Limb splinting for intravenous cannulae in neonates: a randomised controlled trial

S S Dalal,1 D Chawla,2 J Singh,1 R K Agarwal,1 A K Deorari,1 V K Paul1

ABSTRACT

Objective: To evaluate the efficacy of peripheral intravenous (IV) cannula site joint immobilisation by splint application on functional duration of peripheral IV cannula in neonates.

Design: Randomised controlled trial.

Setting: Neonatal intensive care unit of a tertiary care hospital.

Participants: Neonates requiring continuous IV infusion for an expected duration of more than or equal to 72 hours.

Intervention: Eligible cannulations were randomised to either “splint” or “no-splint” group. In the splint group, a cardboard splint was used to immobilise the joint at peripheral IV cannula site. No attempt was made to immobilise the limb in the no-splint group.

Outcome measure: Functional duration of a peripheral IV cannula measured as interval from time of insertion to the development of predefined sign of removal (extravasation, blockage, inflammation).

Results: A total of 69 peripheral IV cannulations in 54 neonates were randomised to either the splint (n = 33) or no-splint group (n = 36). Both groups were comparable in birth weight, gestation, site of cannulation and nature of fluids administered. Mean functional duration of cannula was lesser in the splint group compared to the no-splint group (h; 23.5 (SD15.9) vs 26.9 (SD15.5), mean difference: −3.3 h, 95% CI −11.02 to 4.3 h) although the difference was not statistically significant (p = 0.38). Extravasation at cannula site was found be the commonest indication for cannula removal in both the groups (84% vs 76.5%).

Conclusion: Joint immobilisation with splint at cannula site did not improve the functional duration of peripheral IV cannula.

METHODS AND SETTING

Study was conducted as a randomised controlled trial in neonatal intensive care unit (NICU) of a tertiary care hospital. All preterm and term neonates admitted in the NICU and anticipated to require peripheral continuous IV infusion for an expected period of ≥72 hours were eligible for enrolment into the study. Neonates with major congenital malformations were excluded. An eligible cannulation was defined as one of the first three successful cannulations performed in eligible neonates with cannula being inserted over one of the four major joints, that is, wrist, elbow, knee or ankle. Eligible and successful cannulations were randomised to “splint” or “no-splint” groups. A neonate could be enrolled more than once with each eligible cannulation being randomised independent of group allocation of previous cannulation. Allocation of group was done by randomisation. 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.

Identical procedure for cannula insertion and fixation was used in both of the groups. Senior (neonatology training fellows) and junior (paediatric residents) residents were responsible for IV cannulation, while nurses assisted them in fixing the cannula. Twenty-four gauge peripheral IV cannulae (BD Neoflon, Becton Dickinson India Pvt. Ltd, Haryana, India) supplied by the hospital were used for cannulation in all neonates. Prior to the onset of the study, all healthcare personnel involved in insertion and fixation of cannula in the NICU were provided with instructions on the technique of insertion and fixation of peripheral IV cannulae at various joints. In the splint group, a splint made up of cotton and gauze piece rolled over a hard cardboard piece was applied to the limb immediately after fixing the cannula, as per the standardised method, to prevent movement at the underlying joint. Dimensions of the splints used were standardised as length extending two inches on either side of the joint and width equal to the width of the limb just proximal to the joint. In the no-splint group the cannula was fixed, as per the standardised method, and no effort was made to immobilise the joint. IV fluids and drugs were administered using syringe infusion pumps. After insertion and fixation, the cannula site was monitored for development of sign of removal every 2 hours by a resident or nurse on-duty. The sign of removal was defined as presence of any one of the following:

- extravasation—characterised by swelling and oedema at the cannula site
- blockage—indicated by high occlusion on infusion pump
- inflammation—characterised by swelling, redness and raised temperature or tenderness over the cannula site.

Figure 1  Study flow chart. *Up to three successful cannulations in each eligible neonate could be enrolled and randomised.

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 functional duration of the cannula was measured in hours, from time of insertion to time of development of a sign of removal. As part of the clinical protocol we did not use intermittent flushes or heparin lock to maintain patency of IV cannula. We also avoided using muscle relaxants or sedatives.

