

Effectiveness of Heparin Lock versus Normal Saline Lock in Maintaining Peripheral Intravenous Cannula Patency: Experimental Study at GIMSR Hospital, Visakhapatnam...

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ABSTRACT

Background: Intravenous therapy is essential for patient care, but maintaining peripheral IV cannula patency remains challenging due to risks of occlusion, phlebitis, and reinsertion. Flushing protocols using normal saline (NS) or heparin lock are debated, with heparin favored for its anticoagulant properties despite concerns over heparin-induced thrombocytopenia (HIT), while NS is promoted for safety in short-term use. This study addresses the need for evidence on their comparative effectiveness in a clinical setting. **Methods:** A true experimental design was employed at GIMSR Hospital, Visakhapatnam, involving 60 patients (30 per group) receiving intermittent IV medications, selected via simple random sampling. Eligible adults in medical-surgical wards met inclusion criteria (conscious, cooperative, 3-day IV therapy) and excluded those with thrombocytopenia or anticoagulants. Post-tests using the Peripheral Intravenous Patency Assessment Tool (PIPAT) assessed patency daily for 3 days after flushing; data analyzed with paired/unpaired t-tests, chi-square, and descriptive statistics (reliability $r=0.93$). **Results:** Heparin lock showed superior patency: Day 1 no-blockage 96.67% vs. 23.33% (NS); Day 2: 76.67% vs. 6.67%; Day 3: 30% vs. 0%. Paired t-tests confirmed significant NS decline (e.g., Day 1-3 mean difference 6.3, $t=7.1$, $p<0.001$) versus heparin stability (Day 1-2 NS, $p=0.36$). No adverse events occurred. **Conclusion:** Heparin lock is significantly more effective than NS for sustaining IV cannula patency over 72 hours, reducing blockages without risks in low-risk adults. Findings support protocol revisions prioritizing heparin for intermittent therapy to minimize reinsertions and enhance care; multicenter trials recommended

Keywords: Heparin lock, normal saline, IV cannula patency, peripheral intravenous, catheter occlusion, PIPAT tool.

How to cite this article Hemanth K, Yogalakshmi S, Effectiveness of Heparin Lock versus Normal Saline Lock in Maintaining Peripheral Intravenous Cannula Patency: Experimental Study at GIMSR Hospital, Visakhapatnam..Int J Drug Deliv Technol. 2026;16 (6s): 339-347; DOI: 10.25258/ijddt.16.6s.58

Source of support: None

Conflict of interest: None

INTRODUCTION

Fluid maintains all body system functions. These balances are maintained by the intake and output of water. Physical, behavioural and environmental factors affect the body's ability to regulate fluids. Imbalances of fluid necessitate the fluid therapy by means of intravenous fluids. Intravenous fluid administration is performed in the hospital, outpatient diagnostic and surgical setting, clinic, and home to replace fluids, administer medications, and provide nutrients when no other route is available. Most peripheral access devices used are cannula. Catheter and cannula are terms that are used interchangeably. These are easy to insert, but because they are small and non-pliable, infiltration occurs easily. [1] Intravenous (IV) therapy is an essential aspect of patient care in both acute and chronic medical settings, facilitating the administration of fluids, medications, and other treatments directly into the bloodstream. One of the common challenges faced by healthcare providers is maintaining the patency of the IV catheter over time. This is crucial to ensure that patients receive uninterrupted therapies and to avoid complications such as clot formation, catheter occlusion, and the need for reinsertion of new IV lines, which can cause patient discomfort and increase the risk of infection. To address these concerns, healthcare providers use flushing protocols to prevent catheter-related

complications. Two primary solutions used for maintaining catheter patency are normal saline (NS) and heparinized saline (heparin lock). [2]

Heparin lock, which involves the use of a diluted solution of heparin, has been a longstanding method in clinical practice to maintain catheter patency. Heparin is an anticoagulant that prevents clot formation within the catheter, reducing the risk of occlusion and maintaining blood flow through the IV line. This approach is often favoured in settings where long-term catheter use is required, as the anticoagulant properties of heparin are believed to be more effective in preventing the formation of blood clots than normal saline. Studies have shown that the use of heparin locks can significantly reduce the incidence of catheter blockages, leading to fewer line replacements and fewer complications associated with IV therapy. Additionally, heparin's ability to prevent clot formation may contribute to better patient outcomes, particularly in patients who are more susceptible to thrombosis or clotting disorders. [3]

