

## Evaluation of Pain and Phlebitis using Topical Heparin Solution at Central and Peripheral venous Punctures

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### Abstract

**Background:** Phlebitis refers to the inflammation of a vein which can occur after repetitive intravenous injections through peripheral or central venous cannulation. Various preventive modalities are available but, none has been established. Topical heparin drops have an edge over other therapeutic modalities being a non-aqueous, non-volatile, non-irritant and non-staining with significant penetration through the skin. **Aim:** The present study aims to evaluate the efficacy of topical heparin for the prevention of phlebitis. **Study design:** A prospective, randomised and double blind study. **Material and Methods:** Two hundred patients were divided into two equal groups. Topical heparin sodium solution (1000IU/mL) was applied to one group following 3 hours of cannulation and was repeated every 8 hours for the next 72 hours. A placebo in the form of normal saline was applied to another. **Statistical Analysis Used:** It was done using SPSS 13. Values for pain and eight other variables associated with phlebitis were calculated before and after intervention in both the groups (Group A and Group B) where there were no signs of pain and phlebitis in the first place. The results were considered statistically significant if the p-value <0.05. **Result:** The redness around the cannula site and pain as assessed by VAS score was statistically significant between the two groups (p<0.05). **Conclusion:** The heparin sodium is effective as a prophylactic measure in reducing redness and pain following peripheral and central venous cannulation.

**Keywords:** Phlebitis; Pain; Heparin; Prophylaxis; Peripheral Intravenous Cannula.

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### Introduction

Phlebitis refers to the inflammation of a vein. It can occur after repetitive intravenous injections or intravenous infusions for therapeutic or diagnostic purposes in a health care setting. Peripheral venous cannulation and central venous cannulation are known to cause phlebitis. Such procedures can cause injury to the vein and might trigger inflammation which is induced by the toxic chemicals released following thrombosis (formation of a blood clot). Systemic diseases like neoplasms, arteriopathies,

collagenosis, Trousseau's syndrome, Mondor's disease, Lemierre's disease, Buerger's disease can also be linked to its occurrence.

*Basic factors leading to phlebitis can be broadly divided into:* [1]

- **Mechanical:** Catheter size, material, length, insertion site, immobilization and the dwell time.
- **Chemical:** Infusion of the medications or fluids with variable pH or osmolality.
- **Bacterial:** Contaminated IV solution, tubing, catheter, insertion site and lack of asepsis.

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Phlebitis appears like a painful cord like mass along the course of cannulated vein with erythematous skin, swelling, tenderness, warmth, hard and lumpy and usually develops 72 hours following cannulation [2]. Associated pain may be critical and may encompass the whole length of the involved vein.

The incidence of phlebitis is found to be 25% to 35% in patients with a peripheral intravenous catheter [3]. Moreover, the occurrence was found to be significantly higher during summers [4].

Phlebitis is usually associated with peripheral intravenous lines but may occur with a central line too due to dislodgement of catheter tip from its central location, extended catheter dwell time, rapid administration of irritating and improperly mixed medications or solutions, large bore catheters, inadequate catheter securement and bacterial infection.

Various pharmacological, non-pharmacological and surgical methods are used for the prevention and treatment of phlebitis, but, none has been established due to uncertainties of natural history and lack of controlled trials. The precautionary and therapeutic modalities employed for phlebitis are elastic compression, application of wet heat, diclofenac and heparin gel, oral diclofenac 75mg twice daily, IV anticoagulants and application of topical heparin solution.

Topical heparin drops have an edge over other therapeutic modalities. It is non-aqueous, non-volatile, non-irritant, an emollient and non-staining. It provides significantly enhanced penetration through the skin. The present study aims to evaluate the efficacy of topical heparin solution for the prevention of phlebitis at central venous and peripheral venous puncture sites. The incidence of pain has also been studied.

## Material and Methods

This study was conducted in the Department of Anesthesiology, from 2017 to 2018 (1 year) on ASA I and ASA II patients, aged 18-60 years, of either gender, who were scheduled to undergo peripheral venous cannulation or central venous catheterisation.

Heparin sodium was used as topical solution in the concentration of 1000 IU/mL to be applied directly over the site as a prophylactic measure to prevent the incidence of pain and phlebitis from the moment a cannula is inserted.

### Allocation of Groups

Two hundred (200) healthy patients (with a viable peripheral intravenous cannula or central venous cannula in situ) were randomly allocated into two

**Table 1:** Andrew Jackson Scale of Phlebitis

Site of Observation	Score	Stage
IV site appears healthy	0	No signs of phlebitis
ONE of the following signs is evident : Slight pain near the cannulation site; OR Slight redness near the cannulation site	1	Possibly first signs of phlebitis
TWO of the following are evident : • Pain at cannulation site • Redness	2	Early stage of phlebitis
ALL of the following are evident : • Pain along path of cannula • Redness around site Swelling	3	Medium stage of phlebitis
ALL of the following signs are evident and extensive : • Pain along path of cannula • Redness around site • Swelling • Palpable venous cord	4	Advance stage of phlebitis Or the start of thrombophlebitis
ALL of the following signs are evident and extensive : • Pain along path of cannula • Redness around site • Swelling • Palpable venous cord	5	Advance stage thrombophlebitis

groups of 100 each by a computer generated number.

