Central Vascular Access
Device Selection

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Venous Access Required:

Navigating the patient towards the best option for daily life with a device
Disclosures

- Northern Colorado Vascular Access Coordinator for Banner Health
- Per Diem Educator - Bard Access Systems
- Images may be from Internet (cited on page), ultrasound images with identifiers removed, clip art, or personal collection

Bottom right to left - First Image Retrieved 4-4-2016 from: https://www.pinterest.com/pin/373939575282736624/
Third Image Retrieved 4-4-2016 from: http://www.bannerhealth.com/Locations/Colorado/McKee+Medical+Center/About+Us/At+a+Glance.htm
Other things you should know about me

- **STRONG patient advocate:**
  - “The secret to caring for the patient is caring for the patient,” Dr. Jack Breen

- **Health Care related biases:**
  - “The BEST care IS the least expensive care,” Dr. Robert Groves
  - “If something needs changing, don’t complain about it…DO something about it,” Linda Zuroski, pharmacist
Objectives

• Describe the role of the infusion or vascular access nurse in the choice of a CVAD

• Identify factors in the selection of a CVAD
First Case Study

• 45 year old man with stage IIB (T1, N1, M0) pancreatic cancer
  – Eight weeks status-post Whipple
  – Six month Chemotherapy / Radiation treatment plan
  – Active, intelligent, working machinist
Second Case Study

• 37 year old woman with left arm cellulitis from a cat scratch
  – Failed PO therapy
  – Now extends from mid-upper arm to wrist
  – Based on culture sensitivities, infectious disease anticipates a minimum of 4 week antibiotic infusion therapy
  – Active, intelligent, mother of 2 children
Third Case Study

• 64 year old grandmother a few hours post cardiac surgery that was unsuccessful
  – Condition is imminently (within hours to a few days) terminal
  – Currently has right IJ tunneled HD catheter, right femoral arterial sheath, and right non-tunneled femoral venous triple lumen
Fourth Case Study

- 42 year old diabetic woman with recurrent left stump infection
  - Failed oral antibiotics
  - 2 weeks IV Ceftriaxone anticipated
  - History of multiple PICC lines, multiple failed midlines, and tunneled catheter
  - SNF physician has consulted for outpatient line placement
Roles of the Nurse

- **expert** [ˈɪkˌspɜːrt] - NOUN
  - a person who has a comprehensive and authoritative knowledge of or skill in a particular area
  - synonyms: specialist · authority · pundit · adept · maestro · virtuoso · master · past master · wizard · connoisseur · aficionado · ace · buff · pro · techie · whiz · hotshot · crackerjack · maven

Retrieved 2-25-2016 from: http://www.bing.com/search?q=expert&src=IE-SearchBox&FORM=IESR02
Which means…

• Know **venous access devices and the alternatives**
• Know **the properties of infusates**
• Know how to place devices (or know who can)
  – and do it very well
• Know **venous anatomy**
  – including surrounding structures
• Know available assessment methods
• Know **venous pathology, how to recognize it, and how to treat it**
And…

• Use ultrasound to:
  – assess vessel health
  – guide insertion for all advanced catheters
  – when needed for short peripheral insertions

• Know how to use an algorithm
  – Create algorithms

• Attend courses, conferences

• Teach courses
And…

• Know where the catheter tip belongs
  – and get it there
• Know your local politics
• Get credentialed!
  – CRNI
  – VA-BC
  – OCN
  – CCRN
Central Venous Access

• Central Venous Catheter:
  – Distal tip is located in the:
    • Superior Vena Cava
    • Right Atrium
    • Common Iliac
    • Inferior Vena Cava
  – Includes: CICC, PICC, Tunneled, Implanted
Central Venous Access

- **CICC**: Centrally inserted central venous catheter (IJ, SVC, Femoral, Axillary/Chest approach)
- **PICC**: Peripherally inserted central venous catheter (Basilic, Brachial, Cephalic, Axillary/Upper arm approach)
  - Includes additional sites in neonates and infants
Central Venous Access

- Tunneled catheter: Vascular catheter that is threaded through a subcutaneous tissue tract prior to vessel cannulation

- Implanted port: Tunneled vascular catheter implanted completely under the skin that originates in a reservoir that must be tapped to gain access to the catheter
Central Venous Access

