PERIPHERAL VENOUS ACCESS: DIFFICULTIES AND LATEST TECHNOLOGIES FOR VEIN VISUALIZATION

Arun Unnikrishnan - Asst.Professor, Panna Dhai Maa Subharti Nursing College, Meerut, India.
Email - arunukpknm@gmail.com

Introduction:

Peripheral venous access in infants and children is technically challenging. Not only in children but also in adults veins may be difficult to locate in some cases. Peripheral venous access is usually required for administration of fluids or medications in hospitalized patients. Even for experts, peripheral venipuncture in infants and adolescents is difficult because of small and deeply-located veins. Several devices adjunct to vein identification and catheter insertion have been devised in the attempt to optimize peripheral catheterization.

Difficulties in venous access:

Difficult Venous Access (DVA) is a clinical condition that is yet to be properly defined and no severity grading system has been developed to allow for comparative research. Many factors contribute to DVA.
Peripheral venous access in infants and children is difficult because their veins are small and located deep in subcutaneous tissue, which makes them difficult to palpate or visualize and an inability to cooperate.
A patient's level of hydration and perfusion certainly affect the ability to access their veins. A prior traumatic venipuncture or indwelling catheter could cause vessels to thrombose, leading to a reduction or even absence of the visible or palpable veins for the future. The condition is dynamic, in that some vessels can re-cannulate with time though they may not be the original size. If the patient is obese, normal cues are usually absent making venous access extremely difficult. The patients who have recurrent health problems which bring them back to the hospital for repeated access will also be a difficult case.

Problems related to difficult venous access:

The goal of every good clinician/nurse is to provide the best care possible. DVA frustrates this goal by delaying needed therapies and inflicting additional suffering on a patient already in need. Multiple attempts mean multiple needles will be used. This increases the risk to the health care provider of a needle stick injury. Failure to gain peripheral access may necessitate placement of a central venous catheter (CVC). Being a DVA patient means enduring the pain of multiple needle sticks.
In the majority of instances, staff nurses are required to initiate intravenous therapy on their assigned patients. As a result, there exists a shortage of practitioners that have the skills and the experience developed by repetition to properly manage the access needs of the patient population. Making matters worse in the current healthcare demographic is the ongoing nursing shortage.
The costs that are associated with missed attempts are a major concern to healthcare facilities.
Another cost that arises from poor venous access is associated with the need for central line placement and maintenance. In many instances, particularly in critical care areas, central venous catheters are placed in patients because of the inability to access a peripheral vein.

Research studies related to difficult venous access:

One of the most challenging aspects of obtaining venous access is to be successful on the first attempt. There have been numerous studies performed over the years attempting to improve the efficiency of gaining venous access. Most of these studies provide the average number of sticks required to gain access.
In a 2005 study designed to address deficits in the process of obtaining IV access, the average number of attempts to gain access was 2.4. The number of penetrations in this study ranged from 1 to at least 14.

In another study performed at a Medical Center in the U.S., the average attempts needed to gain intravenous access was 2.9. When dealing with pediatric patients, the numbers are much more disturbing. In a pediatric study performed in 2005, the average number of attempts to obtain access was documented at 6. The discomfort alone suffered by these patients is enough to demonstrate a need for either improved skill or more efficient methods. Reducing the number of attempts would ultimately result in a reduction in pain.

The Infusion Nurses Society (INS) has set the standard for obtaining intravenous access in the United States. The 2006 INS Standards of Practice includes many procedures that are proven in a clinical setting. Standard states that a nurse attempts a maximum of two (2) peripheral attempts per patient. If those attempts conclude in failure to access the vein, the nurse should stop and call on a second nurse to make an attempt. The averages point to the fact that 2 attempts is not normally enough to gain access, therefore more than 1 practitioner is usually necessary to gain intravenous access. The failure to obtain venous access on the first attempt can also result in delayed treatment in approximately 25% of patients. The results of this scenario could be realized in further complications and longer hospital stays.

Modern Technological solutions:

Several technologies have been introduced but only two have seriously dealt with improving vessel visualization. They are ultrasound and a reflective near infra-red technology.

Ultrasound uses a hand held transducer to bounce sound waves into the tissue and takes advantage of differing reflective signatures of tissues to distinguish vessels from other. With Ultrasound, one makes a fan shaped image of the tissue below. This technology has had a big impact in improving central venous access by visualizing the needle as it enters the major vessels in the neck or elsewhere. Unfortunately for peripheral access, current Ultrasound technology has five major disadvantages.

First, with more superficial vessels, it is difficult to see when the needle tip is actually entering the vessel because of a shadowing effect while trying to get the point of insertion and visualization in the same plane. Second, the view one sees is very two dimensional, so unless one follows out the course of the vessel and can remember the pattern, one cannot be confident of the course of the vessel down stream, making successful cannulation more difficult. Third, most machines require the operator to hold the transducer in one hand while inserting with the other, which can be rather awkward. Fourth, if one is attempting the insertion under sterile conditions, a sterile sleeve would also be needed. This is an added expense and would certainly drive up the cost of insertion. Lastly, the residual gel necessary for ultrasound image quality may interfere with the strength of the catheter securement, requiring extra time to clean the site. Otherwise, there may be a risk of premature loss of the catheter due to the oily surface.

