

To assess the efficacy of a vein visualizing device in patients at risk of difficult phlebotomy

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Abstract:

Objectives: Identification and comparison of vein cannulation sites with the conventional method (CM) with the new infrared vein visualizing (VV) device in the upper extremity of 3 groups of subjects: obese, children and patients requiring frequent intravenous cannulation.

Materials and Methods: The veins were counted by CM and VV in the same subject by the phlebotomist. A total of 100 subjects were recruited.

Results: Medians of counts of veins suitable for phlebotomy were compared in the 3 groups. There was a marked increase in the number of veins visualized by the VV method ($p < 0.001$).

Conclusions: The procedure of phlebotomy can be made easier, with better results in the first attempt, helping in the preservation of the veins, reducing the pain of the patient thereby minimizing pre-analytical errors in diagnostic tests.

Key Word: obese, children, hospitalized, frequent IV, vein finder.

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I. Introduction

Vein finding and venipuncture are important procedures, in medical care by aiding in diagnosis and treatment. Even a skilled medical staff, has difficulty in finding the vein for infants, children, obese, anemic and dark skinned patients¹ with an overall success of 77%². To overcome this difficulty in vein finding, many devices have been invented which help in better visualization of veins. These instruments are harmless, which uses near infrared or laser lights to show the veins on the surface of the skin of the patient, to the health care provider so that phlebotomy becomes an easy procedure³.

In the recent past many vein finding devices have been developed. They use the near infrared light-emitting diodes (NIR-LED) to visualize superficial veins. The principle of its working is that the hemoglobin (in the red cells in the veins) absorb of the light emitted, forming a dark image on the skin surface⁴. In conventional practice, to enhance the visibility of vein, a tourniquet is tied, the vein is tapped and the patient is asked to clench his/her fist. All these causes physiological disturbance on veins which in turn cause significant variability in several laboratory test results⁵. Vein visualizers (VV) help in the reduction of pre analytical error, by prevention of hemolysis of the blood sample, as it helps in finding the best vein to be punctured for drawing blood⁶. The pre analytical error in the laboratory results, which contributes to the maximum of 61.55% of error percentage, affecting the diagnosis and treatment process⁴.

Repeated attempts of phlebotomy are painful and expensive². It can also cause swelling, hematoma, extravasation, thrombophlebitis and nerve injury leading to 'causalgia'⁷⁻⁹. We conducted this study to assess the efficacy of the vein visualizer device as compared to conventional method (CM) of naked eye visualization of veins in our in-patients and out-patients department on the difficult for phlebotomy group.

II. Material And Methods

Study design:

It was a prospective study conducted on volunteer subjects attending Out-patients department and admitted in medicine and oncology wards who required frequent intravenous (IV) cannulation. After the approval of the Institutional Ethical Committee, the study was carried out with informed consent of patients and phlebotomists.

Study Setting and Population:

100 participants were included among which were 34 adult obese patients, 40 were children, and 26 hospitalized patients. Study participants included males and females of all ages, irrespective of race or ethnicity. This was conducted in a government tertiary care hospital and academic institution in Eastern India.

Study Protocol:

We used a vein visualizer AV400 from AccuVein Inc, New York, USA, which uses two safe barcode-scanner class lasers: an invisible infrared and a visible red. The two lasers work in tandem to provide a real-time image

of the subcutaneous vasculature up to 10 mm deep. First, the hemoglobin in the blood absorbs the infrared light, so there is a reduced amount of light reflection from the veins. Then, a custom detection system uses this change in reflection to determine vein location and pattern, which it digitally projects on the surface of the skin. Lastly, the red laser makes the vein mapping visible to the clinician. The result is a visual projection that has centerline accuracy of less than the width of a human hair¹⁰.

Measures:

The 3 groups of subjects in our study were obese, children and patients requiring frequent IV cannulations. In those patients who gave consent, we asked the phlebotomist to count the number veins which can be used for venipuncture by conventional method of applying tourniquet in the upper arm. Then using the AccuVein AV400, the same personnel was asked to count the veins suitable for phlebotomy.

Inclusion criteria:

1. Subjects willing to participate
2. Either sex
3. All age groups

Exclusion criteria:

1. Pregnant women;
2. Patients with anatomical anomalies or genetic disorders
3. Patients on wheelchair or who were unresponsive to verbal commands.
4. Patients who were physically inactive.

