Strategies for Lesser Known Vesicants

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Objectives

• Describe Irritants and Vesicants
• Discuss Infiltration and Extravasation
• Discuss Complications of Irritants and Vesicants
• Identify Ten Lesser-Known Irritants or Vesicants
• Describe Strategies to Identify, Deliver, and Manage infusion therapy
• Discuss Strategies to Manage Complications

Sir Christopher Wren (1632–1723).
Fast Facts

• 90%-95% of hospitalized patients have some form of intravenous access
  » Richardson, 1999

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Irritant versus Vesicant

• Irritant
  – An intravenous medication that may cause pain within the internal lumen of the blood vessel.

• Vesicant
  – A intravenous medication capable of causing blistering, tissue sloughing, or necrosis when infiltrating the surrounding tissue.
  » Alexander, Corrigan, Gorski, Hankins, Perucca, 2010

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Infiltration versus Extravasation

• Infiltration
  – The inadvertent administration of a non-vesicant solution or intravenous medication into the tissue

• Extravasation
  – The inadvertent infiltration of a vesicant solution or medication into the surrounding tissue
  » Alexander, et.al. 2010

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How Infiltration Occurs

- Inadequate cannulation of IV device
- Damage to the Tunica Intima causing inflammation
- Clot within the vessel or around the device
- Cannula punctures the vessel
- Catheter is malposition, or needle
  - Central line malposition less frequent, however, very dangerous
- Fibrin Sheath or tail
  » Rosenthal, 2007

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Layers of the Vein
Ignatavicius, Bayne, 1991

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Layers of the Vein
Ignatavicius, Bayne, 1991
Fibrin Tails and Thrombus

Infiltration Complications

- Ulcerations and Necrosis
  - May take days or weeks to occur
- Compartment Syndrome
  - Inflexible areas of skin, muscle, and bone become compressed
- Reflex Sympathetic Dystrophy Syndrome
  - Trauma to the nerve complexes
    » Hadaway 2002

Infiltration Scale

- Grade
  - 0  No signs or symptoms
  - 1  Skin Blanched- Edema < 1 inch in any direction
  - 2  Cool to touch
    • With or without pain
    • Skin Blanched
    • Edema 1-6 inches in any direction
      Alexander, et.al. 2010
**Infiltration Scale**

- **Grade**
  - 3 Cool to Touch
  - With or without pain
  - Skin Blanched, translucent
  - Gross edema > 6 inches in any direction
  
  Alexander, et.al. 2010

**Evolution of an Encore**

**Infiltration Scale**

- **Grade**
  - 4
  - Cool to touch
  - Mild to moderate pain
  - Possible Numbness
  - Skin Blanched, translucent
  - Skin tight, leaking
  - Skin discolored, bruised, swollen
  - Gross edema > 6 inches in any direction
  - Deep pitting tissue edema
  - Circulatory impairment
  - Moderate to severe pain
  - Infiltration of any amount of blood product, irritant or visicant

  Alexander, et al. 2010

**Evolution of an Encore**

**pH and Osmolarity**

- **pH** of blood plasma 7.35-7.45
  - Acidity and alkalinity is determined by the pH.
  - pH of 7.0 is considered neutral
  - Damage to the tunica intima can be caused by pH values below or above the neutral measure

- **Osmolarity** of blood plasma is 290mOsmol per kilogram of water
  - Osmolarity of a solution is based on how it influences water movement in and out of the cell

  Kirschner, 2010

**Evolution of an Encore**
pH and Osmolarity

- Blood and plasma contain buffering agents.
  - Buffering agents attempt to correct the
    - Acidity of an agent
    - Alkalinity of an agent
    - Hypo-osmolarity of an agent
    - Hyper-osmolarity of an agent

  - Kirschner, 2010

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pH and Osmolarity

- The slower the solution is infused the faster the solution can be neutralized
- The faster the solution is infused the chances of neutralization is less

  - Kirschner, 2010

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What Makes a Vesicant or Irritant?

- Non-antineoplastic Vesicant Agents
  - Hypertonic
    - Higher osmolarity than human plasma
    - Intracellular to extracellular space - severe damage to tunica intima- Chemical phlebitis
    - Vasoactive agents cause tissue injury through severe vasoconstriction
    - Through altering intracellular pH
    - Hypotonic- Swelling of cells
      - Extracellular to the intracellular- edema
      - High concentration of electrolytes
      - Stimulate vasoconstriction leads to ischemia

  - Di Giacomo, 2010
  - Sauerland, Engelking, Wickham, Corbi, 2006

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Ten lesser known Vesicants and Irritants

- Emend-Antiemetic pH 3.2-7.85 Acidic-Alkalitic depending on what is reconstituted with
- Sodium Bicarbonate- Alkalizer pH 7-8.5
- Radiographic Contrast-Hyperosmolar- Vary from Acidic to Alkalizer
- Dextrose > 20% - Hyperosmolar
- Amiodarone pH 4.08 Antiarrhythmic Gahart, Nazareno, 2009

Case Studies

- 71 year with thoracic aortic aneurysm
  - 100ml of sodium bicarbonate given through IV in the dorsum of the left hand.
  - Extravasation of left hand noted in ICU
  - Drains were inserted, no flushing was performed
  - Necrosis advanced to soft tissue
  - Multiple debridement required
  - A vascularized latissimus dorsi flap was performed
    Schrummer, Schrummer, Bayer, Muller, Karzai, 2009

