Cryotherapy in Relieving Arteriovenous Fistula Cannulation-Related Pain: Non-Randomised Crossover Trail

Articoli originali

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ABSTRACT

Introduction. Pain during arteriovenous fistula (AVF) cannulation remains a major concern among patients undergoing maintenance hemodialysis. This study was done to assess the effectiveness of cryotherapy in reducing patient perceived pain during AVF cannulation.

Methods. This randomised crossover study was carried out on 111 hemodialysis patients. During the first four sessions, the patients received cryotherapy intervention and during next four sessions, the patients received standard care without cryotherapy. Pain was assessed using the Wong-baker faces pain rating scale.

Results. There was a significant difference between pain scale with intervention and without intervention, with p value of 0.001.

Conclusions. In hemodialysis patients, pain was reduced during AVF cannulation when cryotherapy was used.

KEYWORDS: Chronic kidney disease, Arteriovenous Fistula Cannulation, Hemodialysis, Pain, Cryotherapy

Introduction

The prevalence of chronic kidney disease in the Indian population is 17.2% [1]. A functioning vascular access is essential to offer effective hemodialysis, with an arteriovenous fistula (AVF) being the preferred long-term approach [2]. However, pain during AVF cannulation remains a major concern among patients undergoing maintenance hemodialysis (HD).

Patients on thrice-weekly hemodialysis with an AVF undergo approximately 24 needle punctures each month. The experience of AVF puncture-related pain can have unpleasant effects on patients, causing greater disability, irritability, and insomnia among those undergoing hemodialysis [3]. This recurrent pain can contribute to chronic pain, depression, and a decline in overall quality of life. Reducing cannulation-related pain has been shown to improve both quality of life and adherence to HD. Local anaesthesia is not commonly used due to concerns of vasoconstriction, burning sensation, scarring, and infection [4, 5].

The Hegu point, also called the LI4 point, is an essential acupoint in the body. Stimulation of this point is believed to alleviate pain in various regions of the body. It is located on the dorsum of the hand, between the first and second metacarpal bones, between the thumb and the index finger. The LI4 point can be easily stimulated by needle pressure or intense cold where the energy flow is closer to the skin surface [6]. Several studies have confirmed the effectiveness of lidocaine gel in relieving pain. However, Vajihe Arab and colleagues reported in their study that Hegu point ice massage was more effective than lidocaine gel in reducing pain intensity [4]. The analgesic effect of cryotherapy can be explained through the gate control theory. According to it, skin stimulation generates nerve impulses that travel to the spinal cord, where they are either inhibited or amplified. Pain impulses transmitted to the brain via small nerve fibers tend to keep the “pain gate” open, while impulses traveling via large nerve fibers close the gate, reducing pain perception [7].

Cryotherapy involves the use of substances that lower tissue temperature by removing heat from the body. This leads to vasoconstriction, reduced tissue blood flow, decreased muscle spasm, and lowered tissue metabolism. These physiological responses induce cold-induced neuropraxia, producing a local anaesthetic effect [8]. The purpose of this study is to estimate the effectiveness of cryotherapy in reducing patient-perceived pain during AVF cannulation.

Materials and methods

This is a non-randomized crossover interventional study carried out in the Department of Nephrology, SRM Medical College Hospital and Research Centre from August to November 2024 after obtaining Institutional Ethical Committee approval (SRMIEC-ST0124-1021).

Patients undergoing maintenance hemodialysis for 3 months could be included if they were older than 18 years, undergoing hemodialysis via AVF, and provided informed consent. Patients with a history of cold intolerance, Raynaud phenomenon and nerve or tissue damage were excluded from this study.

Cryotherapy was applied in the form of an ice cube pack (height: 19cm, length: 10cm, and width: 3.5cm) at Hegu point which is located on the web between thumb and index finger in the contralateral arm of fistula. Intervention was started by the researcher 10 minutes before AVF cannulation, which was performed by the staff nurse and was continued till the puncture ends.

Patients first received four consecutive sessions of HD with cryotherapy application during AVF cannulation, followed by four consecutive sessions of HD without cryotherapy application. Pain was assessed using the Wong-Baker Faces Pain Rating Scale, which ranges from 0 (“no hurt”) to 10

("hurts like the worst pain imaginable"). Scoring system used in this study was as follows: Scores 0–1, no hurt; 2–3, hurts a little bit; 4–5, hurts a little more; 6–7, hurts even more; 8–9, hurts a lot; and 10, hurts the worst. This scale is accompanied by visual depictions and written descriptions, to assist patients in communicating and quantifying their pain.

The primary outcome was an assessment of patient-reported pain during cannulation, according to the Pain Rating Scale, recorded at each of the eight sessions of hemodialysis.