*Group A: (n=100):* Topical heparin solution was applied at the site of PIC or CVC after 3 hours of cannulation for 3 days, 3 times a day.

*Group B: (n=100):* Application of normal saline at the site of cannulation at the same doses as that of study group.

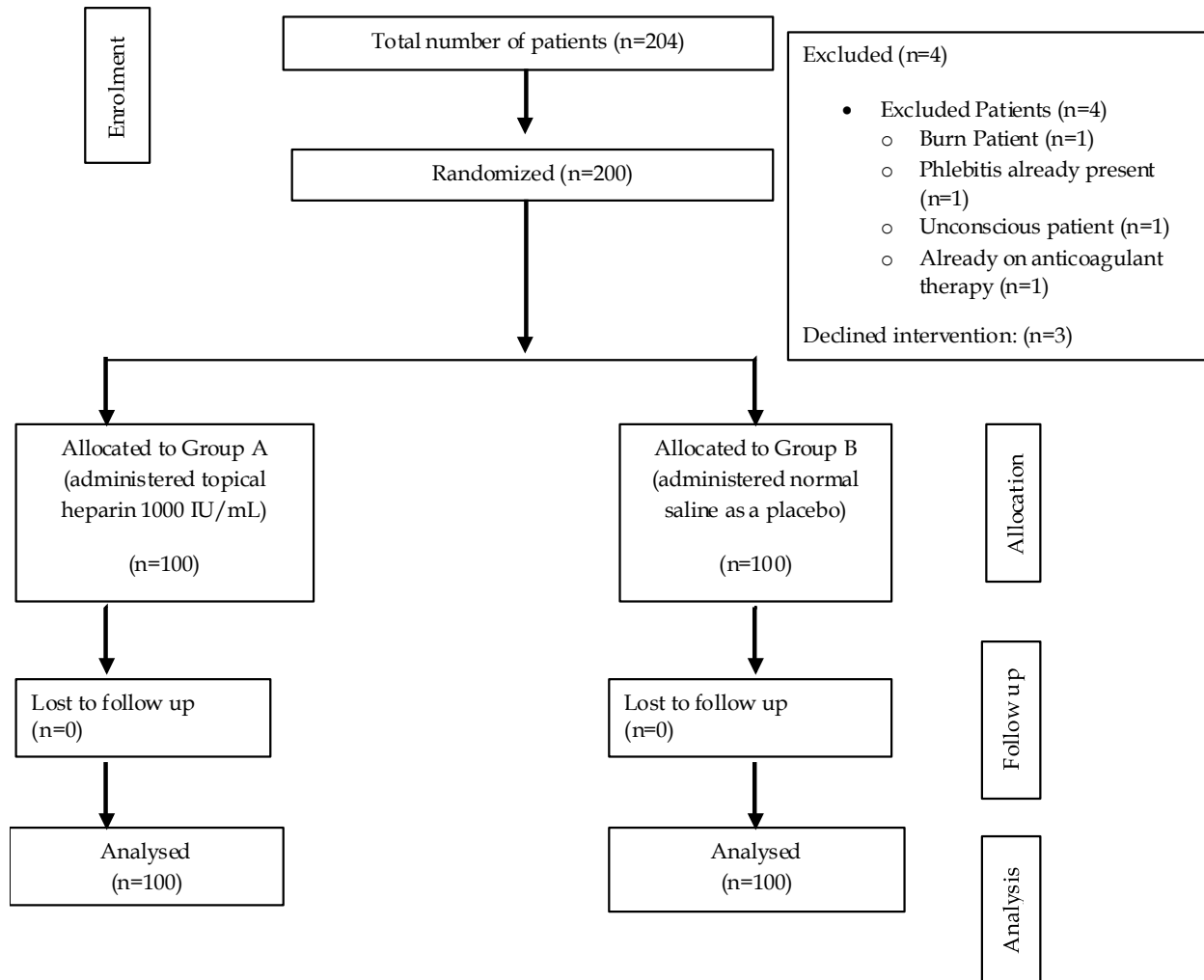
Following cannulation, time and date were noted. After 3 hours of cannulation, the topical heparin solution drops was applied to the puncture. This was repeated every 8 hours for the next 72 hours. The site was observed for any signs of redness or swelling and if any signs and symptoms of incidence of

thrombophlebitis were found, it was graded according to the scale developed by Andrew & Jackson (1998).

The incidence of pain was also measured during the time period using the Visual Analogue Scale (VAS) which is a psychometric response scale and can be used in questionnaires and is presented by a 100-mm horizontal line on which patient's pain intensity is represented by a point between the extremes of "no pain at all" and "worst pain imaginable."

The data from the above study was systematically collected, compiled and statistically analysed.

Consort Diagram:



## Observations and Results

As shown in Table 2, the variables involving redness (i.e. slight redness, redness and redness around site) have been compared with each other.

