Original Article

Effects of LED Light on Peads Patients

Usefulness of Light-Emitting Diode (LED) Light in Transilluminating Superficial Venous System for Peripheral Venous Access in Paediatric Patients

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ABSTRACT

Objective: To study the utility and efficacy of LED light in venipuncture in pediatric patients,
Study Design: Experimental study.
Place and Duration of Study: The study was conducted at Shahina Jamil Teaching Hospital, Abbottabad from January to December 2016,
Materials and Methods: All pediatric patients between the ages of one to six months, requiring venous access and hemodynamically stable were included in the study. All those patients who were more than six months of age, or hemodynamically unstable or critically ill were excluded from the study. There were 140 study participants who were divided randomly into two groups. First group received venipuncture using light emitting diode (LED) device and the second group received venipuncture using conventional method and without LED. Primary endpoints were the number of attempts and time taken till successful venipuncture.
Results: There were 140 patients in our study with 70 patients in each group. There was a male preponderance in both groups. The venipuncture success rate was higher in LED group where 57.1% were successfully performed on first attempt as compared to conventional group where the success rate at first attempt was 21.4%. Similarly, the failure rate was quite low, (5.7%), in LED group as compared to conventional group where the failure rate was 27.1%. Most of the venipunctures, (54.3%), were performed in less than two minutes in LED group while only 8.6% took more than three minutes. Conversely, 44.3% of cannulation took more than three minutes while only 20% could be performed in less than two minutes in conventional group.
Conclusion: LED light provides an inexpensive yet very convenient and efficacious adjunct to conventional method of venipuncture in pediatric patients. This results in improved success rates and offers a cheap alternative to more expensive options available like near-infrared spectroscopy, especially in developing countries.
Key Words: Light-emitting diode (LED), venipuncture, venous access

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INTRODUCTION

Venipuncture is an important clinical procedure which is required to gain and secure intravenous access. The prevalence of this procedure is as high as 80% among in-patients based on the condition of a patient and the locality of health facility.[1,2] Rapid and successful venous access is of paramount importance for the safety and treatment of patients .i.e. to administer fluids, drugs or anesthesia and in cases of emergency.[3]

But, this is not routinely a case especially in pediatric patients where it is often difficult to gain venous access as well as the procedure is painful.[3] It usually takes between 02-10 attempts to secure venous access successfully.[4] Lack of care and adequate skills or clinical conditions with poor peripheral venous access are some of the reasons for these multiple attempts.[1,5,6] Excessive venipunctures are painful and time and resource consuming. Therefore, it is of paramount importance to develop ways to improve its success rate.[2] Different approaches have been used to improve the success of venipunctures. These approaches include: i) - use of chemicals to aid conventional way of venipuncture, but, this strategy is inappropriate for children and unsuccessful in dark-skinned people, ii) - ultrasound guided procedures, but they are expensive and resource consuming as they need extra trained personnel and dedicated and costly equipment, iii) - visualization of veins using "near infrared (NIR) spectroscopy", but this is a very expensive and hence, infeasible option for developing countries, and iv) - use of secondary lights e.g. light emitting diode (LED) to

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visualize veins in a darkened room to transilluminate the venous system.[7] As these light sources are cheap, they can provide a viable alternative to assist in pediatric venipuncture especially in developing countries. Therefore, we have conducted this study to determine the utility and efficacy of LED light in venipuncture in pediatric patients as compared to the conventional methods of venipuncture.

MATERIALS AND METHODS

This was an experimental study was conducted in Shahina Jamil teaching hospital, Abbottabad, Pakistan, from January to December 2016. All pediatric patients between the ages of one to six months, requiring venous access and hemodynamically stable were included in the study. All those patients who were more than six months of age, or hemodynamically unstable or critically ill were excluded from the study. There were 140 study participants and they were randomly divided into two groups. One group received venipuncture using LED device and the other group received venipuncture using conventional method and without LED. Primary endpoints were the number of attempts and time taken till successful venipuncture. Braun (gauge 24) cannula was used for venipuncture while the selection of hand (either right or left) to be cannulated was random. All data was entered, organized and analyzed using SPSS (version 20). P-value of less than 0.05 was considered significant.

RESULTS

A total of 140 patients were enrolled in the study with 70 patients in each group. There was a male preponderance in both groups. The venipuncture success rate was higher in LED group where 57.1% were successfully done on first attempt as compared to conventional group where the success rate at first attempt was 21.4%. Similarly, the failure rate was quite low, (5.7%), in LED group as compared to conventional group where the failure rate was 27.1%. Most of the venipuncture, (54.3%), took less than two minutes in LED group while only 8.6% took more than three minutes. Conversely, 44.3% of cannulation took more than three minutes while only 20% could be performed in less than two minutes in conventional group, (Table 1).

The result shows that the venous cannulation using LED light is more successful and less time consuming as compared to the conventional method, especially in over weight subjects, (Table 2).

