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Original Research Article

A randomised controlled trial on effect of splinting a joint on the lifespan of intravenous cannula in pediatric patients

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ABSTRACT

Background: Children admitted to hospital and ICUs for various reasons like sepsis, respiratory distress, dehydration, shock etc. require an intravenous line for medications and IV fluids. Properly securing an intravenous line is very important. It is equally important to maintain the patency of the intravenous line for longer periods of time. But there is no adequate data regarding factors affecting the duration of patency of an IV line. This study was done to compare effect of limb splinting versus non-splinting with the functional duration of peripheral IV cannula.
Methods: This study was done over 3 months between October - December 2018 in pediatric patients (age 6 months to 5 years) admitted to Kempegowda Hospital. Patients were randomised into splint group and non-splint group. In the splint group a firm splint was applied to the joint that was cannulated. No such intervention was done in the non-splint group. Time from IV line placement to removal was measured.
Results: Total 438 patients were taken into study. After exclusion 200 patients were given a splint and 200 were not splinted. The median survival time was more in splint group when compared to non-splint group.
Conclusions: This study shows that splinting helps to maintain patency of IV line for a more longer duration than non splinting of the joint.

Keywords: Extravasation, Intravenous cannula, Splint

INTRODUCTION

Intravenous cannulation is where a cannula is inserted into a vein providing venous access for sampling of blood and administration of fluids, medications, parenteral nutrition, chemotherapy, blood products etc.[1] Children admitted to hospitals undergo peripheral venous cannulation for administration of various medications and intravenous (IV) fluids. Some children require an IV line for a longer period of time due to various reasons. Anxiety, pain, and needle phobia occurs if child is repeatedly pricked to place an IV line. Adequately preparing the child helps reduce its distress. Some children, like those with congenital heart disease or single ventricle physiology, pose a great risk of decompensation with multiple IV attempts.[2]

Repeated cannulations increases the risk of infections and stress in infants and children. Another disadvantage of multiple cannulations is the increased anxiety amongst parents and more tendency towards refusal of treatment.

Hence methods used like splint application to prolong the patency of an IV cannula may reduce the number of cannulation attempts and prevent the aforementioned complications. How a splint helps can be explained by the fact that it restricts limb movement and kinking of intravenous catheters thereby allowing free flow of intravenous fluids.[3] It also ensures proper positioning. Splints increase the duration of catheter patency.

This study was done to prove the efficacy of splinting a joint on the duration of patency of an IV cannula. We

hypothesised that in children, splinting a limb would prolong the functional duration of an IV cannula as compared to no immobilisation.

METHODS

A randomised control trial was conducted over 3 months between October -December 2018 in pediatric patients (age 6months to 5 years) admitted to Kempegowda Hospital, Bangalore. A total of 438 children were taken up for the study.

Inclusion criteria

All children requiring an IV line were included in the study.

Exclusion criteria

Children who came to the hospital with IV line in situ or who required more than 3 attempts to place the intravenous catheter were excluded from the study.

Cannulations which were one of the first three successful ones performed in eligible children, with the line inserted over one of the major joints, being either the wrist, elbow, ankle was included and were randomised to ''splint'' or ''no-splint'' groups.

Randomisation was done by the following method. A random number sequence was generated in a fixed block size of four each using a web-based random number generator. The random codes were kept in serially numbered, opaque and sealed, identical envelopes. The children were subsequently randomised into splint group and non-splint group.

Help was taken from junior residents and staff nurses. A 24 gauge needle was used for iv cannulation. Prior to iv cannula insertion all the staff nurses and junior residents involved in iv cannulation were instructed about the procedure of iv cannulation.

After cannulation a firm splint made of plastic with the inner side covered by soft sponge was used for the splint group. No similar intervention was done for the no splint group. After insertion the cannulated site was monitored for any signs of removal which included -

- Any swelling at the iv cannula site indicating extravasation
- Any blockage indicated by the increased pressure experienced while giving any medications through the cannula.
- Any signs of inflammation

Time from insertion to removal of IV line was measured and noted for both groups.

RESULTS

A total of 438 patients were admitted during the study period. After meeting the inclusion criteria and after randomisation 200 children were taken up into the splint group and 200 into the no splint group. 38 children were excluded. In the splint group 57% were males and 43% females while in no splint group 61% were males and 39% were females (Table 1).

Table 1: Comparison of study variables between splint and no-splint group.

