

## **PRESERVING VESSEL HEALTH: A REVIEW OF VASCULAR ACCESS DEVICES AND STRATEGIES**

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**ABSTRACT:** Vascular Access is an essential procedure for intravenous therapy, which helps to give intravenous fluids, intravenous drugs, total parenteral nutrition, contrast injections for diagnostic purposes, etc... "Vascular access is a Boon for medicine world but has Bane in the name of Complications". Different types of vascular access devices are available and chosen according to the patient's clinical conditions and therapeutic needs. Vascular access devices include Short peripheral or peripheral intravenous catheters, Long peripheral catheters, Central venous catheters, Midline catheters, Dialysis catheters, and implanted ports. This review shares the insights of previous research carried out by researchers from different countries and provides valuable feedback on the best practices of vascular access devices and their usage by current healthcare professionals. This review can help clinicians to enhance patient outcomes in vascular access

**KEYWORDS:** Vascular access, vessel health, Clinical practice, healthcare, vascular access devices.

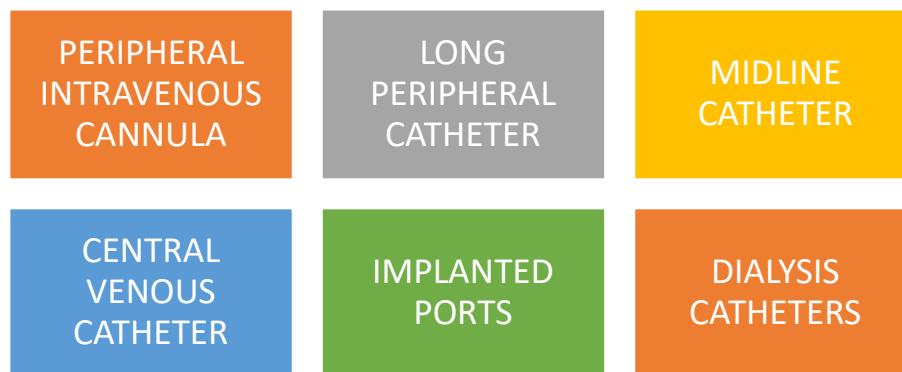
### **INTRODUCTION**

Vascular access plays an important role in healthcare services, which helps healthcare workers to deliver medications such as antibiotics, vasopressors, analgesics, etc., and intravenous fluids like normal saline, dextrose, Ringer lactate (RL), Dextrose Normal Saline (DNS), etc... directly into the bloodstream with vascular access device usage and helps in diagnostic

procedures like contrast injection and therapeutic interventions. Various vascular access devices are available, short peripheral or peripheral intravenous cannula, long peripheral catheters, central venous catheters, midline catheters, implanted ports, and dialysis catheters. These catheters are a boon to healthcare society in drugs and fluid management but there is a bane in the name of complications. Pain, Swelling, Thrombophlebitis, infiltration, extravasation, and catheter-related bloodstream infection (CRBI) are complications faced in the current clinical practice. These complications lead to vascular access device failure causing repeated cannulation and compromising vessel health.

Clinicians may face difficulties in finding a vein and selecting and securing a Suitable vascular access device for a patient’s treatment plan. Maintaining the patency of such devices (VAD’s) is very challenging for healthcare workers. This narrative review will emphasize the proper device selection criteria, managing difficult intravenous access, insertion techniques, aseptic precautions, evidence-based practices that enrich vessel health, and emerging trends in vascular access. It will also focus on healthcare systems the improvement in vascular access and improving outcomes of the patient.

