

Research Article

Effect of joint immobilization on the lifespan of intravenous cannula: a randomised controlled trial

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ABSTRACT

Background: The use of peripheral intravenous cannulas (IVCs) for the purpose of providing fluid and medications to the newborn is a consistent requirement in Neonatal Intensive Care Units (NICUs). Proper securement of cannulas can preserve catheter life. However; no consensus is available on the factors affecting the duration of patency. The present study was a randomized controlled trial designed to compare the effect of limb splinting versus non-splinting with the functional duration of peripheral IV cannula in neonates requiring IV infusion and/or medications.

Methods: This prospective interventional study was conducted over a period of 5 months in the NICU of Father Muller Medical College. Eligible cannulations were randomised to either “splint” or “no-splint” group. In the splint group, firm splint covered with sterile gauze was used to immobilise the joint at the peripheral IV cannula site. No attempt was made to immobilise the limb in the no-splint group. Duration from time of insertion to removal on the basis of predefined criteria was measured.

Results: A total of 449 peripheral IV cannulations in 390 newborns were randomized to either the splint (n= 230) or no-splint group (n=219). After exclusion, 202 cannulations in the splint group and 184 cannulations in the no-splint group were analyzed. The median survival time of IVC in the splint group was marginally more compared to the no-splint group (h; 51.08 hours (SD 32.6) vs. 50.93 (SD 33.1), mean difference 0.9 hours, p value 0.807). Extravasation at the peripheral infusion site was the commonest indication for cannula removal in both the groups occurring more in the splint group (93.6 % versus 85.3%).

Conclusions: This study concludes that the application of limb splinting for intravenous cannulation only marginally prolongs the duration of the cannula and thus may not be useful. The authors believe that there is a need for more larger, planned RCTs involving specific variables to come to scientifically valid, evidence- based guidelines.

Keywords: Intravenous cannula, Splint, Neonate

INTRODUCTION

A Neonatal Intensive care unit is home to numerous procedures, one of them being peripheral intravenous (PIV) access which provides for administration of medications and fluids.¹ It is the one of the most common procedures done in neonatal intensive care unit.²

Repeated venipunctures increases the risk of infections and stress in the neonate resulting in adverse effects on health and long-term neurodevelopmental outcome.³

Reduction in infection risk, pain and stress to neonates may be achieved by measures to lengthen the functional period of a peripheral IV cannula. One such method was the development of softer, flexible, easily insertable cannula compared to scalp vein needles used in the past.⁴

Immobilization of the limb using splints is a widely used traditional method to prolong the functional duration of cannulas. There is no clear evidence to support the fact that the use of splints increases the functional duration of cannulas.⁴ It has been known to promote extravasation as well as reduce the visibility of the cannula site masking early phlebitis.⁵

METHODS

A randomised controlled trial was conducted in the NICU of a tertiary care hospital from March 2015 - July 2015. All preterm and term neonates anticipated to require peripheral IV infusion and/or medications for an expected period of >48 hours were enrolled.

Eligible cannulations were randomised to either “splint” or “no-splint” group. In the splint group, a firm splint covered with a sterile gauze was used to immobilise the joint at peripheral IV cannula site and no such attempt was made in the no-splint group.

A random number sequence was generated using a web-based random number generator divided into 6 sets of 75 numbers each and were kept in serially numbered, opaque and sealed, identical envelopes.

Prior to the onset of the study, all healthcare personnel (postgraduates, junior nursing staff, senior nursing staff) involved in insertion and fixation of cannulas in the NICU were provided with instructions on the technique of insertion and fixation of peripheral IV cannula at various joints.

The IV's used were twenty-four and twenty-six gauge peripheral IV cannula (BD Neoflon, Becton Dickinson India Pvt. Ltd, Haryana, India) supplied by the hospital. Standardized technique for cannula insertion and fixation was used in both the groups.

After insertion and fixation, the cannula site was monitored for development of signs of removal (extravasation, blockage, signs of inflammation) by a resident or nurse on-duty. The time from insertion of the peripheral IV cannula to the development of our predefined signs of cannula removal was noted.