Several studies have supported the use of heparin locks for maintaining peripheral and central venous catheters. For instance, Goossens (2015) noted that heparin flushing is commonly used in many institutions due to its effectiveness in preventing thrombus formation in catheters, particularly in patients who require prolonged IV access. Moreover,

research by Randolph et al. (1998) demonstrated that heparin is more effective than saline in reducing the incidence of catheter occlusions and thrombotic events, particularly in high-risk patients. In another randomized controlled trial by Schallom et al. (2012), the use of heparin versus saline was compared in an intensive care setting, showing that heparin lock reduced catheter occlusion rates without increasing adverse events related to heparin. [4]

Despite the potential benefits of heparin in maintaining catheter patency, normal saline is another widely used solution, especially in general practice and for short-term use. Normal saline flushes are isotonic and free from any anticoagulants, making them safer for patients who may be at risk of heparin-induced thrombocytopenia (HIT), a serious complication that can arise from the use of heparin. HIT occurs when the body forms antibodies against heparin, leading to a drop in platelet levels and an increased risk of thrombosis. For this reason, many institutions have moved toward using normal saline as a safer alternative, particularly in patients who are at higher risk for HIT or who do not require long-term catheter maintenance. [5]

However, the shift toward the exclusive use of normal saline has been met with mixed results. Some studies suggest that normal saline may not be as effective as heparin in preventing catheter occlusions. For example, Doellman et al. (2009) observed that while saline flushes are safe and widely used, their effectiveness in preventing occlusions over long periods, particularly in central venous catheters, may be inferior to that of heparin. Additionally, normal saline lacks the anticoagulant properties of heparin, which may increase the risk of catheter-related thrombosis, particularly in patients with hypercoagulable conditions or those receiving IV therapy over extended periods. [6]

Given the ongoing debate surrounding the use of heparin versus normal saline for IV maintenance, it is essential to evaluate the effectiveness of these two solutions in clinical practice. The key question remains whether heparin lock offers superior outcomes in terms of IV catheter patency, complication rates, and overall patient safety, particularly when compared to normal saline. Previous studies have highlighted the potential benefits of heparin in reducing the incidence of catheter occlusions and thrombotic events, but concerns about safety and side effects have led to increased use of saline in some clinical settings. [7]

This research aims to investigate the effectiveness of heparin lock versus normal saline in maintaining peripheral IV catheter patency in a diverse patient population. By reviewing the existing literature and conducting a clinical study, the research seeks to determine whether heparin lock is more effective in preventing catheter occlusion, reducing the need for catheter replacement, and improving patient outcomes. Specifically, this study will focus on the comparative effectiveness of these two solutions in terms of the frequency of catheter blockages, the incidence of complications such as thrombosis, and the overall safety profile of each method.

The results of this study will provide valuable insights into the best practices for maintaining IV catheter patency, particularly in patients who require long-term IV therapy are

at higher risk for catheter-related complications. If heparin lock proves to be more effective than normal saline, healthcare providers may reconsider current flushing protocols and move toward reintroducing or maintaining the use of heparin in select patient populations. Additionally, understanding the safety risks associated with each solution will help guide clinicians in making informed decisions about IV maintenance, ultimately improving the quality of care provided to patients.

The comparison of heparin lock versus normal saline in maintaining IV catheter patency is a critical area of research with significant implications for nursing practice. The findings of this study will contribute to the growing body of evidence on the most effective and safe methods for IV maintenance, supporting evidence-based decision-making in clinical settings. By addressing this gap in knowledge, the research aims to enhance patient outcomes, reduce catheter-related complications, and optimize the use of healthcare resources in IV therapy management.

NEED FOR THE STUDY

Heparin has typically been used as a flushing or infusion solution for vascular lines in daily practice. However, several clinical trials have yielded controversial results about the benefits of heparin in maintaining peripheral venous catheters. In total 32 eligible studies were included, from which the pooled standard mean difference (SMD), relative risk (RR) and corresponding 95% confidence interval (CI) were calculated. The use of heparin as a continuous infusion significantly prolonged the duration of patency (SMD, 0.90; 95% CI, 0.48-1.32; $P < 0.001$), reduced rates of infusion failure (RR, 0.83; 95% CI, 0.76-0.92; $P < 0.001$) and occlusion (RR, 0.82; 95% CI, 0.69-0.98; $P < 0.05$) in a peripheral intravenous catheter. [8]

