VENOUS ACCESS CHOICE IN ONCOLOGY PATIENTS

M. Kunecki (PL)
Venous access choice in oncology patients

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Learning objectives:

- Know the venous accesses for nutrition, chemotherapy and imaging
- Know the main complications (infections, interactions, obstruction) of the different options
The need for venous access in oncological therapy

- Antineoplastic therapy (cytotoxic, targeted, etc.)
- Fluids, Electrolytes, PN (TPN)
- Anesthetics substances
- Diagnostic substances
- Blood and/or blood component therapy.
- Analgetics
- Anti-infectives (Antibiotics, antivirals, antifungals, etc.)
- Anti-emetics
- Anti-seizure medications
- Cardiac, respiratory and other system specific medications
- ...

and

- Frequent blood draws
IV therapies can be administered through:

• Peripheral IV access
  - inserted into a vein in the arm during each visit to the chemotherapy unit and removed before the patient returns home,

• Central venous access devices (CVADs)
  - Short term, non tunneled CVAD
  - Long term CVADs
    - peripherally inserted central catheters (piccs)
    - implanted vascular access devices (“ports” and tunneled catheters).

• Significant differences in terms of duration, costs, morbidity, specific merits and complications.

<table>
<thead>
<tr>
<th>Access type</th>
<th>Peripheral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwelling time</td>
<td>24 – 72 (96 ?) h</td>
</tr>
<tr>
<td>Setting</td>
<td>Hospital</td>
</tr>
</tbody>
</table>

**Advantages**
- Fast access, excellent in emergency
- Good for intermittent infusion
- Nurses, paramedics, techs
- General infection rate - 0.1% (0.5/1000 d)
- Low thrombotic complications

**Disadvantages**
- Failure rate - 35% - 50%
- Phlebitis,
- Extravasation, local tissue damage,
- Loss of peripheral veins.


BSI – blood stream infection
Advantages of central CVADs:

• allow delivery of veinoirritant solutions
• improve the quality of life of the patients,
  • minimizes the discomfort of frequent venipuncture and cannulation,
  • minimizes the interference in the daily activities of patients,
• fewer delays in therapy related to loss of vascular access,
• fewer device complications (?)
• preserve of peripheral veins,
• less nursing time spent attempting to gain vascular access,
• shorter hospital stays.

### Complications of central vascular access devices (CVAD)

<table>
<thead>
<tr>
<th>Insertion procedure related</th>
<th>Late Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acute</strong></td>
<td><strong>Infectious</strong></td>
</tr>
<tr>
<td>pneumothorax</td>
<td>exit site infection,</td>
</tr>
<tr>
<td>artery puncture</td>
<td>tunel infection,</td>
</tr>
<tr>
<td>air embolism</td>
<td>port pocket infection</td>
</tr>
<tr>
<td>arrythmia</td>
<td>Central line associated blood stream infection (CLABSI)</td>
</tr>
<tr>
<td>heart tamponade</td>
<td></td>
</tr>
<tr>
<td>brachial plexus injury</td>
<td></td>
</tr>
<tr>
<td><strong>Early</strong></td>
<td><strong>Thrombotic</strong></td>
</tr>
<tr>
<td>haematomata</td>
<td>catheter occlusion,</td>
</tr>
<tr>
<td>wound dehiscence</td>
<td>catheter related deep vein thrombosis (CR-DVT),</td>
</tr>
<tr>
<td>infection</td>
<td>pulmonary embolism (PE)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Mechanical</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>dislodgement (accidental removal)</td>
</tr>
<tr>
<td>non-thrombotic occlusion</td>
</tr>
<tr>
<td>catheter fracture</td>
</tr>
</tbody>
</table>
Central vascular access – main issues

• WHEN? Timing of central access insertion
• WHAT? Type of central access
• WHERE? Insertion site
• HOW to maintain the access for long time?
Central Venous Catheter Care for the Patient With Cancer: American Society of Clinical Oncology Clinical Practice Guideline

Charles A. Schiffer, Pamela B. Margo, James G. Wade, Dawn Camp-Serrell, Diane G. Cape, Basel F. El-Rayes, Mark German, Jennifer Ligibel, Paul Mansfield, and Mark Levine