We also recorded an Infusion score grading from 0-4 as defined by Visual Infusion Phlebitis (VIP) scale.⁶ A neonate could be enrolled more than once with each eligible cannulation being randomised independent of group allocation of previous cannulation. If a baby no longer needed the cannula for a clinical indication or no longer required continuous IV fluids, time to such an event was noted.

The institutional ethics committee cleared the protocol. All baseline and outcome data were recorded prospectively in a predesigned and pretested data collection form. The data was checked for completion,

consistency and accuracy. Univariate analysis was carried out to compare the groups. Analyses of relationships between factors were conducted using Chi-square and statistical significance was established at $p < 0.05$. Data was analysed using the software SPSS software version 13.0.

RESULTS

A total of 449 peripheral IV cannulations in 390 newborns were inserted during the study period in neonates with birth weights ranging from 750 to 4,100 grams (median; 1800 grams) and gestational age varying from 28 to 42 weeks (median; 36 weeks). After exclusion of cases owing to premature stoppage of fluids than our established time, our analyzed group consisted of 202 cannulations in the splint group and 184 cannulations in the no-splint group. The cumulative lifespan of these 386 cannulas summed up to 19690 hours. The mean duration of insertion was 51.01 ± 32.71 hours.

Figure 1 provides the participant flow as per CONSORT guidelines.⁷ Baseline characteristics of neonates enrolled in the study along with infusion details are summarized in Table 1.

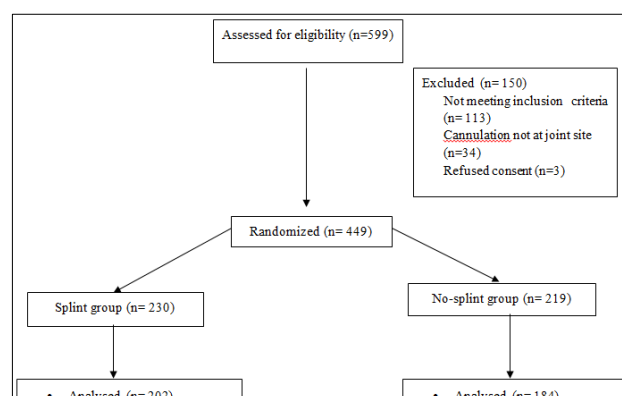


Figure 1: CONSORT 2010 showing study flow chart.

In the splint group, 62.9% of the neonates enrolled were females, 49% were late preterm and 33.2% were VLBW babies. The most common site of cannula insertion was at the wrist joint (91.1%), followed by ankle (7.9%) and lastly elbow joint (1%).

In the no-splint group, 57.6% of the neonates enrolled were females, 50% were late preterm, 36.4% VLBW babies. The most frequent site of cannula insertion was at the wrist joint (89.7%) followed by ankle (9.8%) and lastly elbow joint (0.5%).

The most frequent reason recorded for loss of IV site was extravasation, followed by cannula blockage. In the splint group, 93.6% reported extravasation rate was lower (85.3%) with a statistically significant p value of 0.01.

Table 1: Baseline characteristics of enrolled neonates.

Baseline variable	Splint group (202)	No splint group (184)	P value
Male	75	78	0.29
Female	127	106	
Preterm <34 weeks	49	36	0.607
Late preterm	99	92	
Term	54	56	
<2.5 kgs	116	90	0.01
>2.5 kgs	86	94	
NVD	96	108	0.03
LSCS	106	76	
Wrist	284	165	0.69
Ankle	16	18	
Elbow	2	1	
PG inserter	51	38	0.23
Junior nurse	86	94	
Senior nurse	65	52	
Extravasation	189	160	0.011
Blockage	12	20	
Inflammation	0	5	
Infusion score:			0.31
0	1	5	
1	96	79	
2	79	74	
3	26	25	
4	0	1	
Time cannula lasted (in hrs)	51.08 (SD 32.61)	50.93 (SD 33.01)	0.807

We also found that nurses primarily performed cannula insertion with 46.6% being done by junior nurses followed by 30.3% by senior nurses and only 23.1% done by resident postgraduates.