• Open-ended (non-valved)
  – Think of a straw
  – Requires a clamp at rest

• Valved (closed at rest)
  – Valve opens with pressure
  – May be at distal end
  – May be at proximal end / in hub

First Image Retrieved 4-1-2016 from: http://www.bardpv.com/portfolio/groshong/
Third Image Retrieved 4-1-2016 from:
http://www.bing.com/images/search?q=Triple+Lumen+Central+Venous+Catheter&view=detail2&id=5EBC4EB1FA67131C9D07C88C3BD5934A24D57C65&selectedIndex=2&ccid=vxBjNuYL&simid=608025391320663293&thid=OIP.Mbf106336e60b202a9ef969b44ba46476o0&ajaxhist=0
Peripheral Venous Access

• Peripheral Venous Catheter
  – Distal tip located outside of the trunk
  – Short PIV, Midline

![Peripheral Venous Catheter](image)

- 8cm / 3.1”
- 10cm / 3.9”
- 20 cm
- 1.75”
Truncal Venous Access

- Suboptimal “Central” Venous Catheter
  - Distal tip located in truncal vein not previously listed (e.g. subclavian, innominate/brachio-cephalic)
Alternatives: Fluid Delivery

• Hypodermoclysis: Subcutaneous fluid administration
  – Limit 2L per site, 3L (over 2 sites) in 24 hours
  – Sodium chloride or sodium chloride with glucose solutions only
  – No medication except hyaluronidase, when used\(^2\) to increase tissue permeability to fluids\(^3\)

Alternatives: Medication Delivery

• Buccal / Sublingual
  – Pain management
  – Anti-emetics
  – Anxiolytics

• Rectal
  – Anti-emetics
  – Anti-pyretics
Access Pros and Cons

- Freedom of activity
  - External line or tubes
- Frequency of care
  - Implanted port
  - Valved verses open catheter
- Ease of insertion and removal
- Risk of infection
  - Lowest in implanted ports and midlines
Access Pros and Cons

• Limitations
  – Infusate
  – Dwell or life of catheter expectancy

• Risk of complication
  – Continuous vesicant

• Cosmetic considerations

• Expense
  – Initial and ongoing
(Per in text citation of Alexander, et al 2010):

• **Vesicant** [vesˈɪkənt] Infusate
  – Intravenous medication capable of causing blistering, tissue sloughing, or necrosis when infiltrating the surrounding tissue.

• **Irritant** (irˈi-tänt) Infusate
  – An intravenous medication that may cause pain or reactive change to the *tunica intima* of the blood vessel.⁴
Factors that influence the vein or tissues

- pH $<5$ or $>9$
- Osmoality $>600$

(Per in text citation of Di Giacomo, 2010 and Sauerland, et al 2006):

- Vasoactive agents
  - Severe vasoconstriction may lead to tissue injury

- High concentration of electrolytes
  - Stimulates vasoconstriction may lead to ischemia$^4$
Vessel Anatomy

- Brachiocephalic veins
- Right subclavian vein
- Axillary vein
- Brachial vein
- Cephalic vein
- Basilic vein
- Internal jugular vein
- External jugular vein
- Left subclavian vein
- Superior vena cava
- Azygos vein
- Accessory hemiazygos vein
- Hemiazygos vein
- Posterior intercostals
- Inferior vena cava
- Ascending lumbar vein

- Median cubital vein
- Median antebrachial vein
- Cephalic vein
- Radial vein
- Basilic vein
- Ulnar vein
- Deep venous palmar arch
- Superficial venous palmar arch
- Digital veins

Vessel Anatomy

• Assessment methods
  – Visualization

  – Palpation
Vessel Anatomy

– Ultrasound

• Healthy vessels and surrounding structures

Vessel Anatomy
Vessel Anatomy

Image Retrieved 3-31-2016 from: https://www.youtube.com/watch?v=lBmblak5fY
Vessel Anatomy

• Nerve

Image Retrieved 3-31-2016 from: https://www.sciencephoto.com/media/485958/view
Vessel Health Assessment

- Thickened walls / thrombosis

Vessel Health Assessment

• Based on evidence for general and specific patient populations
  – Will work for most patients
  – Pay attention to individual patient circumstances and needs