Central venous access in oncology: ESMO Clinical Practice Guidelines

B. Sousa, J. Furlanetto, M. Hutka, P. Gouveia, R. Wuerstein, J. M. Mariz, D. Pinto & F. Cardoso, on behalf of the ESMO Guidelines Committee

Clinical Guidelines

American Society for Parenteral and Enteral Nutrition Guidelines for the Selection and Care of Central Venous Access Devices for Adult Home Parenteral Nutrition Administration

Debra S. Kovacevich, MPH, RN; Mandy Corrigan, MPH, RD, LD, CNSC, FAND; Vicki M. Ross, PhD, RN; Liam McKeever, MS, RDN; Amber M. Hall, MS; and Carol Braunschweig, PhD, RD

Espen Guidelines on Parenteral Nutrition: Central Venous Catheters (access, care, diagnosis and therapy of complications)

Mauro Pittiruti, Helen Hamilton, Roberto Biffi, John MacFie, Marek Pertkiewicz

Espen
European Society for Clinical Nutrition and Metabolism

Aspen
American Society for Parenteral and Enteral Nutrition
Indications for placement of central venous access

**Standard indications**

- No possibility of administration of chemotherapy medication (CTh) via peripheral veins
- High number of courses and toxicity of CTh
- Acute reactions to the administered drugs
- No possibility of peripheral vein cannulation

**Non-standard indications**

- Parenteral nutrition
- Repetitive administration of fluids, drugs
- Repetitive transfusion of blood products *
- The need to take frequent blood samples *
- Renal replacement therapy
- IV fluids with different pH, hyperosmolar
- Administration of catecholamines

*Frequent blood sampling and transfusion of blood products via central access shortens its functioning time!
Long term central venous access insertion - contraindications

**Absolute contraindications**

- No patient’s informed consent
- INR > 1.3
- Thrombocytopenia < 60 G/L
- Leukopenia < 3 G/L
- Neutropenia < 1 G/L
- No technical skills to perform implantation
- Skin changes at the site of possible implantation
- Infection at the site of possible catheter placement
- Generalised infection (bacteriaemia, fungaemia)
- Active vein thrombosis in the area of possible implantation

**Relative contraindications**

- Relative coagulation disorders/therapy with anticoagulants
- ASA derivatives or platelets inhibitors in the previous 7 days
- No possibility to perform a control radiologic test

INR — international normalised ratio, ASA - acetylsalicylic acid
Time to perform central vascular access?

• when all available peripheral veins ceased to be usable and peripheral access is impossible

• scheduled procedure at the early stages of treatment
  • to preserve peripheral veins as convenient access for
    • blood sampling,
    • administration of blood products,
    • contrast administration during imaging tests, especially those requiring high pressure infusion.
Short term central vascular access in oncology patients (from Gallieni M, CA Cancer J Clin 2008;58:323–346)

**little importance in oncological therapy**

<table>
<thead>
<tr>
<th>Access type</th>
<th><strong>Short term CVC</strong> (non tunneled)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwelling time</td>
<td>1 – 3 weeks (?)</td>
</tr>
<tr>
<td>Setting</td>
<td>Hospital</td>
</tr>
</tbody>
</table>

**Advantages**
- Low costs,
- Suitable for hyperosmotic, irritant solutions

**Recommendations:**
- Use of antiseptic/antibiotic-impregnated short-term CVCs and chlorhexidine-impregnated sponge dressings (ESPEN, ESMO, ASCO)
- Avoidance of routine replacement of CVCs to prevent infection (ESPEN, ESMO)
- Guidewire exchange is not routinely recommended, unless access options are limited (ASCO)
- The utilisation of neutral pressure mechanical valve connectors to avoid the risk of infection is recommended (ESMO)

CVC – central venous catheter, CRBSI – catheter related bloodstream infection
<table>
<thead>
<tr>
<th></th>
<th>TUNELED CATHETER (BROVIAC, HICKMAN, GROSHONG)</th>
<th>TOTALLY IMPLANTED PORTS</th>
<th>PICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>DWELL TIME</td>
<td>3 months–years</td>
<td>3 (6) months – years</td>
<td>unknown</td>
</tr>
<tr>
<td></td>
<td>(limited punctures number)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLINICAL APPLICATION</td>
<td>Long-term PN;</td>
<td>Low-frequency, intermittent access (CTh)</td>
<td>Acute care and short-and medium-term PN</td>
</tr>
<tr>
<td>ADVANTAGES</td>
<td>Daily, multiple access option (PN)</td>
<td>Low risk for CLABSI when reduced manipulation (CTh)</td>
<td>Low risk of insertion complications</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Suitable for tracheostomy patients</td>
</tr>
</tbody>
</table>