Ten Lesser Vesicants and Irritants

- Zosyn- Antibiotic pH- 4.5-6.8 Acidic
- Nafcillin- Antibiotic pH 6-8.5 Acidic-Alkalizer
- Nitroglycerine 3-6.5 Antianginal, Vasodilator
- Valium- Benzodiazapines- Antianxiety pH-6.2-6.9 - Acidic
- Magnesium Sulfate- Anticonvulsant- Acidic pH-3.5 Gahart, Nazareno, 2009
Deep Tissue Necrosis of left hand
100ml of Sodium Bicarbonate (8.4%)
Anesthesia & Analgesia (2005)
Schummer, et al. (2005)

Wound debridement of Skin Necrosis
Anesthesia & Analgesia (2005)
Schummer, et al. (2005)

Vascularized latissimus dorsi flap
Anesthesia & Analgesia (2005)
Schummer, et al. (2005)
Case Studies

- 10 month old child extravasation of approximately 10 ml of contrast medium
  - Dorsum of left hand
  - Within 3 hours incisions and flush out procedure was performed. 200ml of normal sterile saline was used
  - Drains were placed for 24 hours
  - No further surgery was required
  - Schrummer, et.al. 2005

Guidelines for Treatment

- Stop infusion immediately
- Withdrawing drug
  - Lowering concentration of the drug will lower the size of any impending injury.
- Remove cannula or leave in?
  - Removing prevents site being re-injected
  - Leaving in situ allows antidote to be directly injected to damaged tissue
  - Dougherty, 2008

Ten month old extravasation of contrast medium approximately 10ml
Anesthesia & Analgesia (2005)
Schrummer, et.al. (2005)
Guidelines for Treatment

• Elevate Limb
  – Helps reduce local edema - encourage movement and prevent compression of extremity

• Apply Cold
  – Cooling promotes vasoconstriction - contains the extravasation until drug can be diffused by lymphatic and vascular system

• Apply Heat
  – Promotes healing through increasing of blood supply
  – Recommended with certain drugs

  Dougherty, 2008

Guidelines for Treatment

• Antidotes
  – Localize and neutralize
  – Spreads and dilutes drug

• Examples
  – Steroid creams (not injection)
  – Hyaluronidase – Enzyme
  – Dimethyl Sulfoxide (DMSO)

  Dougherty, 2008

Guidelines for Treatment

• Surgical Intervention
  – Surgical excision
    • Wound causes lingering pain, or insignificant healing

  • Flushing out technique - less invasive
    • Stab incisions made at site and normal saline is flushed through the tissue. Must be done ASAP after extravasation.

  Dougherty, 2008
Strategies: Collect Information

• Consider from the beginning
  – What is the prescribed therapy?
  – Duration of therapy?
  – Physical Assessment of vasculature
  – Patient History
  – Resources for patient
  – Patient preference

  » Di Giacomo, 2010

Strategies: Assess

• The degree of injury depends on the timing of intervention
  – Educate patient
  – Check site every one to two hours
  – Observe for
    • Blanched, taut skin
    • Edema
    • Cool skin
    • Slow infusion or pump alarms
    • Leaking at the site

  » Rosenthal, 2007

Strategies: Prevention

• Know organization’s policies prior
  – Administering irritants and vesicants
  – Warm- cold
  – Antidotes

• IV location
  – Low in forearm as possible
  – Do not use the volar aspect of the wrist
  – Use smallest size catheter to deliver treatment

  » Rosenthal, 2007
Strategies: Stabilization

- Stabilization Devices: Study from Brighton and Sussex University Hospital UK
  - Prior to stabilization device unscheduled IV re-starts was 69.2%
  - Post study unscheduled re-starts were 13% a decrease of 81%.
  - Cost savings of IV starts reduced by 30%
    
    » Bolton, 2010

Strategies: Skill of Nurse

- IV and CVAD skills
  - Knowledgeable of low risk site to cannulate
  - What patients are at risk for infiltrates and extravasation
  - Sequencing of drugs
  - Preventing extravasation
  - The Rate of administration
  - How to manage extravasation

  » Dougherty, 2008

Strategies: Interdisciplinary Solutions

- Form a Vascular Access Device Task Force with
  - PICC team nurses
  - Staff RNs from all areas
  - Infection control staff
  - Managers
  - Pharmacist
Strategies: Interdisciplinary Solutions

- Join with informatics nurses and pharmacist
  - Identify common irritants and vesicant IV drugs given by staff nurses
  - Identify ten of the most commonly given
  - Present to the informatics committee
    - Discuss attaching alerts to Electronic Medication Record (E-MAR) pop ups
    - Discuss what is included in the pop up menus
    - Discuss what the current infiltration and extravasation rate is

Strategies: Interdisciplinary Solutions

- Present to Nurse Practice
  - Decide what unit pilot
  - Discuss in-service for unit
  - Present drugs chosen
  - Present menus for pop ups
  - Develop a tool that will track infiltrations and extravasations
  - Discuss education strategy for staff

Strategies: Interdisciplinary Solutions

- Electronic Medication Record (E-MAR)
  - Ten medications alert staff nurse as a vesicant or irritant.
  - Route of delivery suggested
  - Question pop up of what type of VAD patient has
  - Question how old is the peripheral line/ if over 24 hours, suggestion to reconsider new site or central line
Strategies: Interdisciplinary Solutions

- Tracking infiltrations and extravasations
  - Educate staff
  - Develop a documentation tool for staff to report incidents
  - Through VAD task force assign staff to collect data
  - After six months compare statistics to prior implementation of E-MAR pop ups

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Conclusion

- IV Therapy has been the indicator for the growth of nursing practice
  - IV therapy includes administration, placement of devices, ultrasound guided venipuncture, and independent nurse practice.

  * Scales, 2009

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Conclusion

- Standards of Practice
  - Best current evidence in nursing practice

- Evidence Based Practice (EBP)
  - EBP provides guidelines for daily health care via Best Evidence

  * Alexander, et.al. 2010

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Simple Questions can result in big changes

Questions

References


References


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