Original Articles

Does elective re-siting of intravenous cannulae decrease peripheral thrombophlebitis? A randomized controlled study

S. NISHANTH, G. SIVARAM, R. KALAYARASAN, VIKRAM KATE, N. ANANTHAKRISHNAN

ABSTRACT

Background. Peripheral venous thrombophlebitis (PVT) is a common complication of intravenous cannulation, occurring in about 30% of patients. We evaluated the effect of elective re-siting of intravenous cannulae every 48 hours on the incidence and severity of PVT in patients receiving intravenous fluids/drugs.

Methods. We randomized 42 patients who were admitted for major abdominal surgery to either the control or study group ($n = 21$ in either group). Informed consent was obtained from all of them. Cannulae in the control group were removed only if the site became painful, the cannula got dislodged or there were signs and symptoms suggestive of PVT, namely pain, erythema, swelling, excessive warmth or a palpable venous cord. Cannulae in the study group were changed and re-sited electively every 48 hours. All the patients were examined every 24 hours for signs and symptoms of PVT at the current and previous sites of infusion.

Results. The incidence of PVT was 100% (21/21) in the control group and only 9.5% (2/21) in the study group ($p < 0.0001$). The severity of PVT was also less in the study group compared with that in the control group. Day-wise correlation of the incidence of PVT showed that 82.6% of the episodes of PVT occurred on day 3.

Conclusion. Elective re-siting of intravenous cannulae every 48 hours results in a significant reduction in the incidence and severity of PVT. We recommend that this should be adopted as standard practice in managing all patients who require prolonged intravenous therapy.

Natl Med J India 2009;22:60–2

INTRODUCTION

Peripheral venous thrombophlebitis (PVT) is common in patients who receive intravenous therapy, and accounts for considerable iatrogenic morbidity. The incidence of thrombophlebitis associated with peripheral intravenous catheters (PIVC) has been reported to range from 25% to 35%.[1] One key factor that increases the risk of thrombophlebitis is the duration of the cannula remaining *in situ.* The present clinical practice is to wait for signs and symptoms of PVT to manifest before the cannula and its site are changed. In addition to causing distress to the patient, the cannula can cause infection and fever, masking the fever of the underlying disease, thus posing diagnostic and therapeutic problems. Other effects include increased healthcare costs due to prolonged hospitalization, need for additional antibiotic therapy and, rarely, surgical intervention.[2] In patients receiving peripheral parenteral nutrition, it has been shown that an elective change of the intravenous cannula results in a marked reduction in the incidence of PVT.[3] Hence, we studied the effect of an elective change of a short intravenous cannula every 48 hours on the incidence and severity of PVT in surgical patients receiving intravenous crystalloids or drugs.

METHODS

This prospective, randomized, controlled unblinded study was conducted in the Department of Surgery, Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER) between May and June 2006. Ethical approval was obtained from the Institute Ethics Committee. The event rates in the control and study groups were assumed to be based on a study done by Barker *et al*. on the elective re-siting of intravenous cannulae[4] and the sample size was calculated using the PS software.[5] We wanted to avoid a type 1 error of 5% and type 2 error of 20%.

Forty-two patients admitted for major abdominal surgery were included in the study after obtaining informed consent (n=21 in either group). The clinical profile of these patients was noted as per a pre-designed proforma. Patients were excluded if they were receiving total parenteral nutrition (TPN), if the duration of requirement of intravenous therapy was <3 days, if they already had a cannula *in situ* or if they were terminally ill (Fig. 1). The patients were allocated to either the study or the control group using block randomization–restricted randomization method. The patients were divided into 6 blocks with a block size of 8 or 10 or 12 arranged randomly. Within each of these blocks the study and control groups were randomly arranged using computer generated random numbers. Finally, the group name was placed on an opaque serially numbered sealed envelope (SNOSE). After assessing the eligibility and obtaining informed consent, the

Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry 605006, India

S. NISHANTH, G. SIVARAM, R. KALAYARASAN, VIKRAM KATE, N. ANANTHAKRISHNAN Department of Surgery

Correspondence to VIKRAM KATE; *drvikramkate@gmail.com*

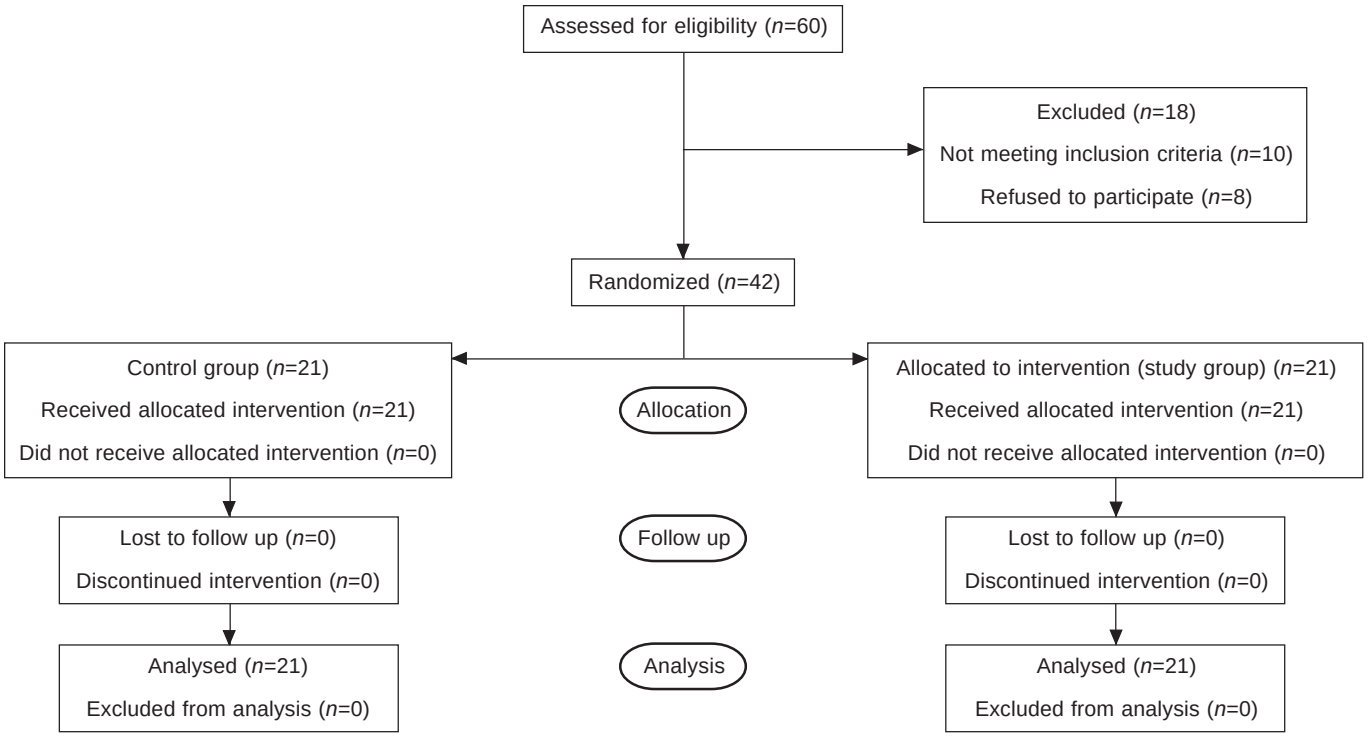

FIG 1. Flow of patients in the study

patients were enrolled. The investigator wrote the name and address of the patient with the date of enrolment on the sealed envelope, opened the envelope and the patient was allocated to the group mentioned on the card within the envelope. The random number table was placed in the 61st envelope and sealed (to be seen by the investigator only after the study was over).

Study group

Intravenous cannulation was done by introducing a short intravenous peripheral cannula under strict aseptic conditions. In the study group the cannulae were changed electively and re-sited every 48 hours.

Control group

In the control group the cannulae were changed only if the site became painful, the cannula got dislodged or if signs of PVT developed.

All cannulations were performed by the residents/ward nurses under the supervision of the investigators. Patients were examined every 24 hours for signs of PVT at the current and all previous sites of infusion. PVT was defined as the development (at a site of infusion) of 2 or more of the following signs: pain, erythema, swelling, excessive warmth or a palpable venous cord. The severity of PVT was classified as mild (presence of 2 signs), moderate (2–4 signs) or severe (all 5 signs present).[6]

Statistical analysis

The differences between groups were compared using the Student *t*-test and Fisher exact test. The software used for statistical analysis was GraphPad Instat version 3.