CTh – chemotherapy, CLABSI - central line–associated blood stream infection, PN – parenteral nutrition, DVT – deep vein thrombosis

### Types of long term central vascular access devices (CVAD)

<table>
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<tr>
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<td>Long-term PN;</td>
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</tbody>
</table>

**Disadvantages & Complications**

- External part sensitive to injury
- Exit site complications
- Needle replacement (every 7 days)
- Continuous / frequent access offsets resistance to infection (daily PN)
- Increased risk for DVT and occlusion.
- Limited use when vessel preservation is a priority
- Difficult clothing and stabilization
- Need of caregiver
- Central line associated blood stream infection (CLABSI)
- Catheter occlusion
- Catheter related deep vein thrombosis & Pulmonary embolism

• Rupture of the external portion of the catheters due to high pressure infusion of contrast medium at MR or CT scan.
  • (most frequently, silicone catheters)
• A specific warning of the FDA recommends utilizing power injectors only
  • on peripheral short cannulas or
  • specific venous access devices certified to resist high pressures ('pressure injectable' or 'power' devices)

Selection of the site of CVA insertion

- There is **insufficient evidence** to recommend a specific **type** of CVA, the type of **material** from which it is made, or **insertion site**,

- The choice of CVAD should be selected based upon complexity of therapy, experience of the operating physician, patient choice.

- **femoral vein insertion should be avoided** due to the increased risk of infection and concerns about thrombosis [I, A]

  unless

- emergency settings

- subclavian or jugular venous access route is difficult/contraindicated (e.g. superior vena cava syndrome)

- French Catheter Study Group in Intensive Care,
- Randomized controlled study, 8 ICUs, 1997 - 2000

<table>
<thead>
<tr>
<th></th>
<th>Femoral</th>
<th>Subclavian</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical (n = 289)</td>
<td>17,3</td>
<td>18,8</td>
<td>NS</td>
</tr>
<tr>
<td>Infectious (n = 270)</td>
<td>19,8</td>
<td>4,5</td>
<td>&lt; 0,001</td>
</tr>
<tr>
<td>Thrombotic (n = 223)</td>
<td>21,5</td>
<td>1,9</td>
<td>&lt; 0,001</td>
</tr>
<tr>
<td>Complete vein thrombosis</td>
<td>6,0</td>
<td>0,0</td>
<td>&lt; 0,01</td>
</tr>
</tbody>
</table>

Femoral vein catheterization – independent risk factor for:
- infection (HR = 4,83, CI = 95%, 1,96 – 11,93; p < 0,001)
- thrombosis (OR = 14,42; 95% CI; 33,33 – 62,57; p <0,001)
Complications in the Three-Choice Comparison, According to Insertion-Site Group.

• avoiding placement of silicone catheters via infraclavicular venepuncture of the subclavian vein

• ‘pinch-off’ syndrome - compression → malfunction, obstruction, damage, fracture of the catheter, with embolization of pulmonary artery.
Central line associated blood stream infections (CLABSIs)

- Remain one of the more common nosocomial infections,
- Associated with a significant increase in morbidity and mortality (20%–50% of deaths related to HPN**)
- An iatrogenic problem, largely preventable*
- Practices used to prevent and treat CRBSIs have evolved dramatically over the years.
- The science behind current practices has reduced the CRBSI rate by 50% between 2008 and 2014***
- „Much progress has been made but the journey continues”****

****NHSN Bloodstream Infection Surveillance in 2018
Central venous catheter bloodstream infection (BSI) rates pre– and post–evidence-based practice (EBP) implementation

