WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Comparison of Failure Rate between Plastic Catheters and Scalp Vein Sets during Intravenous Use

***Dr Saurodeep Bhattacharjee* [*a], *Dr Parashuram* [*b]**

[a] *Dr. B. R. Ambedkar Medical College and Hospital, Bangalore, Karnataka*
[b] *Dr B. R. Ambedkar Medical College and Hospital, Bangalore, Karnataka*

A B S T R A C T

The failure rates of IV catheters and scalp vein sets in a ward settings with 100 patients(50 males+50 females) was compared. The relationship between failure rates and age, diagnosis, drugs given and gender of the patient was found. Scalp veins are easier to insert(40%),less painful to the patient(87% had no pain),have lesser complications(30%) and stay upto 5 days(80%).They are more suitable for women(66% success rate) and in those patients whose veins are not properly visible or are sclerosed. They are cheaper compared the IV catheters.(4 times less cost)The drawbacks of scalp vein sets include choosing proper insertion site, ideally the forearm, preventing excessive movement by splinting and not being able to give every type of medication. The IV catheters on the other hand can be kept for longer duration(40%),do not need specific insertion site or splinting and can be used comfortably in males(80% success rate).But they are more expensive and have more complications. Both types of cannulas have to be changed 3 times on an average for most patients

Keywords: IV catheters, scalp vein, thrombophlebitis, drug delivery

INTRODUCTION

Starting and maintaining an intravenous line is highly important in today's medical scenario. From emergency situations to long term supply of chemotherapy, a well placed and patent IV line is the prime armament in the doctor's arsenal against disease.

But the failure rates of cannulas (cannula refers to both catheters and scalp vein sets) are very high, ranging from 33%-69%.The causes of failure include occlusion, displacement, infiltration, pain and thrombophlebitis.[1]

It necessitates removal and re-insertion of the cannula, thereby adding to the woes of the patients as well as increasing the cost of treatment due to the additional need of materials and man hours.

Scalp vein sets have been used for infusion for more than half a century. They are cheap, easy to insert even in smaller veins, and even can be inserted without seeing the vein , especially in babies. They remain patent for weeks and can deliver large amounts of fluids at a rapid pace.[2]The drawbacks include infiltration[3][6] and rarely needle breakage.[4]

Intravenous catheters provide an alternative route for parenteral therapy. Made of plastic, they are more flexible and have lesser chances of infiltration. But they are 4 times as expensive as scalp vein sets, are painful to insert and remove(due to large needle size),[1] are prone to get displaced and kinked[5] and have a higher chance of phlebitis .[6]Also ,their side port serves as a nidus for pathogens which can lead to sepsis.[7]

In this study,we will try to compare the occlusion rates of the two methods to calculate the cost to benefit ratio. Using that data, we can streamline our practices to ensure lesser discomfort and pain for the patient while reducing the monetary burden on them as well as the hospital

OBJECTIVES

1)To find out the intravenous channel failure rate of each method

2)To compare the results and select the superior method

CONSENT AND ETHICS

Informed consent will be taken from all the patients before enrolling them in the research. This research will be carried out after obtaining approval from ethical committee of the college.

RECRUITMENT STRATEGIES

1) Patients will be recruited constantly till the sample size is attained

2) Patients will be explained regarding the procedure to remove fear and

Doubt

PROCEDURE [6][8][9]

Patient population:

The study will be conducted on the patients admitted to the male medicine ward of our hospital for a period of 3 months

Inclusion criteria:

1) All patients above 18 years of age, requiring infusion

2) Male patients

Exclusion criteria:

1) Patients having infusion for less than 24 hours

2) Very obese or dehydrated patients

MATERIALS

Jelco 1 inch, #23 gauge catheter and Top scalp vein set , 3/4 inch,#22 gauge

PATIENT ENROLLMENT

Eligible patients will be divided randomly into two groups

Group A – IV catheter

Group B – Scalp vein set

The following information will be obtained from each patient – Age , disease and type of fluids and medicines infused through the set.

PROTOCOL

All cannulas will be inserted by trained nurses. The site chosen would be the dorsum of the hand, which would be first cleaned with 70% isopropyl alcohol. Gloves will be worn, the intravenous tubing will be changed as and when needed and no inline filters will be used.

IV catheters will be secured with tegaderm, whereas the scalp veins will be secured by tape placed perpendicular to the needle The site will be checked daily,without further application of antiseptics

The cannulas will be removed after the completion of the treatment or if there are complications like:

1) Occlusion – failure to infuse fluid or flush the cannula even when it is in place. It is due to thrombus formation

2) Displacement- accidental removal of the cannula

3) Infiltration – puncture of the vein resulting in leakage to surrounding tissue, swelling and occasional ulceration.

4) Thrombophlebitis- presence of a palpable cord along the vein more than 3cm from insertion site, having warmth, erythema, tenderness and induration

5) Local Infection – lymphangitis and purulence. The cannulas will be removed by nurses .For removal, the skin will be swabbed with alcohol, dried and then the cannula will be removed aseptically.