When heparin was given as a continuous infusion at 1 U/ml the risk of phlebitis decreased (relative risk 0.55; 95% confidence interval 0.39 to 0.77), the duration of patency increased, and infusion failure was reduced (0.88; 0.72 to 1.07). Heparin significantly prolonged duration of patency of radial artery catheters and decreased the risk of clot formation (0.51; 0.42 to 0.61) (*Deborah J Cook, associate professor was conducted a study heparin benefit in 28 March 1998*) Heparin 100 U/mL in the maintenance of peripheral venous catheters was more effective than saline solution, in that it reduced the number of catheter-related phlebitis/occlusions and the number of catheters per patient, with potential advantages to both patients and the health system. It also appeared safe. However, subjects with platelet or coagulation defects were excluded, and, therefore, caution should be used when prescribing this type of catheter maintenance to patients at risk of bleeding. [9]

To determine whether flushing peripheral intravenous catheters with 3 mL of a 100 U heparin/mL solution instead of saline improves the outcome of infusion devices. Phlebitis or occlusion were 45 (42.1%) in the heparin group and 68 (63.6%) in the saline group (OR 0.41; 95% CI 0.24–0.72; $p = 0.002$); patients with occlusion alone were 23 (21.5%) and 47 (43.9%), respectively ($p = 0.03$); patients with phlebitis alone were 28 (26.2%) and 56 (52.6%)

respectively ($p = <0.001$). Similar results were obtained when the analysis was based on catheters. No heparin severe side effects were identified. [10]

The decision to conduct this research study originates from the higher catheter occlusion rates observed with normal saline, particularly among patients requiring long-term IV therapy. Despite the widespread use of normal saline, the increased rate of occlusion and the subsequent need for catheter replacements suggest that an alternative approach may be necessary to improve patient outcomes. Heparin lock has been shown in various studies to be more effective in maintaining catheter patency, especially in long-term use, but its adoption is limited due to concerns over cost, potential side effects, and outdated institutional protocols.

This research was selected to provide evidence-based insights into the comparative effectiveness of heparin lock versus normal saline in maintaining IV catheter patency. By focusing on a specific hospital, the study aims to generate data that is directly applicable to the local healthcare setting, ensuring that the findings can be used to inform clinical practice. Additionally, the study seeks to address the gap in current research by evaluating patient outcomes, cost-effectiveness, and the incidence of complications associated with both flushing solutions.

The present research is crucial for determining the most effective and safe method for maintaining IV catheter patency, particularly in patients requiring long-term IV access. The study will provide valuable data that could potentially lead to a shift in hospital protocols, favoring the use of heparin lock in select patient populations, thereby reducing catheter-related complications and improving patient care.

AIM OF THE STUDY

The aim of this study is to evaluate the effectiveness of normal saline lock versus heparin lock in maintaining the patency of peripheral intravenous cannulas among patients receiving intravenous medications in the medical and surgical wards of GIMSR Hospital, Visakhapatnam, using a true experimental design with 60 participants. Specifically, it seeks to assess patency levels in each group via the Peripheral Intravenous Patency Assessment Tool (PIPAT), compare their relative effectiveness over three days through post-test scores and statistical analyses (e.g., paired t-tests, chi-square), and determine associations with selected demographic variables such as age, gender, BMI, and medication frequency. By addressing the debate on flushing protocols, the research aims to provide evidence-based recommendations for reducing occlusions, reinsertions, and complications in clinical nursing practice.

METHODOLOGY

Statement of the problem:

“Effectiveness of Normal Saline Lock Versus Heparin Lock On The Patency Of Peripheral Intravenous Cannula Among Patients Receiving Intravenous Medications in GIMSR Hospital, Visakhapatnam”. -True Experimental Design

Objectives:

1. To assess the level of patency of peripheral IV cannula among the patients receiving heparin lock.
2. To assess the level of patency of peripheral IV cannula among patients receiving normal saline flush.
3. To compare the effectiveness of normal saline lock versus heparin lock on patency of peripheral IV cannula.
4. To find out the association between post-test level of IV patency of patients receiving heparin lock and normal saline lock with their selected demographic variables.

Research approach:

Quantitative research approach was adopted for the study.

Research design:

The research design selected for the study is True Experimental Research Design. Simple random sampling technique

Setting of the study:

The study was carried out in GIMSR Hospital where it is located in Vishakhapatnam. Bed strength of the hospital is 850 bed hospitals. The census of hospital in OP is 1000-3000/per month and 4 type of ICUs are present in the hospital with good environment and ICU beds was each in 16 beds. The investigator selected this setting in medical ward and surgical ward for the availability of the sample and feasibility of the study.

Population:

The population of this study are patients who are admitted and having intravenous cannula in hospital

Sampling technique:

The investigator selected samples by simple random sampling technique.