Characteristics		Splint group (N=200)	No splint group (N=200)	p value
Age in years in Mean(SD)		6.1 (4.8)	7.2 (4.6)	0.02*
Gender	Male	114 (57)	122 (61)	0.41
	Female	86 (43)	78 (39)	
Number of days of IV cannula lasted in Mean(SD)		3.0 (0.7)	2.3 (0.7)	0.001*
Extravasation	Yes	141(70.5)	155(77.5)	0.11
	No	59 (29.5)	45 (22.5)	
Blockage	Yes	62 (31)	39 (19.5)	0.008*
	No	138 (69)	161(80.5)	
Signs of inflammation	Yes	7 (3.5)	7 (3.5)	0.99
	No	193(96.5)	193(96.5)	

Note: Data expressed in mean (standard deviation) or n (%); # p value based on independent sample t test, others chi-square test; * Statistically significant (p<0.05).

Of the total cannulations the splint group showed to last longer than the no splint group. The splint group lasted for a mean of 3 days while the no splint group lasted for a mean of 2 days and 3 hours. The most common reason for loss of the IV cannulation was because of extravasation i.e. 70.5% amongst the splint group and

77.5% amongst the no splint group. The next most common reason for iv cannula loss was due to blockage i.e. 31% in splint group and 19.5% in no splint group. The least common cause was due to inflammation i.e. 7% in each group.

DISCUSSION

The study conducted by us in conclusion showed that the patency of the IV cannula can be maintained longer by splinting the joint which has been cannulated as it provides joint immobility. Our study provides the advantage of studying older children. Also the sample size can be considered another advantage

Many studies have been done on neonates in NICU regarding the same issue but more studies are required to study the effect of a splint on IV cannula patency in older children.

The utilisation of splint along with intravenous cannulas in order to provide joint stability and immobilize the particular joint cannulated is considered a very common practice. This practice along with many others, is used to lengthen the functional lifespan of the IV cannula. Such practice has shown that the number of risk factors associated with continuous infusion reduces to a considerably good level, hence diminishing the need for repeated cannulization.[4]

There are a few studies only which have identified exactly, the duration of the lifespan of the cannulas after being inserted. Some of the studies also discuss whether the IV cannula's lifespan is responsive to prolongation by changing certain cannula or treatment variables. Other factors including size of the cannula, site of insertion, use of a variety of medications and various Intra Venous fluids are also believed to affect the cannula patency.

Bilal addressed a similar question in their review of various databases comparing the survival of cannula with and without splint.[5] In their review three different studies (two RCT, one observational cohort) were involved which demonstrated no improvement in functional duration with neonatal splint usage, but it should be taken note of that the RCT excluded cannulae over common sites such as hands and feet.

Tripathi et al conducted a randomised control trial in a paediatric ward.[6] They arrived at a conclusion that usage of splint improves patency of cannulas. 82 subjects were taken up of which 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. It was also found that they significantly prolong survival, especially in younger patients. There was no increased risk of complications associated with splint use.

Gupta and colleagues examined splint application in a prospective survey of peripheral intravenous cannulation practices in one NICU in India.[7] In this study, splints were used at the discretion of staff nurses. Splints were 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 the intra venous catheters were found for various factors including the application of splints. It was concluded that the median survival time of intra venous catheters in their setup was comparable with those in developed countries and was not governed by the cannula or patient variables.

A randomised controlled trial conducted by Dalal and colleagues in the recent past was aimed at the evaluation of the efficacy of splinting the joint on the functional duration of peripheral intra venous catheter in neonates.[8] Over a period of 8 months, 54 preterm and term neonates were taken up for the purpose of 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. But this difference was not statistically or 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). The most common reason for removal of the intra venous catheter was extravasation at the catheter site in both groups (84% vs. 76.5% of cases). Dalal et al theorised that when splints are used and are secured with tape at the proximal end a pressure is being placed on the draining veins thereby, probably consequently causing the extravasation.

Another randomised controlled trial conducted by Dr.Megha raghavan et al, in neonates in the NICU, showed the following findings: 449 peripheral IV cannulations in 390 newborns were inserted during the study period in neonates. 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). The most common cause for the loss of intra venous cannula was extravasation, followed by cannula blockage. 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.[9]

Extravasation was observed more frequently in the splint group compared to non-splint group in our study also. Our study happens to address quiet a common practice issue via randomization in the general pediatric ward. Our study carries the advantage of a larger sample size. Also our study considers a wide age range as compared to most of the other studies. 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.

The limitations of this study were that blinding of the observers monitoring for signs of removal was not possible because of 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. Neonatal and paediatric patients require limb splinting to preserve intravascular access.

Limb boards used in splinting have been implicated in pressure injury development. Hence while applying a splint care should be taken to avoid applying the splint too tightly.[10]

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