Figure No.1. LED light used in the study to transilluminate the superficial veins

Table 1– Demographics and Comparison among attempts or cannulation time with and without an LED light

Characteristics		LED Used n (%)	LED Not Used n (%)	Total n (%)	P value
Gender	Male	39 (55.7)	40 (57.1)	79 (56.4)	
	Female	31 (44.3)	30 (42.9)	61 (43.6)	
Hand	Right	33 (47.1)	37 (52.9)	70 (50)	
	Left	37 (52.9)	33 (47.1)	70 (50)	
Weight	3.6 - 5 kg	16 (22.9)	19 (27.1)	35 (25)	
	5.1 - 6.5 kg	23 (32.9)	21 (30)	44 (31.4)	
	6.6 - 8 kg	31 (44.3)	30 (42.9)	61 (43.6)	
Attempts	One attempt	40 (57.1)	15 (21.4)	55 (39.3)	
	Two attempts	26 (37.1)	36 (51.4)	62 (44.3)	0.000*
	Failed	4 (5.7)	19 (27.1)	23 (16.4)	
Cannulation Time	Under 2 minutes	38 (54.3)	14 (20)	52 (37.1)	
	2-3 minutes	26 (37.1)	25 (35.7)	51 (36.4)	0.000*
	Above 3 minutes	6 (8.6)	31 (44.3)	37 (26.4)	

***p value < 0.05 – statistically significant**

Table No.2: Comparison among attempts or cannulation time with and without an LED light based on infant weight

Weight	Tasks	Groups	P Value
3.6 - 5 kg (n=35)	Attempts	One Attempt vs Two Attempts (n=34)	0.064
		One Attempt vs Failed (n=24)	0.709
		Two Attempts vs Failed (n=12)	0.909
	Cannulation Time	Under 2 min. vs 2-3 min. (n=32)	0.381
		Under 2 min. vs Above 3 min. (n=24)	0.319
		2-3 min. vs Above 3 minutes (n=14)	0.454
5.1 - 6.5 kg (n=44)	Attempts	One Attempt vs Two Attempts (n=38)	0.298
		One Attempt vs Failed (n=20)	0.080
		Two Attempts vs Failed (n=30)	0.320
	Cannulation Time	Under 2 min. vs 2-3 min. (n=31)	0.583
		Under 2 min. vs Above 3 min. (n=24)	0.041*
		2-3 min. vs Above 3 minutes (n=33)	0.086
6.6 - 8 kg (n=61)	Attempts	One Attempt vs Two Attempts (n=45)	0.003*
		One Attempt vs Failed (n=34)	0.000*
		Two Attempts vs Failed (n=43)	0.091
	Cannulation Time	Under 2 min. vs 2-3 min. (n=40)	0.017*
		Under 2 min. vs Above 3 min. (n=41)	0.000*
		2-3 min. vs Above 3 minutes (n=41)	0.036*

***p value < 0.05 – statistically significant**

DISCUSSION

Peripheral venous access is vital for administration of fluids and transfusion, medications, anesthesia and for collection of test samples.[2, 3] The major aim of securing venous access is to do it rapidly, in fewer attempts and without causing major pain to the patient. For this purpose, local anesthetics have been tried to reduce pain by applying them at the site before venipuncture. Repeated attempts and prolonged procedure time can lead to local trauma, pain and hemorrhages especially in pediatric patients. Therefore, attempts have been made to develop different systems which can help in visualizing the superficial veins and hence lead to successful venipuncture with minimal pain and trauma.[3, 9-12] Purpose of these systems is to visualize the veins directly before and during the procedure. This way, cannula can be inserted properly into the vein by directly visualizing it. There are several such systems available, for example, Accuvein® AV300, VeinViewer®, Veinsite® and VascuLuminator.[1] All these devices are based on NIR spectroscopy and they distinguish arteries from veins on the basis of different absorption patterns of oxygenated an deoxygenated blood.[13] The major disadvantage of these systems is the cost, they are costly.

LED light is a simple and cheap alternative which can be used to visualize superficial veins and help facilitate the venipuncture. Our study has shown that the success rate was quite high on first attempt in study subjects where LED light was used to facilitate venipuncture. Similarly, the failure rate was as low as 5.7% when LED light was used as an aide during venipuncture while the failure rate was quite high, 27.1%, when conventional method was used. In majority of cases, (54.3%), the procedure took less than two minutes with LED light while, 44.3%, of procedures took more than three minutes in conventional group. This means that use of LED light has not only significantly increased the success rate but also reduced the procedure time. This has clearly shown that LED light provides a better option for visualizing superficial veins of hand in newborns. This not only improves the initial success rate of the procedure and reduces procedure time but also significantly minimizes failure rate at the same time. Therefore, LED, being cheap and cost-effective, can be used in pediatric patients and provides a better alternative to more costly options like NIR based vein visualizing systems.

CONCLUSION

LED light provides an inexpensive yet very convenient and efficacious adjunct to conventional method of venipuncture in pediatric patients. This results in improved success rates and offers a cheap alternative to more expensive options available like near infrared spectroscopy, especially in developing countries.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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