Sample size:

Simple Random sampling methods is a type of sampling procedure, where every member of population has an equal chance of being selected as subjects

Investigation first assigned a unique number for each member of population

Each member is placed in a bowl and mixed thoroughly

Then blind fold researcher picked the number tags from the bowl

All the individuals bearing the numbers picked by the researcher are the subjects for the study either in the Heplock group or in the Normal Saline lock group

Criteria for selecting sample:

Exclusion criteria:

1. Patients with thrombocytopenia, bleeding disorders, hypersensitivity to heparin.
2. Patients receiving anticoagulant therapy.
3. Patients on maintenance drip.
4. The patient who is on chemotherapy treatment and long term antibiotics therapy.

Inclusion criteria:

1. Patients who will be having IV cannula and admitted in medical and surgical wards.
2. Patients who will be conscious and able to follow instructions.
3. Patients who will be co-operative and willing to participate in the study.
4. Patients who will be receiving IV medications for at least 3 days

Variables:

1. Independent variable: normal saline lock and heparin lock.

2. Dependent variable: patency of the peripheral intravenous cannula.

Demographic variables: the demographic variables are age, gender, diet, habits, undergone surgical treatment, body mass index, frequency of medication, type of ambulation.

Development of the tool:

The research design chosen for this study was a quantitative approach and true experimental research design. The study was conducted among patients on intermittent intravenous medication (twice daily) from the general medical and surgical wards, and they were included in the study. The sample size was 60 (30 each in the normal saline lock and the heparin lock Group respectively). A simple random sampling technique was used to select the samples. Patients with intermittent intravenous medication were included in the study, and patients who were receiving continuous infusion and getting blood transfusions were excluded from the study. The method is represented that to give the information check list with a consent form to be given to the patient. The tools have given to the 9 experts in Doctors and Medical Surgical Nursing faculties in other universities and colleges. The experts' suggestions have been made about the peripheral intravenous patency assessment tool.

Description of tool:

The tools are divided into two sections as outlined below.

SECTION 1: It consists of demographic variable like age, gender, diet pattern, habits, whether undergone surgical treatment, body mass index, frequency of medication, type of ambulation.

SECTION 2: This section addresses a checklist covering the meaning, general information, signs and symptoms, and the Peripheral Intravenous Patency Assessment Tool. Factors such as blood backflow, medication flow through the peripheral intravenous catheter, pain along the cannula site, and warmth were considered in determining the blockage score.

Interpretation:

5-No blockage

6-10 Mild blockage

11-15 Moderate blockage

16-20 Severe blockage

Validity of the tool:

To determine the content validity and appropriateness of the tool that investigator submitted the prepared structured questionnaire 7 experts in the field of nursing and medicine. there valuable suggestions have taken where in corporate in the final structured questionnaire.

Reliability of the tool:

Reliability of the tool is defined as the extent to which the instrument yields the same results in repeated measures it concerns with stability, internal consistency and it is conducted in the GIMSR Hospital Vishakhapatnam

To establish the reliability of the tool t test method standard deviation, mean CO- Efficient and CO- was used, tool was administered to six samples who were not included in the

main study. the reliability score r-0.93 which indicates that tool was reliable

Pilot study and result:

The pilot study is a small version of trail runs done in preparation for major study formal permissions was obtained from the GIMSR Hospital authority. pilot study was conducted and 6 samples who full fill the inclusion criteria were selected, consent obtained from subjects by establishing good rapport and sample selected for pilot study was based on simple random sampling technique statistically by using descriptive and inferential statistics and the found the results post test scores where normal saline lock scores were high for samples under pilot study.

Ethical consideration :

The study conducted only after approval by the institutional ethical committee, informed written consent from the subject was taken. Samples who were willing to participate were included in the study. Anonymity of study subjects and confidentiality was maintained. Ethical issues associated with heparin lock in iv cannulation patients include ensuring that the study will not cause any side effects to the patients, secondly the study is with minute dose of heparin lock, no additional risk is expected to occur from this study than the standard management protocol.

Data collection procedure:

In order to collect data a formal written permission was obtained from the GIMSR Hospital Vishakhapatnam. Permission obtained from the subject of patients were gathered and explained the purpose of the study with patient consent form and information check list give to give patient after giving the Heparin Lock another sample is Normal Saline Lock with and 1 hour time to check the any abnormalities and scored from using peripheral intravenous patency assessment tool was conducted with scores was noted and check blockage level to identify the effectiveness of study T-Paired ,T-Test, Standard deviation ,Mean ,Chi Square total duration of data collection 1 month.