Mean functional duration of the peripheral IV cannula without splint was found to be 48 hours (SD36 hours) in our NICU in a pilot study (unpublished). To detect a difference of at least 24 h with 80% power and 95% confidence interval (CI), we needed to enrol 36 peripheral IV cannulations. The protocol was cleared by the Institutional Ethics Committee. Informed written consent was taken from one of parents of enrolled newborns.

All baseline and outcome data were recorded prospectively in a predesigned and pretested data collection form. The data were checked for completion, consistency and accuracy. Data were analysed using the software Stata V.9.1. Group characteristics were compared with χ² test and two-sample t test for discrete and continuous variables respectively. A p value of <0.05 was taken as statistically significant. Analysis was by intention to treat.

RESULTS

The study was conducted from November 2006 to July 2007. Figure 1 provides the participant flow as per CONSORT guidelines.4 A total of 387 neonates were admitted to NICU during the study period. Of these, 54 neonates were enrolled into the study and 69 cannulations performed on these neonates were included into the study. Out of the 69 cannulations enrolled, one cannulation in each group was excluded from analysis as the cannulation site was not over a joint. One
patients, only two significant infiltrations (1%) were observed in
and the factors influencing the life span of an IV cannula. During a
neonatal intensive care unit to ascertain the rate of complications
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study, therefore, attempts to resolve the issue of the usefulness of
issue has never been studied in a controlled trial. The present
peripheral IV cannula insertion has remained unresolved as this
DISCUSSION

The usefulness of splint application to immobilise the joint after
peripheral IV cannula insertion has remained unresolved as this
issue has never been studied in a controlled trial. The present
study, therefore, attempts to resolve the issue of the usefulness of
splint in prolonging the functional duration of a peripherally
inserted IV cannula through a randomised controlled trial. Johnson et al surveyed prospectively peripheral IV cannula use in a
neonatal intensive care unit to ascertain the rate of complications
and the factors influencing the life span of an IV cannula. During a
three-month period in which 199 IV cannulae were inserted in 69
patients, only two significant infiltrations (1%) were observed in
more than 5000 hours of IV therapy. None of the factors studied,
including weight, age, type and rate of fluid administration, and
type of medication (except pancuronium bromide), had any
discernible effect on the functional life span of IV cannulae.

In another similar study Gupta et al studied variables affecting life span of a peripheral IV cannula in a NICU of a
developing country. The median survival time of an IV cannula,
as expressed by Kaplan-Meir survival analysis, was 40 hours
(SE, 2.49; 95% CI, 35.12 to 44.88). Birth weight, gestation,
application of splint, fluid and glucose infusion rate, site of
 cannulation and administration of antibiotics (ampicillin, gentamycin, amikacin, vancomycin) phenobarbitone, blood
products, or calcium gluconate did not influence the median
life span of IV cannulae.

In present study, mean functional duration of peripheral IV
cannulae in both groups was less than as reported by Gupta et al. This is probably due to the enrolment of a greater number of
premature babies in the present study. Splint application was
found to be associated with a decrease in functional duration of a
peripheral IV cannula, although the difference was not
statistically significant. This effect is more pronounced in
neonates with lower gestational age (gestational age <30 weeks); however, the number of subjects in this group
was too small to draw any conclusion. Extravasation at the
cannula site is found to be the commonest indication for
cannula removal. From these observations it can be hypothesised that splint application may promote extravasation by
causing pressure on the draining veins via the adhesive tape used
for fixing the splint proximally. Infants with a lower gestational
age have immature thin walled veins with poor vascular tone,
predisposing them to greater risk of extravasation even with
slight external pressure. The type of fluid administered may also
affect the rate of extravasation. Irritant fluids may cause early
extravasations, however, there was no difference in the nature
of fluid administered in the two groups. Also, previous studies
have found no effect of type and rate of fluid administration on
functional life span of the peripheral IV cannula. The present
study addresses a common practice issue through a randomisa-
tion trial in NICU 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.

In conclusion, it can be stated that application of a splint to
immobilise the joint while using a peripheral IV cannula does
not prolong the functional duration of the cannula.

Competing interests: None.

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