Mean functional duration of the peripheral IV cannula without splint was found to be 50.93 hours (SD 33.01) while that with splint was 51.08 hours (SD 32.61) in our NICU. It was also noticed that in the splint group, even though 37.1% of the neonates received intravenous calcium as opposed to 26.1% in the no-splint group, the difference in mean functional duration was only marginally higher.

DISCUSSION

The use of splints to immobilize and provide stability to the limb is a familiar practice used to lengthen the functional lifespan of PIV catheters. It has been suggested that securement of PIV catheters can reduce the number of risk factors associated with continuous infusion, thereby diminishing the need for repeated cannulization.⁸

Only few studies have attempted to identify exactly how long the cannulas last once inserted or whether their lifespan is amenable to prolongation by manipulating

certain cannula or treatment variables. Various factors such as cannula size, site, use of various medications and different IV fluids are also believed to affect the cannula patency.

Bilal⁴ addressed the same question in their review of various databases which yielded three different studies (two RCT, one observational cohort) comparing the survival of cannula with and without splint. These studies demonstrated no improvement in functional duration with neonatal splint usage, but it should be noted that the RCT excluded cannulae over common sites such as hands and feet.

Tripathi and colleagues¹ conducted a randomised control trial in a paediatric ward and concluded that usage of splint improves patency of cannulas especially in younger patients without any increase in the complications. Out of the 82 subjects, 32% were neonates and the use of splints compared to no splint significantly prolonged duration of catheter patency, with a mean duration of 50.29 hours compared to 39.75 hours respectively. The authors found that they significantly prolong survival, especially in younger patients. There was no increased risk of complications associated with splint use.

Splint application was one of the factors examined by Gupta and colleagues⁵ in a prospective survey of PIV practices in a single NICU in India. In this study, splints were used at the discretion of staff nurses. A splint was used in 69 (37.1%) catheters with median survival time of an IV cannula being 40 hours (SE, 2.49; 95% CI, 35.12 to 44.88). No significant differences in the functional lifespan of PIV catheters were found for various factors including the application of splints. They concluded that the median survival time of IVCs in their setup was comparable with those in developed countries and was not governed by the cannula or patient variables.

Similarly, a more recent RCT was conducted by Dalal and colleagues,⁹ which aimed to evaluate the efficacy of splinting the joint on the functional duration of peripheral intravenous catheter in neonates. Over an 8-month period, 54 preterm and term neonates were enrolled into the study, where 69 cannulations were performed and included into the study. The mean functional catheter lifespan was less in the splint group compared to the no-splint group, although this difference was not statistically nor clinically significant [23.5 hours (SD 5.9) vs. 26.9 hours (SD 15.5); mean difference -3.3, 95% CI: -11 to 4.3, $p=0.38$]. Extravasation at the catheter site was the most common reason for catheter removal in both groups (84% vs. 76.5% of cases). The authors hypothesized that when splints are used and are proximally secured with tape, the resulting pressure placed on the draining veins may consequently promote extravasation. In our study also, extravasation was observed more frequently in the splint group compared to non-splint group ($p<0.05$).

The present study addresses a common practice issue through a randomization trial in the NICU setting. The current study was conducted in a single NICU thereby, limiting the applicability of this information to other settings. A similar study carried out in a broader setting would assist in validating the results of this study. As it was a hospital-based study the prevalence of exposure and outcome variables may be different from a community setting. Blinding of the observers monitoring for signs of removal was not possible due to the nature of the intervention, which might have introduced some bias.

Currently, there is no consensus on the optimal method of PIV catheter securement due to the paucity of scientific research in the neonatal population.

CONCLUSION

It can be stated that application of a splint to immobilize the joint while using a peripheral IV cannula does not prolong the functional duration of the cannula. There is limited available evidence regarding the functionality of splints in improving the duration on cannulas in neonates. A well designed, multicenter, randomized, control trial is needed to reach a confident conclusion.

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Ethical approval: The study was approved by the institutional ethics committee

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