The data was collected in the following through the dates:

Post test for heparin lock and normal saline groups sample collection dates

Post-test was conducted among the patients' receiving medications through the peripheral intravenous cannula on day 1 to check the patency of heparin lock and normal saline lock based on the inclusion and exclusion criteria after giving heparin lock and normal saline lock those who are experiencing mild, moderate and severe blockage and scoring level is high, by using peripheral intravenous patency assessment tool. After administering heparin lock and normal saline lock the sample were observed for the patency of Iv cannula with the help of PIPAT checklist post-test comparison is done with the help of Chi-square and paired T-test and un-paired t test between Normal Saline lock & Heparin lock

Plan for data analysis:

The plan of data analysis includes both descriptive and inferential statistics the collected data was statistically analyzed and tabulated by applying statistics such as mean standard deviation, paired t test, unpaired t test value computed from raw scores obtained in post-test the values

were compared to assess the effectiveness of normal saline lock versus heparin among patients. The data was planned to analyze based on the study objectives with the help of descriptive and inferential statistics. Frequency and percentage distribution were used to demographic variables. Percentage, mean distribution and standard deviation were used to describe the level of post test scores. Inferential statistics paired t test & unpaired t test used to find out association between post test scores of days 1 day 2 day 3 and demographic variables. Inferential parametric statistical analyze t test was used the research hypothesis under study of post test scores to find the effectiveness of Normal Saline Lock lock versus heparin lock among patients.

RESULTS

Section A

Table 1: Frequency and percentage distribution of demographic variables

DEMOGRAPHIC VARIABLE S	FREQUENCY NORMAL SALINE LOCK	PERCENTAGE	FREQUENCY HEPARIN LOCK	PERCENTAGE
AGE				
20-29	6	20.0 %	8	23.3%
30-39	9	16.7 %	4	13.3%
40-49	9	30.0 %	9	30.0%
50 above	10	33.3 %	10	33.3%
GENDER				
a) Male	9	63.3 %	14	80.0%
b) Female	11	36.7 %	6	20.0%
DIET				
a) Vegetarian	4	13.3 %	2	6.7%
b) Non-vegetarian	26	86.7 %	28	93.3%
HABITS				
a) Cigarette smoking	4	13.3 %	23	23.3%
b) Alcohol consumption	4	13.3 %	6	20.0%
c) Tobacco	3	10.0 %	1	3.3%
d)None	16	63.3 %	16	53.3%
UNDER SURGICAL TREATMENT				
a) Yes	14	46.7 %	13	53.3%

b) No	16	43.3 %	17	56.7%
BODY MASS INDEX				
a) Thin	16	53.3 %	15	50.0%
b) Moderate	13	43.3 %	1	36.7%
c)Obese	1	3.3%	4	13.3%
FREQUENCY OF MEDICATION				
a) Once in a day	14	46.7 %	16	53.3%
b) Twice in a day	8	26.7 %	7	23.3%
c)Thrice in a day	8	26.7 %	7	23.3%
TYPE OF AMBULATION				
a) Mobilised	26	86.7 %	29	96.7%
b) Partially mobilized	4	13.3 %	1	3.3%

Table 1 presents the frequency and percentage distribution of selected demographic variables of patients allocated to the normal saline lock and heparin lock groups, indicating that the two groups were broadly comparable. The majority of patients in both groups were aged 40 years and above, with 63.3% in the normal saline lock group and 63.3% in the heparin lock group falling in the 40–49 years and 50 years and above categories, reflecting a predominance of middle-aged and older adults. Males constituted a higher proportion of the sample, particularly in the heparin lock group (80.0%) compared with the normal saline group (63.3%), while females formed 36.7% and 20.0% of these groups, respectively. Most participants were non-vegetarians in both groups (86.7% in normal saline lock and 93.3% in heparin lock), and a large subset reported no habits such as smoking, alcohol consumption, or tobacco use (63.3% in normal saline and 53.3% in heparin lock), suggesting a relatively low burden of lifestyle risk behaviors. Nearly half of the patients in each group had undergone surgical treatment (46.7% in normal saline lock and 53.3% in heparin lock), and the body mass index distribution indicated that around half were thin (53.3% and 50.0% in the respective groups), with a smaller proportion categorized as obese, especially in the heparin lock group (13.3%). With respect to treatment pattern, most patients received medications once daily (46.7% in normal saline lock and 53.3% in heparin lock), and the majority were fully mobilized (86.7% and 96.7%, respectively), indicating that the samples largely consisted of ambulatory patients receiving intermittent intravenous medications in both comparison groups.