RESULTS

A total of 21 cannulations were studied in the control group and 39 in the study group. The details of cannulation and patient characteristics of the control and study groups are shown in Table I.

In the control group, the median gauge (interquartile range [IQR]) of the cannula was 18G (0). Cannulations were studied for a mean duration (SD) of 3.1 (0.38) days and the average number of cannulae used per patient was 1. All the patients received drugs as well as crystalloids; none of them received hypertonic solutions.

In the study group, the median gauge (IQR) of the cannula was 18G (1). Cannulations were studied for a mean duration (SD) of 3.7 (0.88) days and the average (SD) number of cannulae used per patient was 1.9 (0.54). All the patients received drugs as well as crystalloids; 2 of them also received hypertonic solutions, neither of whom developed PVT.

The study and control groups were comparable in terms of age, gender distribution and gauge of cannula. In the study group the end-point of follow up of a patient was the development of PVT/ cessation of requirement of intravenous therapy; therefore, the patients in the study group were followed up for a longer duration than those in the control group. This difference in the number of days was significant between the two groups (p=0.0215). Similarly,

TABLE I. Patient characteristics and details of cannulation

Characteristics	Control group	Study group
Number of patients	21	21
Age (years)	40.2 (15.00)	42.9 (14.99)
Men:Women	17:4	16:5
Median (IQR) cannula gauge	18 (0)	18 (1)
Duration of cannulation (days)	3.1 (0.38)	3.7 (0.88)
No. of cannulae per patient	1(0)*	1.9 (0.54)

* Details of cannulation were studied for a single cannula for every patient in the control group. Values in parentheses are standard deviation except where indicated.
IQR interquartile range

TABLE II. Day-wise incidence of peripheral venous thrombophlebitis

Day	Control group (*n*=21)	Study group (*n*=21)
1	—	—
2	—	2 (8.7)
3	19 (82.6)	—
4	2 (8.7)	—

Values in parentheses denote the percentage of the total number of episodes of peripheral venous thrombophlebitis, which is 23 (21 in the control and 2 in the study group).

the average number of cannulae used per patient (1.9 per patient) was higher in the study group than in the control group (1 per patient).

Peripheral venous thrombophlebitis developed in all the 21 patients in the control group and in only 2 patients in the study group ($p<0.0001$). Both patients in the study group had mild PVT, whereas in the control group the majority (14/21) had moderate-to-severe PVT. Since there were no patients with moderate or severe PVT in the study group the p value was not calculated. The risk of thrombophlebitis in the study group was decreased by 90% (RR=0.10; 95% confidence interval 0.03–0.36).

Table II shows the day-wise correlation of the incidence of PVT. In the control group there were no episodes of PVT in the first 2 days; 19 of 21 episodes of PVT occurred on day 3 and 2 on day 4. In the study group, 2 episodes of PVT occurred on day 2. Overall, 82.6% (21/23) of the episodes of PVT occurred on day 3.

DISCUSSION

The infusion of fluid into a vein predisposes a patient to PVT. Factors relating to the infusate which have been shown to influence the development of PVT include osmolality, pH, chemical composition and the rate of infusion.[7,8] However, it has been shown that the presence of an intravenous cannula without an infusion running could also result in PVT, with an incidence of about 40% over 5 days.[9] This provides the rationale for minimizing endothelial trauma, by electively removing the cannula before the occurrence of phlebitis.