The following points will be noted down :

1. Pain and discomfort felt by the patient during insertion, maintenance and removal of the cannula

2. Appearance of the puncture site

3. total time each cannula remained patent

4. Number of cannulas used for each patient.

DATA MANAGEMENT AND STATISTICAL ANALYSIS

All data will be recorded by us in a separate book everyday. SSPS software version 25 will be used for statistical analysis. Chi square test will be used to compare the results of the two methods to find the significance

Results

From the 100 patients,we first classified them based on age upon admission. In males,the majority of the patients(24%) belonged to the age group of 40-50 years whereas among the 50 female patients, the majority(32%) were in the age group of 60-70 years. As the age of the patients increase, there is more risk of thromobophlebitis while there is more chance of extravasation in young age. Also, old people have associated comorbities like Diabetes mellitus and Hypertension which also contributes to cannula failure

Upon admission,the most common diagnosis in males was Chronic Pulmonary Obstructive disease(24%) and 16% had alcoholic liver disease. In females the most common diagnosis was Lower respiratory tract infection(28%).Liver diseases and blood disorders have an increased chance of cannula failure

The most common drugs prescribed to the patients during their admission were Pantoprazole and ondansetron(100%)(Table 1),followed by Paracetamol(80%).Enoxaparin,an anticoagulant was given to 6 patients who were diagnosed with stroke,36 patients received Cefotaxime/Tazobactam and 20 patients received B vitamins.Thick IV medications(antibiotics,vitamin injections,parenteral nutrition etc) are preferably given through cannula since they have bigger bores,whereas normal saline bolus is given better with scalp vein set

Table 1. – Most common drugs used in the ward

Drug used	No of patients
Pantoprazole(Pan)	100
Ondansetron(Emiset)	100
Losartan(Zonate)	40
Paracetamol(Sumol)	80
Frusemide(Lasix)	22
Enoxaparin (Clexane)	6
Cephotaxime + tazobactam(Cefbact)	36
B vitamins	16
Mannitol	12
Normal Saline	90

Next , we studied the site of insertion of the cannula .60% of the patients had the cannula inserted on the dorsum of their hand,followed by forearm(30%)and remaing by wrist(10%).Out of these,the IV catheters had a higher chance of failure in the forearm(53%) compared to scalp vein set(13%) but the scalp vein performed poorly when it was used on the dorsum of the hand(26% failed) and wrist(100% failed).This is due to increased movement in these areas which leads to more chances of infiltration in scalp vein set.The wrist was not the ideal insertion site for IV catheters as well due to high failure rate(80%) and pain

We then compared the ease of insertion of IV catheter and scalp vein sets by the nurses.30% and 40% nurses found it easy to insert the IV catheter and scalp vein set respectively while 10% and 5% respectively found it difficult.The remaining 15% did not notice any difference in either of the two.This result is logical since insertion of scalp vein does not require too much expertise and any vein will suffice.In case of IV catheter,it is of paramount imoortance to find a cleary visible,non tortous and non sclerosed vein,which requires a certain degree of skill and experience on the part of the nurse.

We also asked the patient if they felt pain or discomfort during insertion and removal of the cannula.87% from the IV catheter group reported that they felt pain compared to only 13% from the scalp vein set group.This could be due to smaller size of the scalp vein needle, less resistance by the skin during insertion and lesser need to remove and re-prick the patient compared to IV catheter.

We tried to find the cause for the failure of cannulas.Majority of the IV Catheters either got occluded(27%) or led to local infection(31%) wheras many of the scalp vein sets failed due to infiltration(53%).The rate of thrombophlebitis was also higher for IV catheters(22%) compared to scalp vein sets(13%).

These findings could be explained by the following hypothesis.When a cannula is inserted into a vein,it accumulates static charge due to rubbing with the skin during insertion.In the case of scalp vein set,since the needle is metallic,the static charge is conducted to the inside of the needle and there is no charge on the surface of the needle.But since the IV catheter is made up of plastic,it stores the static charge on its surface.This charge attracts the charged platelets in the blood which leads to occlusion and thrombophlebitis.There is also a higher chance of infection in IV catheters since they have a reservoir for attaching the IV line which can act as a nidus for infection if not properly flushed and handled aseptically.On the other hand,the scalp vein leads to more infiltration and venepuncture due to its sharp metallic needle.