• Next slides are recently developed, evidenced based algorithms from V. Chopra, et al\textsuperscript{5}
Algorithms: Chopra, et al\textsuperscript{5}

**Figure 3.** Venous access device recommendations for infusion of peripherally compatible infusate.

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Proposed Duration of Infusion ≤5 d</th>
<th>6–14 d</th>
<th>15–30 d</th>
<th>≤31 d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral IV catheter</td>
<td>No preference between peripheral IV and US-guided peripheral IV catheters for use ≤5 d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US-guided peripheral IV catheter</td>
<td>US-guided peripheral IV catheter preferred to peripheral IV catheter if proposed duration is 6–14 d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nontunneled/acute central venous catheter</td>
<td>Central venous catheter preferred in critically ill patients or if hemodynamic monitoring is needed for 6–14 d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midline catheter</td>
<td>Midline catheter preferred to PICC if proposed duration is ≤14 d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PICC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tunneled catheter</td>
<td>PICC preferred to midline catheter if proposed duration of Infusion is ≥15 d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{IV} = intravenous; PICC = peripherally inserted central catheter; US = ultrasonography.
### Figure 4. Venous access device recommendations for infusion of non-peripherally compatible infusates.

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Proposed Duration of Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤5 d</td>
</tr>
<tr>
<td>Peripheral IV catheter</td>
<td></td>
</tr>
<tr>
<td>US-guided peripheral IV catheter</td>
<td></td>
</tr>
<tr>
<td>Nontunneled/acutocentral venous catheter</td>
<td></td>
</tr>
<tr>
<td>Midline catheter</td>
<td></td>
</tr>
<tr>
<td>PICC</td>
<td></td>
</tr>
<tr>
<td>Tunneled catheter</td>
<td></td>
</tr>
<tr>
<td>Port</td>
<td></td>
</tr>
</tbody>
</table>

- **Peripheral IV catheter**: No preference among port, tunneled catheter, or PICC for ≥31 d.
- **US-guided peripheral IV catheter**: No preference among port, tunneled catheter, or PICC for ≥31 d.
- **Nontunneled/acutocentral venous catheter**: Central venous catheter preferred in critically ill patients or if hemodynamic monitoring is needed for 6–14 d.
- **Midline catheter**: No preference among port, tunneled catheter, or PICC for ≥31 d.
- **PICC**: PICCs rated as appropriate at all proposed durations of infusion.
- **Tunneled catheter**: Tunneled catheter neutral for use ≥15 d.
- **Port**: No preference among port, tunneled catheter, or PICC for ≥31 d.

*IV = intravenous; PICC = peripherally inserted central catheter; US = ultrasonography.*
### Figure 5. Venous access device recommendations for patients with difficult venous access.

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Proposed Duration of Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤5 d</td>
</tr>
<tr>
<td>Peripheral IV catheter</td>
<td>No preference between</td>
</tr>
<tr>
<td></td>
<td>peripheral IV and US-guided</td>
</tr>
<tr>
<td></td>
<td>peripheral IV catheters for</td>
</tr>
<tr>
<td></td>
<td>use ≤5 d</td>
</tr>
<tr>
<td>Midline catheter</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>PICC</td>
<td>Disagreement on appropriateness of PICC for durations ≤5 d</td>
</tr>
<tr>
<td>Tunneled catheter</td>
<td></td>
</tr>
<tr>
<td>Port</td>
<td></td>
</tr>
</tbody>
</table>

IV – intravenous; PICC – peripherally inserted central catheter; US – ultrasonography.
**Figure 6.** Venous access device recommendations for patients who require frequent phlebotomy.

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Proposed Duration of Infusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤5 d</td>
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<td>Nontunneled/acute central venous catheter</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Tunneled catheter</td>
<td></td>
</tr>
<tr>
<td>Port</td>
<td></td>
</tr>
</tbody>
</table>

- **No preference between peripheral IV and US-guided peripheral IV catheter for use ≤5 d.**
- **US-guided peripheral IV catheter preferred if venous access difficult.**
- **Midline catheter preferred to PICCs if proposed duration is ≤14 d.**
- **Midline catheter neutral for frequent phlebotomy at this duration.**
- **Central venous catheter preferred to PICC for use ≤14 d in critically ill patients.**
- **Disagreement on appropriateness of PICC for durations ≤5 d.**
- **PICC use appropriate if proposed duration ≥6 d; PICC preferred to tunneled catheter for durations of 15–30 d.**
- **Tunneled catheter neutral for difficult intravenous access for use ≥15 d.**
- **Ports inappropriate for frequent phlebotomy, regardless of proposed duration of use.**

