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Central Venous Catheters in Oncology

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Treatment of major cancers requires intravenous administration of chemotherapy or supportive treatment like blood transfusions, antibiotics, antifungals, intravenous fluids, and parenteral nutrition for many months. Repeated venipuncture is needed for same. It is one of the pain points for patients that if addressed well makes the whole journey of treatment more tolerable and less anxious. If you ask any medical oncologist, he will agree that central venous catheter (CVC) is the lifeline of chemotherapy patients. The rationale for CVC is that repeated venipuncture is associated with damage to the tunica intima of the veins and this repeated trauma is associated with thrombophlebitis and thrombosis; with the use of CVC, the trauma is reduced and the substances are instilled directly into the larger lumen veins with thicker walls.[1]

There are mainly four types of central venous devices:

1. Nontunneled CVC—Central lines and rigid dialysis catheters
2. Tunneled CVC—traditional tunneled catheter, tunneled dialysis catheter, Hickmann catheter, and hybrid triple lumen tunneled catheter
3. Implanted ports—Chemoports and arm ports
4. Peripherally inserted central catheter (PICC)

When a patient is planned for CVC, he should be evaluated for the level of care required, the duration of treatment, and the lifestyle of the patient for selecting the device. The position of the device can vary based on above consideration of the patient and his daily activity. If he wants to go to work while on treatment, subclavian line for CVC or an implanted port can be of help. Femoral line should be avoided as it has high chances of infections and hampers the daily activity of a person. Any history of previous CVC placed and any allergy to the device material or any pacemakers and automatic implantable cardioverter-defibrillators should be documented. Lastly, the type of infusions and drugs to be used should help us in selecting the CVC.

Indications

1. Prolonged infusion of multidrug chemotherapy such as R-EPOCH [Rituximab, Etoposide, Prednisolone, Oncovin, Cyclophosphamide, and Doxorubicin (Hydroxydaunorubicin)], FOLFOX (Flurouracil, Leucovorin, and Oxaliplatin), and TPF (Docetaxel, Flurouracil, and Cisplatin).
2. Prolonged infusion of vesicant drugs such as doxorubicin (Wilms tumor) and epirubicin (FEC 5-Flurouracil, Epirubicin, Cyclophosphamide)
3. In bone marrow transplant, for donor- collection of stem cells and for recipient- stem cell infusion.
4. Pediatric patients
5. Patients with difficult peripheral intravenous access [elderly, obese, post-Modified Radical Mastectomy (MRM)]

The indications of different type of devices differs as for PICC or nontunneled CVC that are required for continuous venous access compared with chemoport required intermittently but for a longer duration and have few chances of catheter-related infections.

Contraindications

1. Uncontrolled coagulopathy to be treated before the procedure can be undertaken or assistance with an ultrasound can help in such cases.
2. Bloodstream infections that should be treated first before inserting catheter but not an absolute contraindication.
3. Local site infection demands change in site.

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Types of CVCs

Peripherally Inserted Central Catheter

It was first demonstrated by Hoshal in 1975 for the administration of total parenteral nutrition to the patients with 61 cm long silicon catheter inserted through basilic vein to subclavian vein.[1] It is a long and flexible catheter that is inserted into a peripheral vein and reaches the central circulation.

Life Span of PICC Line Is Weeks to Months

- Sites: Common sites are basilic vein or cephalic vein but can be used in saphenous vein, temporal vein, or posterior auricular vein mainly used in pediatrics. Some PICC lines can be used with power injectors, used for administration of radiocontrast through the peripheral line.
- Maintenance of PICC line: Easy but requires weekly flushing and dressing.
- PICC line is compatible with blood products and total parenteral nutrition.
- Risk of infections: High chances of infections as the catheter is nontunneled.
- Cost: Cheap and easy to insert as compared with CVC.

Advantages

1. Minimal chances of damage to intrathoracic organs.
2. Easy and cheap way to get a venous access for weeks to months duration.
3. Can be used for instilling extreme osmolarity and pH fluids.
4. Can be used for intermittent blood sampling.
5. Easy to insert compared with conventional CVC.