### VASCULAR ACCESS DEVICES USED IN CURRENT CLINICAL PRACTICE

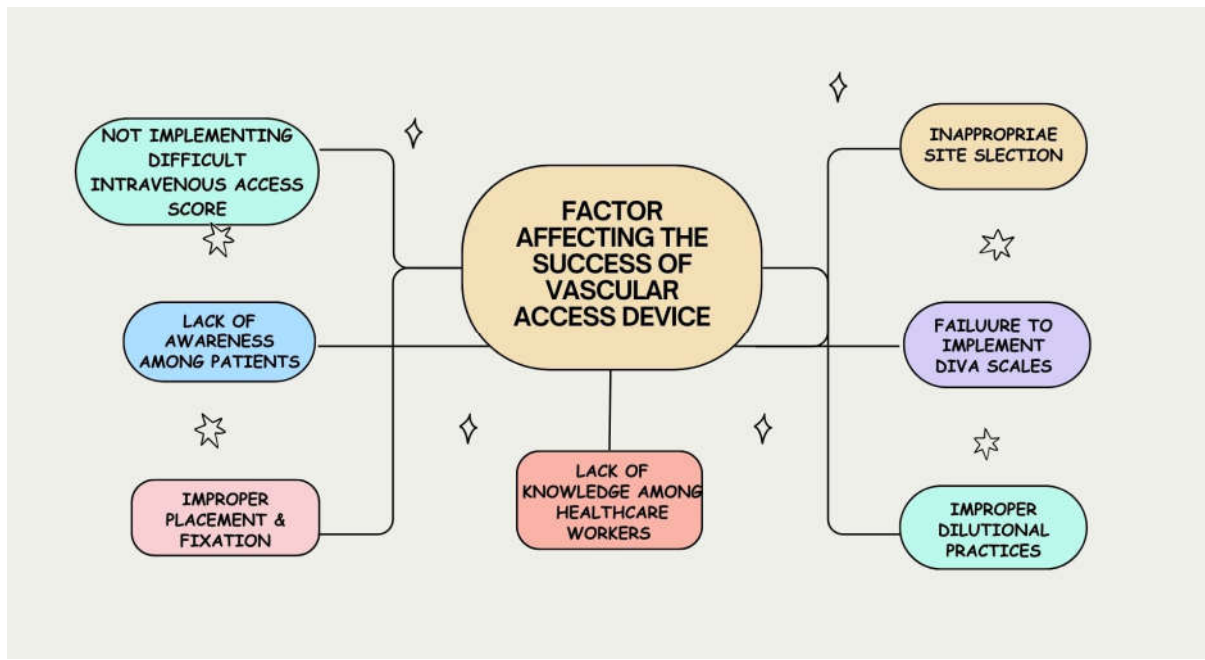


### METHODS:

The literature on preserving vascular access was reviewed using PubMed with the search terms: ((Vascular access) AND (vascular access devices)) AND (complications) AND (Difficult intravenous access) and related keywords. The search covered a date range from 1988 to 2024, yielding approximately 3285 articles. Of these, 2287 articles have been listed due to a review current practice (2015 to 2024) were selected for detailed review. Abstracts were screened for relevance to the topic, and additional articles referenced within the selected studies were also considered for inclusion. The review prioritized articles focusing on vascular access,

particularly those discussing vascular access techniques, associated complications, and the latest advancements in managing difficult access. Special attention was given to recent technologies designed to assist with challenging intravenous access and to techniques and medications aimed at reducing pain and anxiety during IV-line placement

**FACTOR AFFECTING THE SUCCESS OF VASCULAR ACCESS DEVICE:**



**MEASURES TAKEN TO IMPROVE THE SUCCESS RATE:**

Despite advancement, peripheral catheter failure rates from 35 to 45%.<sup>(1)</sup> Even though following many guidelines, proper insertion techniques, and maintenance techniques, many complications and catheter failures are faced in the current clinical practice.

1. A clinical instrument called the DIVA score (Difficult Intravenous Access score) is used to anticipate how difficult it will be for patients to establish IV access, especially in emergency and critical care settings. It evaluates vein palpability, visibility, history of challenging IV access, and patient age. Every component has a point value, and the sum of the scores shows the probability of unsuccessful efforts; larger scores imply more difficulty. To minimize patient suffering and increase the success rate of vascular access, this score assists doctors in making the right plans, such as utilizing sophisticated strategies like ultrasound guidance or enlisting expert IV teams. <sup>(10)</sup>

