RESEARCH PAPER

An Experimental Study To Evaluate The Effectiveness Of Intermittent Saline Flushing In Maintaining The Patency Of Peripheral Venous Catheter Among Patients In Selected Hospitals Of Noida, Uttar Pradesh

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ABSTRACT

Background: Peripheral intravenous catheterisation is a commonly used medical technique that offers transient vascular access for administering fluids, medicines, blood products, and many recommended intravenous treatments to patients in a hospital setting. Notwithstanding its prevalent use, maintaining the patency and optimal operation of a Peripheral Intravenous Catheter (PIVC) over the designated treatment period might be difficult. The buildup of blood or pharmaceutical remnants inside the catheter lumen, fibrin development, inadequate flushing, and several catheter-associated issues might result in either partial or total obstruction. Such issues may interrupt current intravenous therapy, need prompt catheter substitution, subject patients to several venipunctures and pain, and elevate the burden on nursing staff. Intermittent saline flushing provides a pragmatic, secure, economical, and nurse-conducted method for maintaining catheter lumen clearance and ensuring ongoing PIVC patency. Hence, the present study aimed to evaluate the effectiveness of intermittent saline flushing in maintaining the patency of peripheral venous catheters among patients admitted to selected hospitals of Noida, Uttar Pradesh.

Method: A quantitative research approach with a parallel-group, two-arm randomized controlled trial design was adopted. A total of 130 patients with peripheral venous catheters were recruited using a non-probability consecutive sampling technique and subsequently randomly allocated in a 1:1 ratio to experimental and control groups, with 65 participants in each group. PIVC patency was assessed using the Peripheral Intravenous Catheter Patency Assessment Checklist (PIVC-PAC) along with collection of socio-demographic, PIVC-related, and clinical information. The experimental group received intermittent flushing with sterile 0.9% sodium chloride solution at eight-hourly intervals using a standardized aseptic pulsatile push-pause technique, whereas the control group received routine PIVC care. PIVC patency was reassessed following the intervention. Data were analysed using descriptive and inferential statistics, including paired t-test, independent t-test, and Chi-square test at the 0.05 level of significance.

Results: The findings reflected a substantial improvement in PIVC patency among participants in the experimental group following intermittent saline flushing. During the pre-test, 27.69% of participants in the experimental group had good patency, 43.07% had satisfactory patency, 21.53% had impaired patency, and 7.69% had poor/non-patent PIVCs. Following the intervention, good patency increased to 55.38%, satisfactory patency was observed in 38.46%, impaired patency decreased to 6.15%, and no participant remained in the poor/non-patent category. In comparison, the control group demonstrated limited improvement, with 27.69% having good patency, 40.00% satisfactory patency, 30.76% impaired patency, and 1.53% poor/non-patent PIVCs during the post-test. The mean PIVC patency score in the experimental group increased significantly from 9.439 ± 1.26 during the pre-test to 29.681 ± 1.01 during the post-test ($t=19.842$, $p<0.001$), whereas the control group showed only a marginal change from 10.283 ± 2.19 to 11.923 ± 1.79 ($p=0.596$). Furthermore, the mean gain score was substantially higher in the experimental group (20.242 ± 0.25) than in the control group (1.64 ± 0.40), with a statistically significant between-group difference ($t=23.715$, $p<0.001$), thereby supporting research hypothesis H_1. Association analysis further revealed that PIVC gauge, primary clinical diagnosis, presence of comorbidity, duration of hospitalization, type of IV therapy, and frequency of IV medication administration were significantly associated with post-test PIVC patency, whereas socio-demographic characteristics and several other PIVC-related variables showed no significant association. Thus, research hypothesis H_2 was partially accepted.

Conclusion: The study concluded that intermittent saline flushing was an effective nurse-led intervention for maintaining and improving peripheral venous catheter patency among hospitalized patients.

Key words: intermittent saline flushing; peripheral intravenous catheter; PIVC patency; intravenous therapy; catheter maintenance; nursing intervention.

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INTRODUCTION

Intravenous therapy is an essential component of modern healthcare and is widely used for the administration of fluids, medications, electrolytes, blood products, and other therapeutic substances directly into the venous circulation.(1,2) Peripheral intravenous catheters are among the most commonly used vascular access devices because they provide a simple, rapid, and minimally invasive route for short-term intravenous therapy.(2,3) They are routinely used among patients admitted to medical, surgical, emergency, perioperative, and other clinical settings.(4)

Maintaining the patency of a peripheral venous catheter is essential for the safe and uninterrupted administration of intravenous therapy. Although insertion of a peripheral venous catheter is a common clinical procedure, maintaining its functional patency throughout the required duration of treatment can be challenging.(5,6) Catheter occlusion, infiltration, phlebitis, leakage, displacement, and other complications may interfere with catheter function and result in premature removal or replacement.(7)