Section B

Day-1 IV Cannula Patency (PIPAT)

On day 1, a significantly higher proportion of patients in the heparin lock group demonstrated optimal peripheral intravenous cannula patency compared with those in the normal saline lock group, with almost all heparin-treated

patients showing **no blockage** (96.67%) versus less than one-quarter (23.33%) in the normal saline group. In contrast, the majority of patients receiving normal saline lock experienced varying degrees of obstruction, as evidenced by a substantially higher proportion with mild blockage (60.00% vs 3.33%) and the exclusive occurrence of moderate (13.33%) and severe blockage (3.33%) categories in this group, while no cases of moderate or severe blockage were observed among patients receiving heparin lock. These findings indicate that, by day 1 of observation, heparin lock was considerably more effective than normal saline lock in maintaining peripheral intravenous cannula patency and in minimizing early catheter-related blockage among patients receiving intermittent intravenous medications.

Table 2: Day-1 post-test level of peripheral intravenous patency assessment tool among patients with normal saline lock and heparin lock (N=60)

PIPAT at Day-1	Group			
	Normal saline lock		Heparin lock	
	Count	%	Count	%
No blockage	07	23.33%	29	96.67%
Mild blockage	18	60.00%	01	3.33%
Moderate blockage	04	13.33%	00	00.00%
Severe blockage	01	03.33%	00	0.00%
Total	30	100.0%	30	100.0%

showed no blockage and the remaining 23.33% had only mild blockage, with no cases of moderate or severe obstruction, indicating sustained catheter patency under heparin flushing. In contrast, in the normal saline lock group only 6.67% of patients had no blockage, while one-third (33.33%) showed mild blockage and the majority experienced more advanced obstruction, with 50.00% in the moderate and 10.00% in the severe blockage categories, suggesting progressive compromise of cannula patency by day 2 in this group. These findings highlight that, over the first 48 hours of intermittent intravenous therapy, heparin lock is markedly more effective than normal saline lock in preventing clinically significant levels of cannula blockage and in maintaining functional IV access.

Table 3: Day-2 post-test level of peripheral intravenous patency assessment tool among patients with normal saline lock and heparin lock (N=60)

PIPAT at Day-2	Group			
	Normal saline lock		Heparin lock	
	Count	%	Count	%
No blockage	02	06.67%	23	76.67%
Mild blockage	10	33.33%	07	23.33%
Moderate blockage	15	50.00%	00	00.00%
Severe blockage	03	10.00%	00	00.00%
Total	30	100.0%	30	100.0%

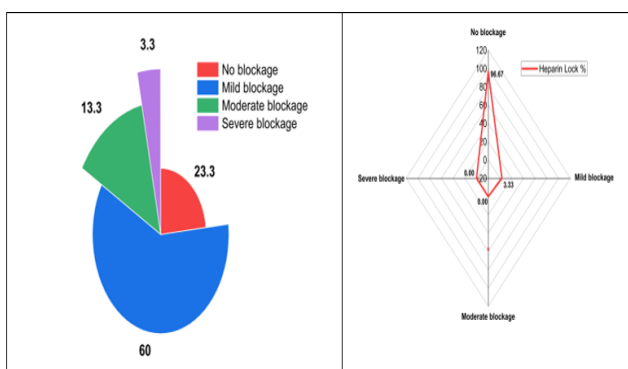


Fig. 1 Plots showing the count and % of post-test level of peripheral intravenous patency assessment tool among patients with normal saline lock and heparin lock

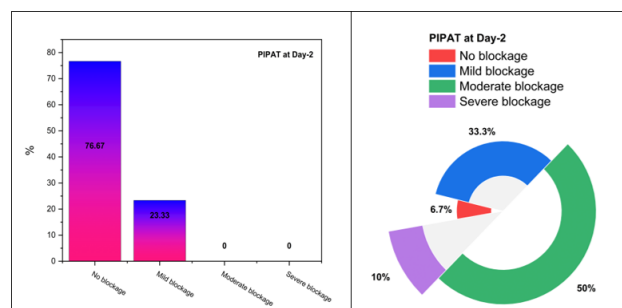


Fig. 2 Day-2 post-test level of peripheral intravenous patency assessment tool among patients with normal saline lock and heparin lock (N=60)

Day-2 IV Cannula Patency

On day 2, patients in the heparin lock group continued to demonstrate superior **peripheral** intravenous cannula patency compared with those in the normal saline lock group, as reflected in the distribution of PIPAT scores. In the heparin lock group, three-fourths of patients (76.67%)

