 to 30 seconds
  - Duration: less than 10 seconds

Double syringe technique
Adenosine

- Sedation needed!

- Increased adenosine dose needed in patients on theophylline, caffeine

- Half dose (3 mg IV) if using central line, if patient is taking dipyridamole or carbamazepine

- Use 1/3 or 1/4x adenosine dose (2-3 mg) in heart transplantation patients

- Avoid adenosine in patients with asthma and/or transplanted hearts

- Storage: Do not refrigerate because of the possibility of crystallization. If crystallization occurs, allow solution to warm to room temperature to dissolve the crystals prior to use.

Keeps Emergency Medication Kits in Check

- Crash cart check!
- Dose and mode of delivery should be provided
Pharmacists can provide many vital services within the ER and OR

Objectives: to improve patient outcomes
  - by improving patient safety, preventing medication errors, and providing optimized pharmacotherapy regimens and therapeutic outcomes

Pharmaceutical services
  - An onsite satellite pharmacy would help in the provision of the services
    - Focusing on emergency situations, high-risk patients, high-alert drug
    - Checklist, drug dosing and delivery methods of medications should be provided

Desirable Activities
  - Direct patient care activities and quality-improvement initiatives
  - Provide education to members of the pharmacy department and other health care providers, (as well as patients and their caregivers)
  - Participate in research and scholarly activities
For more information......