Data Analysis:

The total counts of veins were noted and compiled for statistical analysis.

Statistical analysis

Statistical analysis was done using Wilcoxon signed rank test, within the three groups of subjects. SPSS 19.0 was used for the same.

III. Result

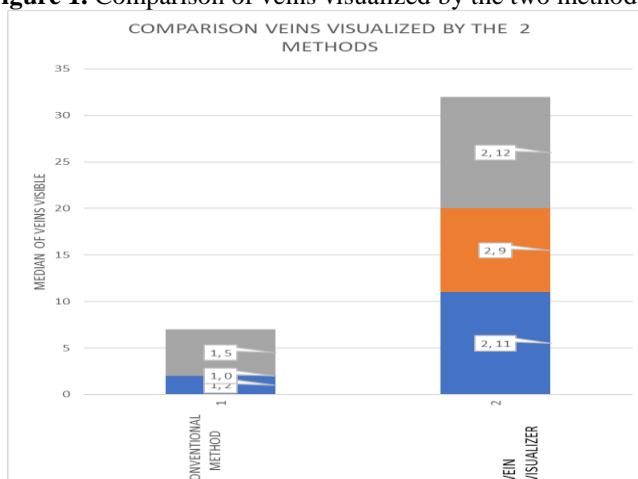
Statistical analysis by Wilcoxon signed rank test, between the three groups of patients: in children, obese, and in hospitalized patients, revealed significant p value of <0.0001 (Table 1). This proves that the vein visualizer, helps the phlebotomist in locating the veins, and that it is better than conventional method.

Table 1: Comparison of veins suitable for phlebotomy by the two methods.

Group	Method	Median	Minimum value	Maximum value	p
Obese n=34	CM	2	1	7	<0.0001
	VV	11	10	16	
Children n=40	CM	0	0	10	<0.0001
	VV	9	5	18	
In patients- frequent I.V n=26	CM	5	3	14	<0.0001
	VV	12	9	26	

CM= conventional method; VV= vein visualizer.

Figure 1. Comparison of veins visualized by the two methods.



IV. Discussion

Phlebotomy, which is a painful, invasive procedure is aided by the instrument vein visualizer, helping to find veins and making the phlebotomy successful in the first attempt, and reducing the pain of the patient, thereby improving the health care provided to the patients. Along with the training of unskilled personnel, these challenges can be overcome with the help of vein finder or vein visualizers which help in easy detection of veins and reduces the number of attempts in cannulation of veins.

Study done by Sebbane et al., 2012, has documented that obesity is an independent risk factor for difficult peripheral venous access¹¹. Chiaoreported that the possible cannulation site with the use of a vein finder device had better results with 9.1 (95% CI 8.6–9.5) compared with the conventional method with 5.8 (95% CI 5.4–6.2) under different patient characteristics¹².

Study done by Phipps et al (2012) showed that in neonates, successful first attempt for peripherally inserted central catheter, was better done with the vein finder which showed success rate of 64% than for standard technique (visualization or palpation) with success rate of 59% only¹³. In young children, despite the high level of skill and dedication of physicians, multiple attempts are often unavoidable, which can be traumatic for the children requiring a blind puncture or sometimes need general anaesthesia¹⁴.

Though some studies have revealed that there is no significant improvement in phlebotomy using the device^{15, 16}, there are more studies in favour of the device. Considering the factors stated above, it significantly increases the first-attempt success rate in vein puncture. Hence, the use of vein visualizers is recommendable.

Limitations: Vein visualizers help in vein finding and accurate vein puncture, but many cannot afford it due to its high cost. Though we counted the veins by both methods we did the phlebotomy using VV in all subjects which were all successful in first attempt. Hence, we could not compare the phlebotomy attempts, time taken and patient satisfaction by the CM.

V. Conclusion

The method of finding the veins with the help of vein visualizer is easy. The procedure of phlebotomy is modernized, made easier, with better results in the first attempt, helping in the preservation of the veins, reducing the suffering of the patient. Cost of the instrument, should be made low, for better utilisation of the instrument at all levels of health care, helping the health care providers as well as the patient in reducing the stress and pain.

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