Loss of catheter patency can have important consequences for both patients and healthcare providers. An occluded or non-functional catheter may interrupt prescribed intravenous therapy, delay the administration of medications and fluids, and require repeated catheter insertion.(8,9) Repeated venipuncture may increase pain, discomfort, anxiety, and dissatisfaction among patients while also increasing nursing workload and the utilization of healthcare resources. Therefore, appropriate maintenance of peripheral venous catheter patency is an important aspect of quality nursing care.(8,10)

Several measures are used to maintain peripheral venous catheter function, including appropriate catheter and vein selection, proper stabilization, aseptic handling, regular assessment of the insertion site, prevention of medication incompatibility, and appropriate flushing practices.(4,11) Among these measures, saline flushing is a simple and important nursing intervention used to maintain the functional patency of peripheral venous catheters, particularly when the catheter is used intermittently rather than for continuous infusion.(12,13) Intermittent saline flushing involves the administration of sterile normal saline through the catheter at scheduled intervals and around medication administration. It helps clear residual medication, solution, and blood from the catheter lumen and may reduce the possibility of intraluminal obstruction.(14,15) Regular flushing also provides an opportunity for nurses to assess catheter function and identify early signs of resistance, pain, swelling, leakage, or other indications of catheter dysfunction.(16,17)

Despite the routine use of peripheral venous catheters, premature catheter failure and loss of patency continue to remain important concerns in clinical practice. Variations in flushing practices and catheter maintenance may further influence the functional life of the catheter. Therefore, there is a need to evaluate simple, safe, feasible, and standardized nursing interventions that can improve catheter patency, minimize unnecessary catheter replacement, reduce repeated venipuncture, and promote continuity of intravenous therapy.(8,18–21)

Nurses have a significant role in maintaining peripheral venous catheters because they are directly involved in catheter assessment, medication administration, flushing, monitoring, and early identification of complications.(18,22) Intermittent saline flushing can be easily incorporated into routine nursing care without requiring complex equipment or procedures. Considering the importance of maintaining functional vascular access and preventing premature catheter failure, the researcher planned a study with an objective to evaluate the effectiveness of intermittent saline flushing in maintaining the patency of peripheral venous catheters among patients in selected hospitals of Noida, Uttar Pradesh.

Materials and Methods: The present study adopted a quantitative research approach with a parallel-group, two-arm randomized controlled trial design. The study was conducted among patients with peripheral venous catheters admitted to selected hospitals of Noida, Uttar Pradesh. A total of 130 patients with PIVCs who fulfilled the predetermined eligibility criteria were recruited using a non-probability consecutive sampling technique. Following recruitment and baseline assessment, participants were randomly allocated equally into experimental and control groups using a computer-generated random allocation sequence, resulting in 65 participants in each group. Allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes.

The research instruments consisted of a structured proforma for collecting socio-demographic, PIVC-related, and clinical information and the Peripheral Intravenous Catheter Patency Assessment Checklist (PIVC-PAC) for assessing the functional patency and clinical condition of the peripheral venous catheter. The PIVC-PAC consisted of 25 items with a total possible score ranging from 0 to 50, with higher scores indicating better catheter patency.

The experimental group received Intermittent Saline Flushing with sterile 0.9% sodium chloride solution for one day according to a standardized protocol. The flushing was administered three times at 8-hourly intervals using an aseptic pulsatile push-pause technique and, where applicable, in relation to intermittent

intravenous medication administration. Before and after each flushing procedure, the PIVC site and catheter function were assessed for pain, tenderness, redness, swelling, leakage, infiltration, phlebitis, displacement, obstruction, and other signs of catheter dysfunction. The control group received routine PIVC care without the structured intermittent saline flushing intervention.

Pre-test PIVC patency was assessed in both groups at the first point of contact using the PIVC-PAC. Following one day of intervention, comprising three intermittent saline flushes at 8-hourly intervals, post-test PIVC patency was assessed in both groups using the same instrument. To minimize assessment bias, post-intervention PIVC patency was evaluated by an outcome assessor who was blinded to the participants' group allocation.