## CVC Clinical Care Management Bundle

<table>
<thead>
<tr>
<th>Component</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand hygiene</td>
<td>Every person entering the room during the insertion procedure should perform hand hygiene</td>
</tr>
<tr>
<td>Maximal barrier precautions upon insertion</td>
<td>Sterile drape extends from head to toe; all health care providers participating in the procedure employ mask, cap, sterile gown, and sterile gloves</td>
</tr>
<tr>
<td>Chlorhexidine skin antisepsis</td>
<td>Skin at the insertion site should be scrubbed with 2% chlorhexidine for 30 seconds and allowed to dry for at least 30 seconds</td>
</tr>
<tr>
<td>Optimal catheter site selection</td>
<td>Subclavian vein is the preferred site for nontunneled catheters; avoid femoral site if possible</td>
</tr>
<tr>
<td>Assessment of CVC necessity</td>
<td>Prompt removal of CVC line after completion of therapy unless clinical circumstances suggest that further infusional therapy is likely to be necessary in the future</td>
</tr>
</tbody>
</table>


Recomendation regarding insertion procedure

• **Education / ongoing training** of personnel who insert and maintain catheters.

• Use of a **CVC clinical care bundle** is recommended

• **Ultrasound guidance** improves the success rate, reduces complications,

• The desired **location of the catheter tip** is at the junction between the right atrium and SVC (fluoroscopy)

• Routine **flushing with saline**, after the completion of any infusion or blood sampling, is recommended

• **Prophylactic systemic antibiotics - NOT recommended** before CVC insertion
Evidence indicates that the risk of catheter-related infection is reduced by:

• Using tunneled and implanted catheters (ESPEN, ASPEN)
• Using single-lumen catheters (ESPEN, ASCO, ESMO)
• Using peripheral access (PICC) when possible (ESPEN)
• Proper education and specific training of the Staff (all)
• Appropriate dressing of the exit site (all)
• Disinfection of hubs, stopcocks and needle-free connectors (ASCO, ESMO - neutral pressure connectors)
• Regular change of administration sets (ESPEN)
Interventions considered **NOT** effective in reducing the risk of infection:

- in-line **filters** (ESPEN)

- **antibiotic** prophylaxis (all)

- prophylactic use of **heparin** with saline flushes (ESPEN, ASCO, ASPEN)

- use of **topical antibiotic ointment or cream** on insertion sites is not recommended because of potential to promote fungal infections and resistance to antimicrobials (ASCO)
there is no evidence to suggest the routine use of taurolidine lock as secondary prophylaxis in ALL patients receiving HPN


The impact of the **concomitant use of implanted CVADs used for HPN & chemotherapy** remains unknown.
Venous thromboembolism (VTE) is the second highest cause of mortality in cancer patients.


<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Tumor type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced age</td>
<td>Very high risk: gastric, pancreas, brain</td>
</tr>
<tr>
<td>Comorbidities</td>
<td>High risk: lung, hematologic, gynecologic, renal, bladder</td>
</tr>
<tr>
<td>Immobilization or</td>
<td></td>
</tr>
<tr>
<td>Hospitalization</td>
<td></td>
</tr>
<tr>
<td>Previous VTE</td>
<td></td>
</tr>
<tr>
<td>Hereditary thrombophilia</td>
<td></td>
</tr>
<tr>
<td>Surgery</td>
<td></td>
</tr>
<tr>
<td>Chemotherapy (e.g. cisplatin-based, antiangiogenesis agents)</td>
<td></td>
</tr>
<tr>
<td>Antibiotics</td>
<td></td>
</tr>
<tr>
<td>Hormonal therapy</td>
<td></td>
</tr>
<tr>
<td>Red blood cell</td>
<td></td>
</tr>
<tr>
<td>Transfusions</td>
<td></td>
</tr>
<tr>
<td>Erythropoiesis-stimulating agents</td>
<td></td>
</tr>
<tr>
<td>Surgery</td>
<td></td>
</tr>
</tbody>
</table>

A recent systematic review reports an annual incidence of VTE from 0.5 to 20%, depending on the cancer type and time since diagnosis.


There is no evidence that there is a benefit from giving antithrombotic prophylaxis to all cancer patients; however, there are selected conditions in which prophylaxis has to be considered.


Deep vein thrombosis & pulmonary embolism

• Indwelling CVC = increased risk for VTE,
  • estimated rate of symptomatic catheter-related DVT is between 0.3 and 28%.
  • this number dramatically increases to approximately 27 to 66% using venography*

• Catheter-related thrombosis
  • can interrupt the infusion of chemotherapy treatment, blood products, or intravenous medications,
  • loss of vascular access
  • cause serious morbidity including PE and postphlebitic syndrome**


- 64 studies (12 with a comparison group and 52 without) - 29,503 patients

- Increased PICC-related DVT in
  - critically ill (13.91%, 95% CI 7.68-20.14)
  - cancer patients (6.67%, 4.69-8.64).