2. Choosing catheters based on the patient's indication is most important. LPC will be appropriate when Intravenous treatment of antibiotics and hydration therapy lasts for 5 days to 4 weeks 1, whereas PICC is preferred for long-term therapies such as chemotherapy, and parenteral nutrition lasting from weeks to months (2). LPC and PICC can be initiated when regular PIVC catheter insertion is challenging or fails 2. It is a safer, less invasive, and a good replacement for central venous catheters with 5-9 pH and <600 mOsm/L osmolarity 3, whereas highly vesicant medications and concentrated solutions with extreme pH <5 or >9 PICC insertion can be done 1. It can be initiated to reduce frequent venipunctures where repeated blood draws or infusions were indicated 4. To avoid peripheral vein damage and vascular impairment Central Venous Cannulations are done (5). It is also used to monitor central venous pressure (6). It can withstand the high flow rates for hemodialysis and plasmapheresis (7).
3. Using the proper vein selection steps is important such as Collecting the proper history to reveal whether the patient has difficulty in IV access. Nowadays, many portable vein finders are available in the market and also Ultrasound can be used for vein selection.<sup>(9)</sup> To help healthcare professionals maintain best practices in vascular access evaluation, device selection, and patient safety, the 2020 UK VHP framework incorporates the most recent evidence-based research and guidelines.<sup>(10)</sup>
4. The catheter's dwell duration is prolonged and lowers the risk of problems, the use of transparent film dressings for peripheral intravenous catheter placement can be advised.<sup>(11)</sup>
5. Proper flushing of the IV lines is essential to maintain its patency
6. Using proper drug dilutional practices is most important to maintain vessel health. Antibiotics, vasoactive drugs, and vesicant drugs may cause injury to the vessel; hence, adhering to proper dilutional guidelines is most important.
7. Inspecting the lines regularly using a Visual Infusion Phlebitis (VIP) score is the most important.
8. Educating patients regarding vascular access is most important.
9. Regular training for the staff nurses may reduce complications for patients with vascular access and improve the standard of nursing care.<sup>(12)</sup>

## **COMPLICATIONS AND ITS MANAGEMENT**

### **PHLEBITIS:**

Phlebitis is an inflammation of the venous wall that can make the area around the catheter red, painful, heated, or swollen. Localized discomfort, redness, edema, and a palpable venous cord are symptoms of phlebitis. There are four categories of factors that contribute to the development of phlebitis. Primary categories, including mechanical variables (catheter material, size, and cannulation time); chemical factors (drugs and fluids); patient factors (age, gender, and underlying diseases); and health professional practices.<sup>(13)</sup> Regular monitoring, maintaining sterility, and educating patients regarding the signs are required.<sup>(14)</sup> Applying heat or cold compression, pain medications, external compressions, and anti-inflammatory drugs can be considered for the management of phlebitis.

### **OCCLUSION**

When a blockage occurs in the catheter is occlusion. It may be caused due to mechanical obstruction such as compression or the formation of a thrombus. Regular flushing prevents occlusion. Anticoagulants can be used as a preventive measure. Thrombolytic agents can be administered to remove the blockage.

### **DISLODGEEMENT**

Dislodgement occurs when a catheter is inadvertently taken out. This may occur due to the patient's movement, improper securement of the device, or loose dressing. Raising awareness and educating people about unintentional IV catheter dislodgement and the many strategies to lower its frequency in clinical settings would enhance patient safety and perhaps result in significant cost savings.<sup>(15)</sup>

### **INFILTRATION & EXTRAVASATION**

When the fluid leaks out from the vessel and oozes out to the surrounding tissue, it is called extravasation.<sup>(16)</sup> when it is a non-vesicant solution or medication, it is called infiltration; when it is a vesicant medication, it is called extravasation<sup>(17)</sup>. Both infiltration and extravasation can have serious consequences. The causes are Patient activity, an unstable catheter, inadequate needle securing, and clot development above the cannula<sup>(18)</sup>. Early identification and management are most important to prevent tissue damage; stop the infusion, aspirate the drug,

and remove the cannula as soon as possible<sup>(15)</sup>. Sometimes it may require surgical intervention as a treatment.

### **OTHER COMPLICATIONS:**

When a harmful microbe develops inside or close to the catheter infection occurs. Antibiotic administration of the infection will be required to treat the cause Hypersensitivity responses are very rare, and may be a severe, instantaneous, and possibly fatal reaction. When a lot of air gets into the vein through the IV, air embolism can occur. Accidental catheter injections into arteries might result in limb loss or arterial spasms.

### **CONCLUSION**

This narrative review shares the existing practices of vascular access, Adequate knowledge and skills among healthcare workers with following the adherence to the proper guidelines to their local policies can improve vascular access and enhance patient outcomes, more clinical research is needed for each type of vascular access device to enhance vessel health preservation.

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The author declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### **Ethical approval**

There is no ethical issue

### **Authors Contribution**

Conceptualization and Data Curation: Hemanth Kumar V R and Alfairose J

Writing – original draft: Alfairose J

Writing Reviews & Editing: Hemanth Kumar V R, Charulatha Ravindran

All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript

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