Results and Discussion: Obtained information were analyzed and grouped as per objectives of the study. The result reflected in tabular form as follows:

Table-1 Frequency and Percentage Distribution of Socio-Demographic Variables

N-130

Socio-demographic Profile		Experimental group (N=65)		Control group (N=65)		Chi-square	p-value
		F	%	F	%		
Age in years	18-24 years	8	12.3	6	9.23	5.918	0.615
	25-30 years	29	44.61	31	47.69		
	31-35 years	18	27.69	20	30.76		
	>35 years	10	15.38	8	12.3		
Gender	38	58.46	42	64.61	38	2.083	0.842
	27	41.53	23	35.38	27		
Religion	Hindu	26	40	31	47.69	4.398	0.763
	Sikh	19	29.23	16	24.61		
	Muslim	11	16.92	10	15.38		
	Christian	9	13.84	8	12.3		
Marital Status	Married	49	75.38	51	78.46	3.471	0.836
	Unmarried	15	23.07	14	21.53		
	Divorced	1	1.53	0	0.0		
Type of family	Joint family	24	36.92	28	43.07	1.937	0.826
	Nuclear family	41	63.07	37	56.92		
Place of living	Urban	42	64.61	39	60.0	2.861	0.738
	Rural	23	35.38	26	40.0		
Educational status	No formal education	12	18.46	10	15.38	4.836	0.748
	Primary education	14	21.53	15	23.07		
	Secondary education	28	43.07	31	47.69		
	Graduation or above	11	16.92	9	13.84		

Occupational status	House wife	21	32.3	18	27.69	4.619	0.684
	Own business	9	13.84	7	10.76		
	Government	11	16.92	9	13.84		
	Private job	24	36.92	31	47.69		
Family's monthly income	< 20,000	8	12.3	6	9.23	6.438	0.762
	20,001 to 30,000	13	20.0	11	16.92		
	30,001 to 40,000	20	30.76	21	32.3		
	> 40,001	24	36.92	27	41.53		
Dietary Pattern	Vegetarian	19	29.23	23	35.38	2.817	0.638
	Mixed	46	70.76	42	64.61		
PIVC gauge	18G	2	3.07	1	1.53	3.972	0.584
	20G	34	52.3	39	60.0		
	22G	28	43.07	24	36.92		
	24G	1	1.53	1	1.53		
Site of PIVC insertion	Hand	19	29.23	15	23.07	6.381	0.759
	Wrist	13	20.0	12	18.46		
	Forearm	29	44.61	31	47.69		
	Antecubital region	4	6.15	7	10.76		
Side of insertion	Right	42	64.61	47	72.3	1.593	0.482
	Left	23	35.38	18	27.69		
PIVC insertion performed by	Staff nurse	48	73.84	42	64.61	3.284	0.814
	Physician	11	16.92	16	24.61		
	Allied health care personal	6	9.23	7	10.76		
Number of insertion attempts	First	52	80.0	56	86.15	2.762	0.639
	Second	11	16.92	7	10.76		
	≥3 attempts	2	3.07	2	3.07		

Table 1 revealed that, in both the experimental and control groups, the highest proportion of participants belonged to the 25–30 years age group (44.61% and 47.69%, respectively), were male (58.46% and 64.61%), were Hindu (40% and 47.69%), and were married (75.38% and 78.46%). The majority belonged to nuclear families (63.07% and 56.92%) and resided in urban areas (64.61% and 60%). Regarding education, the highest proportion had secondary education (43.07% and 47.69%), while private employment was the most common occupational status, accounting for 36.92% and 47.69% of participants. The highest proportion reported

a family monthly income of more than ₹40,001 (36.92% and 41.53%), and the majority followed a mixed dietary pattern (70.76% and 64.61%).

Regarding PIVC-related characteristics, 20G was the most commonly used PIVC gauge in both groups (52.30% and 60%), and the forearm was the most frequent site of PIVC insertion (44.61% and 47.69%). The catheter was predominantly inserted on the right side (64.61% and 72.30%), and PIVC insertion was most commonly performed by a staff nurse (73.84% and 64.61%). In the majority of participants, PIVC insertion was successfully achieved on the first attempt (80% and 86.15%) in the experimental and control groups, respectively. The obtained p-values for all socio-demographic and PIVC-related variables were greater than 0.05, indicating that the experimental and control groups were homogeneous and comparable at baseline.

Table:2 Comparison of distribution of patency level among participants before and after Intermittent saline flushing among both groups:

Level of Patency of Peripheral Venous Catheter	**Experimental group (N=65)**				**Control group (N=65)**			
	Pre-test		**Post-test**		**Pre-test**		**Post-test**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Good patency	18	27.69	36	55.38	17	26.15	18	27.69
Satisfactory patency	28	43.07	25	38.46	24	36.92	26	40.0
Impaired patency	14	21.53	4	6.15	16	24.61	20	30.76
Poor/non-patent	5	7.69	0	0.0	8	12.3	1	1.53

Table 2 presented that, at pre-test, the highest proportion of participants in both the experimental and control groups had satisfactory PIVC patency (43.07% and 36.92%, respectively), while 27.69% and 26.15% had good patency. Following intermittent saline flushing, 55.38% of participants in the experimental group achieved good patency, compared with 27.69% in the control group. Moreover, impaired patency in the experimental group decreased from 21.53% to 6.15%, and poor/non-patent PIVCs decreased from 7.69% to 0%. In contrast, the control group showed an increase in impaired patency from 24.61% to 30.76%. These findings indicate a marked improvement in PIVC patency among participants in the experimental group following intermittent saline flushing.