- PICCs associated with an increased risk of DVT comparing with other CVC (OR 2.55, 1.54-4.23, *p*<0.0001) but NOT pulmonary embolism (no events).

- 7 studies ($n = 2872$) PICC-related vs. tunneled catheter/port-related deep vein thrombosis (DVT)
- DVT confirmed by USG, X-ray, or CT scan.
- Tunneled catheters/ports are associated with a decrease in the odds ratio of DVT compared with PICCs

(OR = 0.45, 95% CI:0.32–0.62, $p < 0.0001$, $I^2 = 0\%$, $\tau^2 = 0.00$).

Patient number/characteristic: 269 PICC / 250 patients (55,293 catheter days)
98% with solid malignancies

Duration (day), median (range): 184 (15–1,384)

Complications rate [n/1,000 catheter days]
- Local infection: 0.11
- CRBSI: 0.05
- Venous thrombosis: 0.05
- Mechanical Complications: 0.63
- Overall Complications: 0.85

Causes of removal, n (%)
- Catheter complications: 19 (7)
- End of IV therapy: 85 (32)
- Death: 165 (61)
A pivotal role to reduce the overall rate of complications and prolong the PICC life span:

- availability of a knowledgeable and experienced central venous access team;

- use of ultrasound-guided venipuncture;

- proper patients’ education and a specific caregivers’ training, along with close monitoring by trained nurses at home.
### Types of venous catheter occlusion

<table>
<thead>
<tr>
<th>Occlusion mechanism</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thrombotic</strong></td>
<td>fibrin buildup (i.e., fibrin sheath or fibrin tail) or a blood clot within the catheter and/or vessel lumen.</td>
</tr>
</tbody>
</table>
| **Mechanical**      | Involving a component of the infusion system:  
  - **External**: a filter, a needleless connector, a malpositioned/blocked non-coring needle, closed clamp.  
  - **Internal**: pinch-off syndrome, kinking or malposition.  
| **Chemical**        | • mixing of two incompatible medications and/or solutions  
  • buildup waxy residue of lipid within the lumen |
Recomendations regarding catheter-related thrombosis—prophylaxis

• Appropriate nursing measures !!!

• **Routine flushing with saline** of the CVC to prevent fibrin buildup is recommended

• Avoidance of routine use of the catheter for **infusion of blood products, blood withdrawal, or infusion of contrast medium** for radiological exams

• **Systemic anticoagulation** (warfarin, LMWH, UFH) has NOT been shown to decrease incidence of catheter-associated thrombosis

• **Routine prophylaxis with anticoagulants** is NOT recommended

• **Routine use of thrombolytics** to prevent catheter occlusion – insufficient data

- 15 studies of CVAD with pharmacological DVT prophylaxis data divided into warfarin group, heparin group, and other thrombolytic group.

- Anticoagulant drug is a beneficial factor in decreasing the incidence rate of thrombosis of patients with CVADs (OR = 0.67, 95% CI: 0.48-0.93, Z = 2.41 (p = 0.02), I² = 57%, Tau² = 0.24, RE)
### Selection of access regarding indications

<table>
<thead>
<tr>
<th>Indication/planned treatment</th>
<th>Vascular access</th>
<th>Comments</th>
</tr>
</thead>
</table>
| CTh + fluids, medication, imaging | • Peripheral (initially),  
• PICC*,  
• Port | *increased risk of occlusion and DVT  
**increased risk of thrombosis due to larger diameter  
***Possibly „powered port” for CT, MRI, PET |
| CTh + long term PN | • Port,  
• tunneled catheter (PN)? + peripheral (CTh)?,  
• PICC,  
• Double lumen device** (port, PICC, tunneled catheter) | |
| CTh + frequent blood sampling/ blood products transfusion | • Port or PICC* (CTh) + peripheral (blood sampling/transfusion) | |
| CTh + frequent contrast studies | • Port or PICC (CTh) + peripheral (contrast)  
• Double (tripple) lumen device***(port, PICC) | |

CTh- chemotherapy, PN – parenteral nutrition, PICC- peripheraly inserted cental catheter, DVT – deep vein therombosis, CT – computed tomography, MRI – magnetic resonance imaging
Thank you for your attention