Disadvantages

1. Slow flow rates and long length reduce chances of administration of blood products and nutrition therapy.
2. Cannot be used for resuscitation.
3. Requires weekly flushing and heparin lock for the prevention of occlusion.
4. Small pressure changes can cause malpositioning of the catheter tip or dislodgement.
5. It is associated with high chances of thrombosis.

Percutaneous Nontunneled CVC

Aubaniac described the cannulation of subclavian vein for venous access for the first time.[1] These catheters may be flexible or rigid and can be directly inserted into the central vein—subclavian or internal jugular. The catheters are conventional CVC and rigid or curved dialysis catheters used for venous access for resuscitation or hemodialysis.

- Life span: The dwell time of the catheter is usually lesser than the PICC but can be salvaged until there is an indication for removal of line.
- Sites: Subclavian and jugular veins are commonly used and subclavian is preferred over jugular vein.
- Maintenance is easy but requires weekly heparin flushing and dressing.
- High chances of infections with gram-negative organisms followed by Gram-positive organism.
- Costlier than PICC and maintenance is cheap and easy as PICC line.

Advantages

1. Can be used for resuscitation.
2. Faster infusions are possible.
3. Monitoring of the central venous pressure possible.
4. Can be used for total parenteral nutrition and blood products.

Disadvantages

1. Frequent flushing and assessment for patency required.
2. High chances of complications—pneumothorax, hemothorax, hematoma formation, arterial cannulation, arrythmias, and dislodgement of guide wire.
3. Catheter dislodgement.
4. Requires change in dressing biweekly to minimize infection at the exit site.

Tunneled Central Venous Catheter

A large bore catheter is inserted into the central circulation with a subcutaneous tunnel to exit away from venous access site. The catheter has a retention guff near the exit site to prevent the bacterial infection along the tract by causing inflammation in the area around the cuff. There are three types of tunneled catheters—traditional—Hickman or Broviac—dialysis catheters and hybrid tunneled catheters.

- Life span: Life span is very long (in months), much more than PICC and nontunneled catheter.
- Site: Subclavian and jugular veins are the most common sites.
- Managing these catheters requires weekly dressing and flushing, and protection of dislodgement.
- Chances of infection are low but high chances of tunnel site infections.
- Costlier than the PICC and nontunneled catheter and requires more expertise for insertion.

Implanted Ports

Implanted ports are CVCs with a reservoir and self-healing septum and the reservoir is placed subcutaneously in a pocket and the catheter is tunneled subcutaneously and reaches the central venous circulation. This port is ideal for patient who requires prolonged intermittent therapy without any daily access. The ports have different lumens and different reservoir characters to have a good flow and preventing thrombosis, and few ports are also provided with power injectors for pushing in radiocontrast for imaging purposes. Commonly these ports are placed in anterior chest wall, upper arm or thigh and use a special Huber needle for accessing the port that does not damage the diaphragm.

- Site: Most commonly into subclavian vein.
- Life span: 140 to 280 days[2] but can go up to years.
- Management: Management requires weekly flushing and requires a special Huber needle even for flushing.
- Chances of Infections: 10-times lesser chances of infection than the other type of CVC.

Advantages

1. Long dwell time for the catheter and can be used 3,000 to 5,000 times.
2. 10 times lesser chances of infections
3. Requires only monthly flushing or before usage.
4. Used for imaging requiring contrast with power injectors.
5. Patients can carry out daily activities like bathing without any problems.

Disadvantages

1. Port has to be surgically placed.
2. Higher cost of placement and managing the ports.
3. Complications are similar to other catheters like fracture, embolization, and thrombosis.

Complications of CVC

The complications associated with CVC can occur during the procedure or after the procedure. Complications at the time of procedure are as follows:

1. Injury to surrounding tissues—vessels, lung parenchyma causing hematomas, hemothorax and pneumothorax—requires chest tube placement.
2. Malpositioning of the catheter tip and repositioning under image guidance can help to correct.
3. Cardiac arrythmias can be stopped by pulling out the line.
4. Air embolism rarely.