Day-3 Patency of Peripheral Intravenous Cannula

On day 3, the distribution of peripheral intravenous cannula patency scores showed a marked deterioration in the normal saline lock group and comparatively better maintenance of patency in the heparin lock group. In the normal saline lock group, none of the patients demonstrated a cannula without blockage (0%), while only a small proportion (10.00%) had mild blockage and the majority exhibited higher grades of

obstruction, with 46.67% showing moderate blockage and 43.33% severe blockage, indicating substantial compromise of IV access by the third day. In contrast, in the heparin lock group, nearly one-third of patients (30.0%) had no blockage and the majority (60.0%) experienced only mild blockage, with just 10.00% progressing to moderate blockage and no cases of severe blockage, reflecting superior preservation of cannula patency under heparin flushing. Overall, the day-3 findings clearly indicate that heparin lock was more effective than normal saline lock in preventing progression to moderate and severe levels of cannula blockage over 72 hours of intermittent intravenous therapy, thereby supporting the use of heparin lock as a more efficacious strategy for maintaining peripheral IV cannula patency in this clinical setting.

Table 4: Day-3 post-test level of peripheral intravenous patency assessment tool among patients with normal saline lock and heparin lock (N=60)

PIP at Day-3	Group			
	Normal saline lock		Heparin lock	
	Count	%	Count	%
No blockage	0	00.00%	09	30.0%
Mild blockage	03	10.00%	18	60.0%
Moderate blockage	14	46.67%	03	10.00%
Severe blockage	13	43.33%	00	00.00%
Total	30	100.0%	30	100.0%

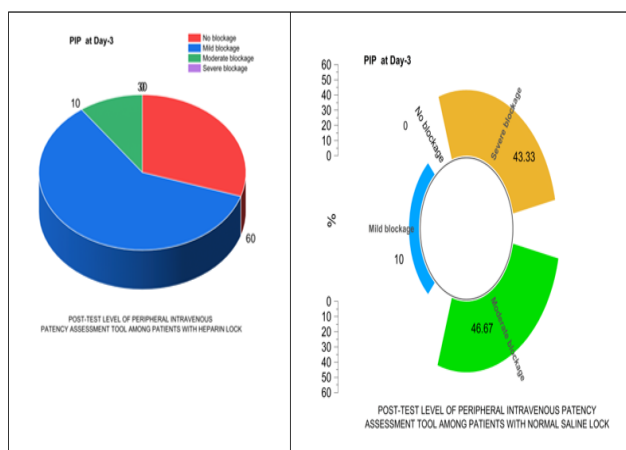


Fig. 3 Day-3 post-test level of peripheral intravenous patency assessment tool among patients with normal saline lock and heparin lock (N=60)

Section C

Comparative Patency Analysis Over Three Days

Table 5 presents a paired t-test analysis comparing peripheral intravenous cannula patency scores (assessed via the Peripheral Intravenous Patency Assessment Tool, PIPAT) between normal saline lock and heparin lock groups across days 1, 2, and 3 (N=60), revealing significant deterioration in the normal saline group and relative stability in the heparin group. In the normal saline lock group, mean patency scores worsened markedly from day 1 to day 2 (mean difference=3.66, paired t=6.2, p<0.001), day 1 to day 3 (mean difference=6.3, paired t=7.1, p<0.001), and day 2 to day 3 (mean difference=2.64, paired t=6.8, p<0.001), with standard deviations indicating increasing variability (e.g., SD=2.88 on day 1-2 comparison). Conversely, the heparin lock group exhibited minimal changes, such as a non-significant shift from day 1 to day 2 (mean difference=0.46, paired t=1.68, p=0.36) and significant but smaller declines by day 3 (e.g., day 1-3: mean difference=1.108, paired t=3.8, p<0.001), underscoring heparin's superior efficacy in sustaining cannula patency over the study period among patients receiving intermittent IV medications.

Table 5: Comparison of the patency of peripheral intravenous cannula among patients receiving iv medications: mean, t-test, standard deviation mean phase differences and paired t-test values for normal saline lock group and heparin lock group on days 1,2 and 3 (N=60)

Gro up	Durat ion of the study	Normal saline lock & heparin lock		Mean differe nce	pair ed T-test valu e	P value
		Me an	S.D			
Nor mal salin e lock grou p	Day 1, Day 2	8.60	2.88	3.66	6.2	P<0.001**
	Day1, Day 3	8.60	0.912	6.3	7.1	P<0.001**S
	Day 2, Day 3	12.26	0.912	2.64	6.8	P<0.001**S
Hepa rin lock grou p	Day 1, Day 2	5.17	0.912	0.46	1.68	P=0.36NS
	Day1, Day 3	5.17	0.912	1.108	3.8	P=0.001**S
	Day 2, Day 3	5.63	1.27	0.75	4.2	P<0.001**