Table:3 Effectiveness of Intermittent saline flushing on Patency of Peripheral Venous Catheter among patients:

Groups	**Experimental group**		**Control group**	
	Pre-test	**Post-test**	**Pre-test**	**Post-test**
Mean	09.439	29.681	10.283	11.923
Standard Deviation	1.26	1.01	2.19	1.79
t-test	19.842		08.593	
P value	<0.001		0.596	

Table 3 revealed a substantial improvement in the Patency of Peripheral Venous Catheter (PIVC) scores among participants in the experimental group following intermittent saline flushing. The mean pre-test patency score was 9.439 ± 1.26, which increased markedly to 29.681 ± 1.01 in the post-test. The obtained t-value was 19.842 with $p<0.001$, indicating a statistically significant improvement in PIVC patency following the intervention.

In the control group, the mean patency score increased only slightly from 10.283 ± 2.19 in the pre-test to 11.923 ± 1.79 in the post-test. The obtained t-value was 8.593 with $p=0.596$, indicating that the difference between the pre-test and post-test patency scores in the control group was not statistically significant. These findings demonstrate that intermittent saline flushing was effective in significantly improving and maintaining peripheral venous catheter patency among participants in the experimental group.

Table:4 Effectiveness of Intermittent saline flushing on patency of PVC among patients by comparing among both groups:

Groups	**Mean Gain**	**SD**	**Mean difference**	**t-value**	**p-value**

	score				
Experimental group	20.242	±0.25	18.602	23.715	<0.001
Control group	1.64	±0.4			

Table 4 revealed that the experimental group demonstrated a substantially higher mean gain in PIVC patency score (20.242 ± 0.25) compared with the control group (1.640 ± 0.40), with a mean difference of 18.602. The difference in mean gain scores between the experimental and control groups was statistically significant ($t = 23.715$, $p < 0.001$), confirming the effectiveness of intermittent saline flushing in improving and maintaining the patency of peripheral venous catheters among patients.

DISCUSSION:

The findings of the present study clearly revealed that peripheral venous catheter patency improved markedly among patients in the experimental group following intermittent saline flushing, whereas participants in the control group receiving routine care showed only minimal improvement. The findings indicate that intermittent flushing with normal saline at regular intervals can help maintain catheter functionality and reduce the occurrence of impaired or poor catheter patency. Similar findings have been reported in previous studies, such as a study by James & Bromeo (2025) has stated the similar findings by stating that normal saline flushing is effective on patency of peripheral venous cannula, as there were significant changes observed in between pre and posttest observations.(23) Another investigation by Deng et al (2025) has supported the present study by stating that maximum studies has found that flushing to peripheral IV catheter has improved the perfusion level of the located PVC.(24) Study by Mohamed et al (2025) has favored the current study findings by mentioning that patients received the intermittent normal saline flushing were having intact IV fluid and medication supply.(15) Study by Pundalik et al (2021) has completely supported existing investigation by supporting that there was a significant effectiveness of intermittent saline flushing for maintaining the patency of PVC among experimental and control groups.(25) A study by Saliba et al (2020) has communicated their findings in support to present study and stated that patients received normal saline flushing were found with less PVC failure compare to other patients PVC, that indicated that saline flushing is an effective method for maintenance of PVC.(26)

Limitations of the study

- The study was conducted among 130 patients with PIVCs in selected hospitals of Noida, Uttar Pradesh, which may limit the generalizability of the findings to other settings and populations.
- PIVC patency was assessed over a short intervention period without long-term follow-up to determine sustained catheter patency.
- Complete blinding was not feasible because intermittent saline flushing was an observable clinical intervention, which may have introduced some degree of bias.
- The study primarily evaluated PIVC patency and did not assess other outcomes such as catheter dwell time, reinsertion, patient discomfort, nursing workload, and cost-effectiveness.

CONCLUSION:

The findings of the present study revealed that peripheral venous catheter patency was comparable between the experimental and control groups before the intervention. Following Intermittent Saline Flushing, a marked improvement in PIVC patency was observed among patients in the experimental group, whereas the control group showed only minimal improvement. The significantly higher post-test patency and mean gain scores in the experimental group demonstrated the effectiveness of intermittent saline flushing in maintaining peripheral venous catheter patency. Overall, the study concludes that Intermittent Saline Flushing is an effective nursing intervention for maintaining PIVC patency, thereby promoting uninterrupted intravenous therapy and reducing the risk of catheter dysfunction and unnecessary catheter replacement.

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