All in all,out of the 37 cases of cannula failure,59% were due to IV catheters failed while 41% were due to scalp vein sets

We then compared the number of days an IV catheter or a scalp vein set would remain patent before it had to be changed(table 2) to find its long term reliability.The average hospital stay for our patients was 5 days.Although 50% of the scalp vein sets remained patent upto 3 days,40% of the IV catheters remained patent even after 5 days.In one male patient,the IV catheter remained patent for a month.This can be explained by the fact that as the hospital

stay increases,there is more chance of failure of scalp vein due to patient's movement.There is also more chance of blockage due to nosocomial infections at the injection site

Table 2 - No of days each cannula remained before needing to be replaced

No of Days	IV Catheter	Scalp Vein set
1-3 days	20	25
3-5 days	10	15
>5 days	20	10

We then found out the number of times a cannula had to be changed in a patient(Table 3).This was to determine the cost to the patient along with the morbidity due to repeated pricking and increased chances of infection due to more handling.56% of IV catheters and 70% of scalp vein sets didn't need to be changed even once,but on an average 20% of IV Catheters and 12% of scalp vein sets had to be changed at atleast thrice

Table 3 – No. of times cannulas and scalp vein sets were changed

No of times changed	IV Catheter	Scalp Vein Set
0	28	35
1	2	4
2	3	2
3	10	6
4	5	2
>4	2	1

Finally, we tried to find the relation between gender and failure rates. We found that females had a higher chance of cannula failure(52%) compared to males(22%).Also there was less failure of scalp vein sets in females(34%) compared to females with IV catheters(65%).This may be due to difficulty in finding good veins in females due to obesity and since the veins ins females are more delicate. In males,there was not a hardly any difference between failure rate of scalp vein sets and IV catheters

Conclusion

From this study, we conclude that

1.Majority of the patients admitted fall in the age range of 40-70 years,who have a higher chance of cannula failures due to comorbid conditions like low immunity,Diabetes Mellitus and Hypertension

2.Most common complaints of patients are related to inflammatory or infectious diseases.Some of these disease can cause increased cannula failure.

3.Most of the drugs given in the wards are fully water soluble and pose no problem while giving IV.However some thick and poorly soluble drugs can block scalp vein sets but not IV catheters.

4.The forearm is the ideal site for insertion of cannulas,especially for scalp vein sets,whereas the wrist should be avoided.

5.Scalp vein sets are comparatively easier to insert than IV catheters

6.Scalp vein sets cause less pain to patients during insertion and removal

7.Scalp vein sets have a significant lesser failure rate compared to IV catheters($p > 0.05$)

8.Scalp vein sets have higher chances of infiltration whereas IV Catheters have more chanced of occlusion and thrombophlebitis

9.For shorter duration of admission,scalp vein sets are preferred but for > 5 days,IV catheters should be used

10.IV catheters have to be changed more number of times than scalp vein sets but both of have to be changed atleast thrice for most patients

10.Females have a higher chance of cannula failure than males and scalp vein sets are preferred to IV catheters in females

INDICATION OF SCOPE FOR FUTURE WORK

We can send the cannula tips for culture and find the prevalent microbes causing infection and thrombophlebitis in our collegeWe can try to develop an IV catheter which is made up of flexible yet conductive material such that it does not accumulate static charge on its surface leading to platelet aggregation and occlusion

Acknowledgements

We would like to thank RGUHS Short term Research for Undergraduate Students for providing the impetus to carry out this study.We would also like to thank the Medicine department and nurses of Dr B.R.Ambedkar Medical College for providing their support.

References

[1] Cooke M, Ullman AJ, Ray-Barruel G,Wallis M, Corley A, Rickard CM (2018) Not "just" an intravenous line: Consumer perspectives on peripheral intravenous cannulation (PIVC). An international crosssectional survey of 25 countries. PLoS ONE 13(2): e0193436. https://doi.org/10.1371/journal.pone.0193436

[2] Crossley K, Matsen JM. The Scalp-Vein Needle: A Prospective Study of Complications. *JAMA*.1972;220(7):985–987. doi:10.1001/jama.1972.03200070073012

[3] Weaver JM. The steel-needle butterfly--an outdated intravenous lifeline technology in modern anesthesiology. *Anesth Prog*. 2000;47(4):117-8.

[4] Bennetts, F. (1986), An unusual complication using a Butterfly needle. Anaesthesia, 41: 556-556. doi:10.1111/j.13652044.1986.tb13298.x

[5] Youssef M S, Atkinson R E. Comparison of Teflon cannulas and metal needles for subcutaneous infusion in terminal care: a pilot study. *BMJ* 1990;300 :847

[6] Complications of intravenous therapy with steel needles and Teflon® Catheters Tully, John L. et al. The American Journal of Medicine , Volume 70 , Issue 3 , 702 – 706

[7] Malhotra S L. Effects of high dietary sugar. *Br Med J (Clin Res Ed)* 1981; 282 :223

[8] Feld, R. , Leers, W. D., Curtis, J. E. and Bergsagel, D. E. (1975), Intravenous catheter infection study: A prospective trial in patients with neoplastic disease. Med. Pediatr. Oncol., 1: 175-181. doi:10.1002/mpo.2950010213

[9] Lowenbraun S, Young V, Kenton D, Serpick AA. Infection From Intravenous "Scalp-Vein" Needles in a Susceptible Population. *JAMA*. 1970;212(3):451–453.doi:10.1001/jama.1970.03170160041007