The current clinical practice is to wait for signs and symptoms of PVT to develop before changing the cannulation site of peripheral intravenous catheters. Recent studies have emphasized that PVT is a cause of considerable iatrogenic morbidity, with an incidence of 20% in patients requiring intravenous cannulation, should not be considered a minor complication and every effort should be made to prevent its occurrence and reduce its severity as it has both patient-related and economic implications. A study of the complications of PIVCs in the hand and forearm reported that PVT can result in morbidity and increased healthcare costs due to prolonged hospitalization, extended use of intravenous antibiotic therapy and surgical intervention.[2]

In our study, the age and sex, and the cannula gauge used were comparable in the control and study groups. The intravenous fluids and drugs administered were those commonly used. Short teflon (polytetrafluoroethylene, PTFE) cannulae were used as these were readily available and PTFE has been shown to be more haemocompatible than materials such as polyurethane or polyvinyl chloride.[10] In our study, 82.6% of the episodes of PVT occurred on day 3. A randomized controlled trial from the UK found that the mean time to develop phlebitis in the control group was 2.5 days (SD 1.3 days; range 1–5 days).[4] These data suggest that endothelial trauma caused by an indwelling catheter was reversible if the cannula was removed within 48 hours following insertion, and PVT was likely to develop if a cannula was left *in situ* for a longer duration. The study also reported that elective change of cannulae resulted in a significant reduction of infusion phlebitis and did not increase the total number of cannulae placed (41 cannulae in the 26 control subjects *v.* 43 in the 21 study subjects). It has also been reported that PVT developed in 11 patients (52.4%) in the control group (*n*=26) and in only 1 patient (4.8%) in the study group (*n*=21; p=0.003). In our study the incidence of PVT was 100% in the control group and only 9.5% in the study group.

A randomized controlled study that examined the relationship between the *in situ* duration of the cannula and the frequency of PVT as well as nurses' care and handling when using a PIVC reported that the frequency of thrombophlebitis after a PIVC insertion was significantly higher, more troublesome and produced prolonged complications in the control group in whom current/daily routines are followed compared with the experimental group in whom *in situ* duration was ≤24 hours. Care and handling suffered with an increased number of days *in situ*. The nurses' documentation of inserted or removed cannulae was incomplete in most cases, and notices about the insertion area were nearly non-existent. It was determined that a short *in situ* duration, when using a PIVC, is an important factor in preventing complications.[11]

The results of the studies mentioned above are similar to the results of the present study. Elective re-siting of intravenous cannulae every 48 hours resulted in a significant reduction in the incidence and severity of PVT in hospital inpatients receiving intravenous therapy in the form of crystalloids and drugs.

REFERENCES

1 Tagalakis V, Kahn SR, Libman M, Blostein M. The epidemiology of peripheral vein infusion thrombophlebitis: A critical review. *Am J Med* 2002;**113:**146–51.
2 Kagel EM, Rayan GM. Intravenous catheter complications in the hand and forearm. *J Trauma* 2004;**56:**123–7.
3 Anderson AD, Palmer D, MacFie J. Peripheral parenteral nutrition. *Br J Surg* 2003;**90:**1048–54.
4 Barker P, Anderson AD, MacFie J. Randomised clinical trial of elective re-siting of intravenous cannulae. *Ann R Coll Surg Engl* 2004;**86:**281–3.
5 PS power and sample size calculations (computer program). Version 2.1.30 software. Nashville TN (USA): Department of Biostatistics, Vanderbilt University School of Medicine; 2003.
6 Tjon JA, Ansani NT. Transdermal nitroglycerin for the prevention of intravenous infusion failure due to phlebitis and extravasation. *Ann Pharmacother* 2000;**34:** 1189–92.
7 Ingram P, Lavery I. Peripheral intravenous therapy: Key risks and implications for practice. *Nurs Stand* 2005;**19:**55–64.
8 Kuwahara T, Asanami S, Kubo S. Experimental infusion phlebitis: Tolerance osmolality of peripheral venous endothelial cells. *Nutrition* 1998;**14:**496–501.
9 Payne-James JJ, Rogers J, Bray MJ, Rana SK, McSwiggan D, Silk DB. Development of thrombophlebitis in peripheral veins with Vialon and PTFE-Teflon cannulas: A double-blind, randomised, controlled trial. *Ann R Coll Surg Engl* 1991;**73:**322–5.
10 Pinto Tde J, Ribeiro Ade D. The influence of the intravenous catheter composition on its hemocompatibility. *PDA J Pharm Sci Technol* 1999;**53:**27–30.
11 Lundgren A, Wahren LK, Ek AC. Peripheral intravenous lines: Time *in situ* related to complications. *J Intraven Nurs* 1996;**19:**229–38.