The mean value of Group A for slight redness came out to be 0.07, whereas, of Group B it was 0.34. The p value was found to be 0.0000 which ascertains that it was *significant*.

The mean value of Group A for redness came out to be 0.08, whereas, of Group B it was 0.21. The p value was found to be 0.0089 which ascertains that it was *significant*.

The mean value of Group A for redness around site came out to be 0.01, whereas, of Group B it was 0.12. The p value was found to be 0.0015 which ascertains that it was *significant*.

As shown in Table 3, the variables involving pain (i.e. slight pain at cannula site, pain at cannula site and pain along path of cannula) have been compared with each other.

The mean value of Group A for slight pain at cannula site came out to be 0.38, whereas, of Group

B it was 0.51. The p value was found to be 0.0649 which ascertains that it was *non-significant*.

The mean value of Group A for pain at cannula site came out to be 0.07, whereas, of Group B it was 0.22. The p value was found to be 0.0025 which ascertains that it was *significant*.

The mean value of Group A for pain along path of cannula came out to be 0.04, whereas, of Group B it was 0.13. The p value was found to be 0.0225 which ascertains that it was *significant*.

As shown in Table 4, non-significant variables (i.e. swelling and palpable venous cord) have been compared with each other.

The mean value of Group A for swelling came out to be 0.41, whereas, of Group B it was 0.44. The p value was found to be 0.6697 which ascertains that it was *not significant*.

The mean value of Group A for palpable venous cord came out to be 0.07, whereas, of Group B it was 0.12. The p value was found to be 0.2300 which ascertains that it was *not significant*.

**Table 2:** Showing variables of redness

Variables involving redness	Slight redness near cannula site		Redness		Redness around site	
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	0.07	0.34	0.08	0.21	0.01	0.12
P value	0.0000		0.0089		0.0015	
Result	<i>Significant</i>		<i>Significant</i>		<i>Significant</i>	

**Table 3:** Showing variables of pain

Variables involving pain	Slight pain at cannula site		Pain at cannula site		Pain along path of cannula	
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	0.38	0.51	0.07	0.22	0.04	0.13
P value	0.0649		0.0025		0.0225	
Result	<i>Non-significant</i>		<i>Significant</i>		<i>Significant</i>	

**Table 4:** Comparison of swelling and palpable venous cord amongst the two groups

Non-significant variables	Swelling		Palpable venous cord	
	Group A	Group B	Group A	Group B
Mean	0.41	0.44	0.07	0.12
P value	0.6697		0.2300	
Result	<i>Not-significant</i>		<i>Not-significant</i>	



phlebitis) were observed which was very distinct after 24 hours [16].

This finding was consistent with another study conducted by Singh R et al. (2008) which also reported that incidence of phlebitis sharply rose post 36 hours of placement of catheter [11]. Another study conducted by Malach T et al. (2006) also supported this fact that presence of catheter more than 3 days (72 hours) was also a noteworthy determinant associated with phlebitis [17].

But, a study conducted by Catney MR et al. (2001) found that difference between incidence of phlebitis in catheters lasting 6 days (144 hours) as compared to a new catheter inserted for 3 days was 1.3%. Therefore, it was suggested that dwell time of a peripheral intravenous cannula may be considered to extend even beyond 72 hours under definite situations which was not found to be consistent with the above findings [18].

Heparin has been used since a long time for the treatment of superficial thrombophlebitis. Marcone Lima Sobreira et al. (2008) recommended usage of unfractionated heparin or low molecular weight heparin in therapeutic doses if there was worsening of clinical status [19]. This was supported by another study conducted by Lee JT et al. (2008) which also recommended usage of low molecular weight heparins to lessen the augmentation of inflammation as a traditional manoeuvre [20].

Vecchio et al. (2008) illustrated the usage of topical heparin in the treatment of superficial thrombophlebitis and concluded that heparin administered directly over the site could be convenient in case of vascular disorders [21]. This finding was also supported by another study conducted by Vilardell M et al. (1999) where phlebitis was cured in 44.3% of patients where heparin administered directly over the site was found to be useful as a remedy for superficial thrombophlebitis [22].

#### Limitations

- Some conditions like immobility, trauma, pregnancy, hormone use, cancer, obesity, inherited and acquired disorders of hypercoagulation naturally predispose a patient to a higher chance of developing thrombophlebitis which was not included in this study.
- Drugs infused through the IV line like those having low pH, potassium chloride, hypertonic solutions, amino acids and some antibiotics may increase the incidence of development of thrombophlebitis which was not included in this study.

#### Conclusion

Results of present study illustrated that majority of signs and symptoms of phlebitis showed a significant difference ( $p < 0.05$ ) between the groups. It was established that usage of heparin sodium (1000 IU/mL) topical solution led to:

- 27% reduction in the incidence of slight redness near cannula site.
- 15% reduction in pain at cannula site.
- 13% reduction in redness.
- 9% reduction in pain along path of cannula.
- 11% reduction in redness around site.

The present findings strongly support the concept that topical heparin sodium (1000 IU/mL) solution is *effective* in preventing intravenous cannula related phlebitis and pain.

*Support:* Nil

*Conflicts of Interest:* Nil

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