**Legend:**
- **Appropriate**
- **Neutral**
- **Inappropriate**
- **Disagreement**

IV = intravenous; PICC = peripherally inserted central catheter; US = ultrasonography.
At NCMC, we wanted to provide consistent care, compatible with both vein preservation and immediate patient needs

- Based on literature review\textsuperscript{6, 7}
- In conjunction with our local Nephrologists

Finding no algorithm that met our need, we created our own!
**Vein Preservation versus PICC Placement for Patients with Compromised Renal Function**

**VAT consulted for PICC placement**
Use lab reported eGFR or calculate:

$$175 \times \text{Serum Creatinine}^{1.154} \times \text{Age}^{-0.203} \times [0.742 \text{ if female}]$$

(max plug in numbers at [www.mdrd.com](http://www.mdrd.com))

- **eGFR of 30 or lower (stage 3 or worse)**
  - **NO**
  - **YES**
    - **PICC clinician reviews history**
      - **Previous history of renal insufficiency and/or likelihood of future dialysis need based on age and comorbidities**
      - **Patient’s primary care physician decides on PICC placement weighing benefits and risks with regard to vein preservation. Consider other options such as IU line or peripheral IV in dorsal veins of dominant hand. Physician specific order citing eGFR will be written if PICC option**
      - **Acute reversible condition:** Dehydration, low cardiac output, hypotension, dye exposure and/or low likelihood of future dialysis need based on advanced age and comorbidities. PICC clinician weighs benefits and risks with regard to PICC use and vein preservation
      - **If decision IS made to place a PICC line, the smallest adequate line will be placed in the largest appropriate vessel available for the shortest duration necessary**
      - **Chronic kidney disease (CKD)**
        - **End stage renal disease (patients on dialysis or under nephrology)**
        - **Nephrologist decides on PICC placement weighing benefits and risks with regard to vein preservation. Consider other options such as IU line or peripheral IV in dorsal veins of dominant hand. Physician specific order citing Creatinine/eGFR will be written if PICC option chosen**
        - **Patient is PICC candidate, as far as renal function is concerned.**
Roles of the Nurse

- **ad·vo·cate** - **NOUN**
  - a person who publicly supports or recommends a particular cause or policy
  - **synonyms:** champion · upholder · booster · supporter · backer · promoter · crusader · proponent · exponent · spokesperson · campaigner · fighter · propagandist · apologist · flag-bearer
Which means…

• Know pertinent patient information
  – Co-morbidities
    • Device limiting conditions
    • Infusion / intravascular device history
    • Relevant diagnostics
  – Individualized Treatment plan
    • Infusate(s) characteristics
    • Length and frequency of infusion therapy
    • Medically anticipated outcome
• Get to know the patient and any caregivers
  – What is their goal for therapy?
  – What lifestyle do they aspire to during therapy?
  – What level of engagement do they display?
  – What is an achievable level of participation?
  – What MATTERS most to them?
    • May be finance driven
And...

- Explain the recommended option(s) first, but be ready to discuss all venous access devices, including doing nothing
- Verify that they understand you
- Be honest when they ask you, “what would you do?” (Because they will)
- Champion your patient’s decision
Co-morbidities

- Device Limiting Conditions:
  - Lymph node dissection
  - Limited limb mobility or limb deformity
  - Bone fractures
  - Diagnosed great vessel occlusions
  - Morbid body habitus
  - Skin conditions
  - Potential for device misuse
  - Patient / Caregiver restrictions
  - Fistula, graft, or HD catheter
  - Medications affecting coagulation
Co-morbidities

• Infusion / Intravascular Device History
  – Infusates that alter vessel health (e.g. Chemo)
  – Previous long term venous catheter(s)
  – Temporary or permanent pacemaker wires

• Relevant Diagnostics
  – Platelets, eGFR, INR
  – Applicable radiographs
  – Vessel health evaluation
Knowing the Patient

• Requires awareness of self
  – Know your biases
  – Understand the need for hope