		6.7 3	2.0 2			S
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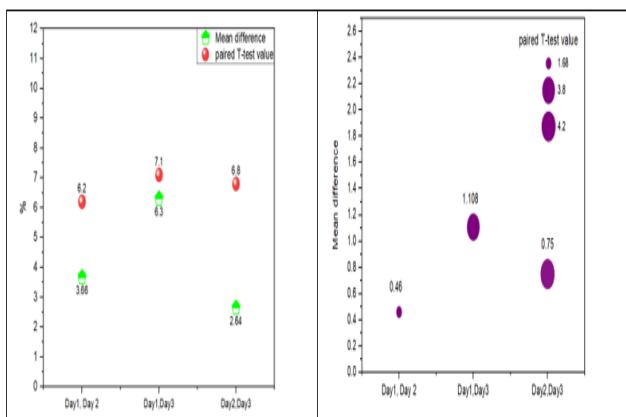


Fig. 4 Plots showing the comparison of the patency of peripheral intravenous cannula among patients receiving iv medications: mean, t-test, standard deviation mean phase differences and paired t-test values for (a) normal saline lock group and (b) heparin lock group

DISCUSSION

The current study reveals that heparin lock significantly outperforms normal saline lock in sustaining peripheral intravenous cannula patency over three days in adult patients receiving intermittent IV medications, with no-blockage rates of 96.67% on day 1 dropping to 30% by day 3 in the heparin group versus 0% in the saline group. Paired t-tests confirmed rapid patency decline in the saline group (e.g., day 1-3 mean difference 6.3, $t=7.1$, $p<0.001$) contrasted by relative stability in heparin (day 1-2 non-significant, $p=0.36$). These outcomes align with meta-analyses demonstrating heparin's superiority in prolonging catheter indwelling time (MD=9.10 hours, 95% CI: 3.30-14.90) and reducing complications (RR=0.84, 95% CI: 0.70-0.95), particularly in neonates but extensible to adults. [11]

Heparin's anticoagulant mechanism prevents early thrombus formation, mirroring findings from randomized trials where low-dose heparin (e.g., 1 U/mL) reduced phlebitis (RR=0.55, 95% CI: 0.39-0.77) and occlusion risks. Unlike studies favoring saline for central lines due to heparin-induced thrombocytopenia concerns, this trial in low-risk adults observed no adverse events, supporting heparin's safety in peripheral use. Demographic balance across groups (e.g., similar age >40 years, mostly non-vegetarian males) isolates intervention effects, consistent with prior RCTs showing heparin reduces reinsertions without elevating bleeding risks in short-term therapy. [12]

Adopting heparin lock could minimize patient discomfort, reinsertion frequency, and costs in medical-surgical wards for intermittent IV access. While some evidence indicates no difference in Chinese adults or arterial lines, peripheral venous contexts favor heparin for patency. Future

multicenter studies with larger samples ($n>60$) and longer durations should explore demographic associations (e.g., BMI, habits) and cost analyses to refine protocols. [13]

CONCLUSION

This study demonstrates that heparin lock is significantly more effective than normal saline lock in maintaining peripheral intravenous cannula patency among adult patients receiving intermittent IV medications over three days in medical-surgical wards at GIMSR Hospital, Visakhapatnam. Key findings from the true experimental design with 60 participants (30 per group) show heparin achieving no-blockage rates of 96.67% on day 1, 76.67% on day 2, and 30% on day 3, compared to rapid decline in the saline group (23.33% to 0%), with paired t-tests confirming statistical superiority (e.g., day 1-3 mean difference 6.3, $t=7.1$, $p<0.001$ for saline vs. minimal change for heparin). No adverse events occurred with low-dose heparin in low-risk adults, aligning with meta-analyses on heparin's anticoagulant benefits in reducing occlusions (RR=0.84) without elevating risks like HIT in peripheral use. These results support revising protocols to prioritize heparin lock for short-term intermittent therapy, minimizing reinsertions, patient discomfort, and costs. Future multicenter trials with larger samples should assess long-term effects, demographic influences (e.g., BMI), and economic analyses to broaden applicability in nursing practice.

Funding: This research did not receive any funding from any government or private institutions.

Data Availability: Data will be made available upon request made to the corresponding author.

Ethical statement

The study was conducted only after approval by the institutional ethical committee, informed written consent from the subject was taken. Samples who were willing to participate were included in the study. Anonymity of study subjects and confidentiality was maintained. Ethical issues associated with heparin lock in iv cannulation patients include ensuring that the study will not cause any side effects to the patients, secondly the study is with minute dose of heparin lock, no additional risk is expected to occur from this study than the standard management protocol.

Patient Consent for Publication: Not applicable.

Competing Interests: All authors confirm that they do not have any conflicts of interest to disclose

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