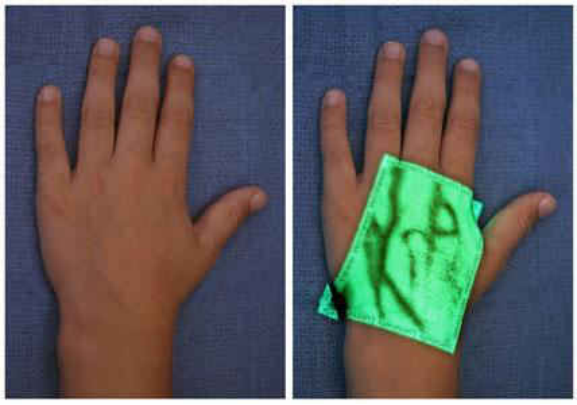
VeinViewer, a reflective, near-infrared technology, is a more recent medical innovation that has solved the problems associated with using ultrasound for peripheral access.

(Vein viewer-device)

VeinViewer technology was introduced in 2006. VeinViewer uses near-infrared light coupled with advanced technologies to display an image of superficial vasculature directly onto a patient's skin. This

patented technology is the first and only device that projects the image of one's vasculature in exactly the same anatomical location as the vasculature itself. This image takes the "guesswork" out of finding veins and gives the clinician a "roadmap" from which to work in a way that is more efficient in gaining intravenous access. The projected image is placed on its three dimensional context (skin of patient) making it very easy to see where the vessels are going With no transducer to hold, it frees up both of the clinician's hands to deal with venous access. The resulting improved peripheral vascular access provides numerous benefits to both patients and healthcare workers.

VeinViewer Technology: VeinViewer by Christie Medical Holdings harnesses the abilities of near-infrared light and other various patented technologies to illuminate subcutaneous vasculature. The science behind the device itself consists of 4 specific functions. The infrared light source emits a harmless, near-infrared light (NIR) that is reflected back from tissues that surround the hemoglobin in the blood. The blood itself does not reflect the light source, therefore only the surrounding tissue creates an image. This image is then captured by a digital video camera located in the head of the VeinViewer unit. The image is processed by an image processing unit located in the base of the VeinViewer device. Once processed, a green LED is used to add contrast to the image and DLP (Digital Light Processing) technology is utilized to project that image back onto the surface of the skin in real-time. This "green" image is placed back onto the skin at exactly the same anatomical location of the subcutaneous vasculature just below the skin.



(Prior) **(After)**

Research studies about vein viewer:

VeinViewer can be utilized in a number of different clinical areas. The primary purpose of VeinViewer is to locate veins for phlebotomy and/or IV access.

A randomized study in a large outpatient clinic was performed in 2006 attempting to validate the presence of a vascular bed beneath the surface image projected by VeinViewer. VeinViewer was utilized to project a vascular image on 100 patients; this image was then verified with the SonoSite "i-Look" Ultrasound Unit. After the VeinViewer image was "mapped", the ultrasound was positioned in the exact same location. The SonoSite "i-Look" Ultrasound unit confirmed both the accuracy and reliability of the projected VeinViewer image in every instance. The superficial vascular bed was verified with 100% accuracy.

In another study performed in early 2005, VeinViewer was tested for efficacy in patients with "known" difficult-to-find and difficult-to access veins. Thirty patients, previously screened and rejected as blood donors, were chosen for clinical evaluation to determine the effectiveness of VeinViewer to locate veins for access. Over a 20 day period, each of the patients were re-screened and imaged with VeinViewer in order to locate a viable vein and attempt venous access of that vein for blood collection. VeinViewer was 100% successful in locating a viable vein for access in each patient. In addition to successfully locating a vein in every instance, the blood center staff members had a 100% blood collection success rate with these same patients that had previously been rejected as donors due to difficult venous access. Incidentally, the greatest finding of this study was the fact that only one stick was required for venous access in all 30 patients. Given the current national average of anywhere from 2.4 to 6 sticks per IV access, this result is quite impressive.

Conclusion:

The latest technology of vein viewer has proven to be helpful in gaining venous access during the first attempt. In the current environment of healthcare facilities attempting to increase revenues while decreasing unnecessary costs, VeinViewer is an extremely favorable option. Aside from the associated cost savings, there is not a price that can be placed on increased patient satisfaction.

Reference:

1. Bauchner H et.al. Randomized control trial venipuncture. Journal of Paediatrics. 2004; May: 119(5):e 1184-98.
2. Min Joung Kim. et.al; Efficacy of VeinViewer in pediatric peripheral intravenous access: a randomized controlled trial; European Journal of pediatrics; Volume 173 / 2012. link.springer.com/journal
3. Innovation in Vascular Access:Near-Infrared Technology Revolutionizes Visualization of Blood Vessels.
   Web site: http//:www.veinviewer.com