• The patient’s goal are their own
  – May not be what you or I would choose
  – May not feel extremely realistic
  – But, probably allows them to get up in the morning
First Case Study

- 45 year old man with stage IIIB (T1, N1, M0) pancreatic cancer
  - Eight weeks status-post Whipple
  - Six month Chemotherapy / Radiation treatment plan
  - Active, intelligent, working machinist
  - Goal: TO LIVE
  - Wife is a Vascular Access Specialist (VAS) nurse
First Case Study

• Patient received thorough education regarding long term access for chemotherapy post-op, but prior to meeting with oncologist

• Biases clashed:
  – Oncologist expected implanted port placement
  – Patient preferred PICC placement

• What is the right CVAD for this patient?
First Case Study

• CHAMPION YOUR PATIENT’S DECISION
  – Stand up for what is right for him!
More on Knowing the Patient

• Assess:
  – Patient / caregiver engagement
    • How interested in the choice are they
  – Ability to participate / provide CVAD care
    • Physical ability of patient
    • Availability of caregiver
    • Level of comprehension / demonstration
Second Case Study

- 37 year old woman with left arm cellulitis from a cat scratch
  - Failed PO therapy
  - Now extends from mid-upper arm to wrist
  - Based on culture sensitivities, infectious disease anticipates a minimum of 4 week antibiotic infusion therapy
  - Active, intelligent, mother of 2 children
  - History of right side mastectomy with lymph node removal
Second Case Study

- VAS nurse consulted for PICC placement
  - Patient immediately voices concern regarding venous access in either arm
  - VAS agrees with high functioning, knowledgeable patient

- Political clash:
  - IR group wants their PA to place a PICC

- What is the right CVAD for this patient?
Second Case Study

- **CHAMPION YOUR PATIENT’S DECISION**
  - Help the patient advocate for themselves
Third Case Study

- 64 year old grandmother a few hours post cardiac surgery that was unsuccessful
  - Condition is terminal (within a few days)
  - Has right IJ tunneled HD catheter, right femoral arterial sheath, and right non-tunneled femoral venous triple lumen
    - Cardiologist wants PICC “to remove sheath”
    - Nephrologist says no PICC “to preserve arm vessels”
    - Family yet to be informed of patient’s imminent mortality
Third Case Study

• Dialogue:
  – VAS nurse: “Peripheral IV?”
  – Cardiologist: “No!”
  – VAS nurse: “Patient condition is not survivable…PICC”
  – Nephrologist: “Place whatever you bleep-bleep want!”

• What is the right line for this patient?
Third Case Study

- Conflicting orders; disagreeing physicians
- Patient and family NOT fully informed
- Advocate for the patient and her family
  - Activate chain of command
  - Bring focus back to the patient
Fourth Case Study

- 42 year old diabetic woman with recurrent left stump infection
  - Failed oral antibiotics
  - 4 weeks IV Ceftriaxone anticipated
  - History of multiple PICC lines, multiple failed midlines, and tunneled catheter
    - History of manipulation of her lines and wound
    - Largest gap in ED visits and hospitalization was after tunneled catheter insertion
Fourth Case Study

- Primary care physicians insist on nursing home placement throughout infusion therapy course
- Patient has been fired from nursing home service and must leave at the end of the week
- What is the right line for this patient?
Fourth Case Study

- Referral, referral, referral
  - Single lumen tunneled catheter
  - Notify PCP of SNF dilemma
  - Consult social work / care coordination
    - Explore care options
    - Avoid gap in infusion therapy

- One more referral!
  - To facility / organization readmissions team
And most importantly

- CARE for the patient
  - Listen
  - Be honest
  - Do not *display* judgment towards the patient

- CARE for yourself
  - Be aware of your own perceptions of blame
  - Talk it through with other health team members
Summary

• Infusion Nurse:
  – Expert
  – Advocate

• Device Selection: Best fit
  – Least invasive adequate
  – Pros outweigh cons
  – Patient / caregivers on board, if not driving
Thanks for ALL you do!
References


Additional Reference Material

- 2016 Infusion Nursing Standards of Practice.
- Association for Vascular Access National Scientific Meeting Proceedings, past five years.
- Infusion Nurses Society National Conference Proceedings, past five years.