Complications postprocedure are as follows:

1. Catheter fracture.
2. Catheter occlusion and thrombosis.
3. Catheter related infections—Central line-associated bloodstream infections and catheter-related bloodstream infections (CRBSI).

Management of catheter-related infections—A CVC infection is any infection that is related to the catheter, may be local (at the insertion site) and systemic (bloodstream), and have been proven by positive blood cultures results.[3] A CRBSI is a bloodstream infection that is due to entry of bacteria into the blood through the CVC. These CVC infections are associated with a mortality rate of 12 to 25% in the United States. The different types of catheters are associated with different rates of infections, but the maximum chances are associated with nontunneled CVC. The risk factors for CRBSI include age, disease, the type of catheter, number of days the catheter was accessed, performance status of patient, and administration of parenteral nutrition. Among the diseases in oncology, hematological disorders cause the maximum risk. CRBSIs occur in 3 to 16% of the catheterizations.

Most common infections in CVC are caused by nosocomial bacteria that most commonly are Gram-positive (60%) and Gram-negative (25%) followed by fungi (10%).[3]

Diagnosis of CRBSI is made with the help of paired blood cultures (7–10 mL each) from the catheter and one from peripheral line, and then checking of differential time to positivity—which should be 2 hours earlier for catheter, or if the colony count is >3 times, then the peripheral line sample. The sensitivity and specificity of this method are 85 and 91%, respectively.

Treatment of CRBSI depends on the dwell time and the type of catheter used. Patients are started on antibiotics empirically after sending paired cultures and then changing to specific drugs depending upon the organism and the sensitivity to antibiotic. Average duration of treatment is 10 to 14 days.

Indications for Removal of CVC

1. Sepsis with septic shock.
2. Port abscess.
3. Catheter fracture.
4. Tunnel infection and infective endocarditis.
5. Septic thrombophlebitis.
6. BSI (Blood stream Infection) if persists after 48 to 72 hours of antibiotics for *Staphylococcus aureus*, *Mycobacterium* and fungi—Candidiasis.

Prevention of CVC Infections

1. Education of health-care personnel involved in insertion and handling of CVC.
2. Use of maximal sterile precautions.
3. Weekly flushing and dressing under aseptic conditions.
4. Avoiding handling of CVC unnecessarily.
5. Use of CVC imbedded with antibiotics or antiseptic agents to prevent CRBSI in short-term catheters.
6. Antibiotic locks.[3]

Salvage of CVC: In cases of CRBSIs, there are chances that we can salvage the line with the use of antibiotic lock therapy (ALT). The successful catheter salvage rates go up to 77% with lock therapy. ALT is defined as administration of antibiotic in the CVC in very high dose that is usually more than 100 to 1000 times higher than minimum inhibitory concentration value to achieve a concentration sufficient to kill the pathogen in biofilm. The antibiotic is usually given with anticoagulant that may be either heparin or ethylenediaminetetraacetic acid, which is locked in the catheter when not in used. This ALT can be used for both therapeutic purposes and prevention of CRBSI. When peripheral cultures are negative and no sign of exit site infection and culture from CVC is positive for coagulase negative *Staphylococcus* or Gram-negative bacteria, ALT cane be used for treatment. The dwell time for the antibiotic will be minimum of 12 hours. Otherwise, it can be used in combination with systemic antibiotics.

Conflict of Interest
None.

References

1 Khan U, Hazard HW, Central venous access device. In: Abraham J, Gulley JL, Allegra CJ, eds. The Bethesda Handbook of Clinical Oncology. 4th edition. Philadelphia: Wolter Kluwer Health; 2014; 534–542
2 Babu KG, Suresh Babu MC, Lokanatha D, Bhat GR. Outcomes, cost comparison, and patient satisfaction during long-term central venous access in cancer patients: Experience from a Tertiary Care Cancer Institute in South India. Indian J Med Paediatr Oncol 2016;37(4):232–238
3 Sousa B, Furlanetto J, Hutka M, et al. ESMO Guidelines Committee. Central venous access in oncology: ESMO Clinical Practice Guidelines. Ann Oncol 2015;26(Suppl 5):v152–v168