The collected data were coded, digitized and processed by SPSS software version 3.0. The demographic data were analysed using frequencies and percentages, and the mean as well as the t-test were used to determine the significance of demographic data, vital signs, and pain scores. The median and mean difference were utilized to compare the pain score with and without intervention.

The sample size was calculated depending on various factors, including margin of error (d), estimated proportion of the population (p = 60), level of significance (99% confidence level) Z, proportion of attribute not present (q = 100 – p).

$$n = Z^2 \frac{\alpha}{2} p.\ q/d^2$$

By using this formula, we get n = 111.

Results

A total of 111 patients were included in this study. The median age was 50 years and 70% were male. The majority of respondents were male, unemployed, had completed secondary education, had hypertension as the underlying kidney disease, had a left arteriovenous fistula, were on dialysis twice a week for 1-5 years (Table 1). The number of dialysis sessions during the study was 888, of which 444 sessions were with the use of cryotherapy and 444 sessions were without cryotherapy.

Table 2 shows that the median pain scores were 2 and 4 (median difference = –1.532; p = 0.001) in the dialysis sessions with and without cryotherapy respectively.

Figure 2 shows that most patients have 0-1 (no hurt) scoring with intervention and 4-5 (hurt a little more) scoring without intervention.

No interdialytic and intradialytic adverse events were reported during the study.

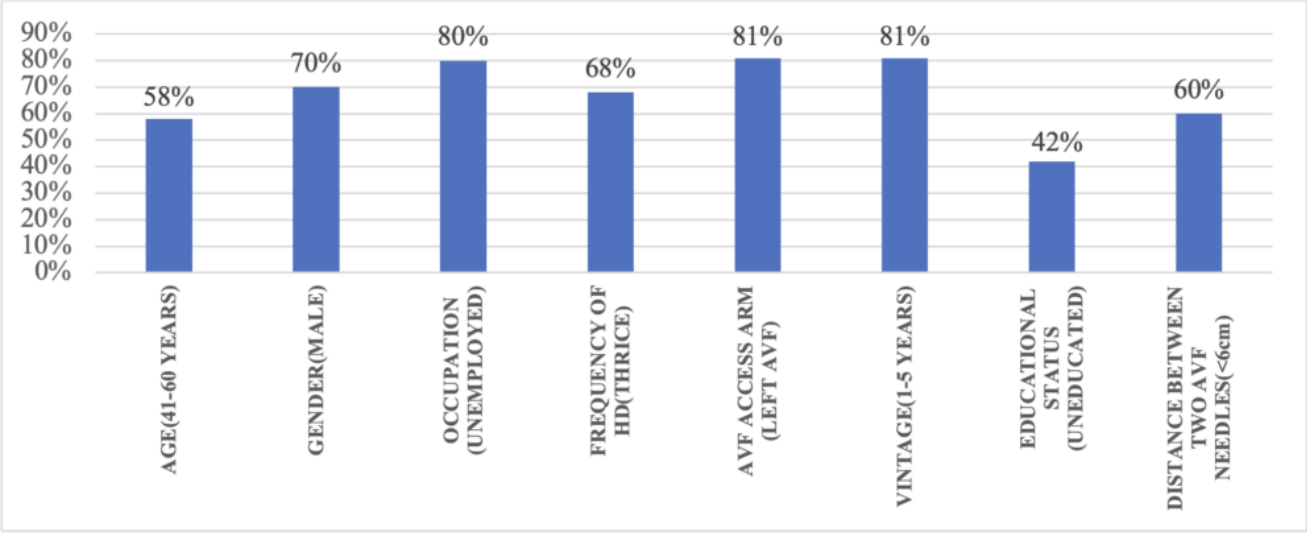

Figure 1. Percentage of patients according to demographic data.

VARIABLE		N	(%)
Age (years)	18-40	26	23
	41-60	64	58
	61-80	21	19
Gender	Male	78	70
	Female	33	30
Basic kidney disease	Hypertension	64	58
	Diabetes Mellitus	36	32
	Others	11	10
AVF Access Arm	Right AVF	21	19
	Left AVF	90	81
Dialysis Vintage(years)	< 1 Year	9	8
	1-5 Years	81	73
	>5 Years	75	19
Frequency of HD	Thrice	36	32
	Twice	75	68
Distance between 2 AVF Needles	<5 cm	61	55
	>5cm	50	45

Table 1. Demographic data.

	HD sessions without intervention (n = 4 × 111)	HD sessions with intervention (n = 4 × 111)	Median difference	p-value
Median pain score (IQR)	4 (2)	2 (2)	–1.532	0.001

Table 2. Comparison of pain scores during Hemodialysis sessions with and without cryotherapy (Primary outcome).

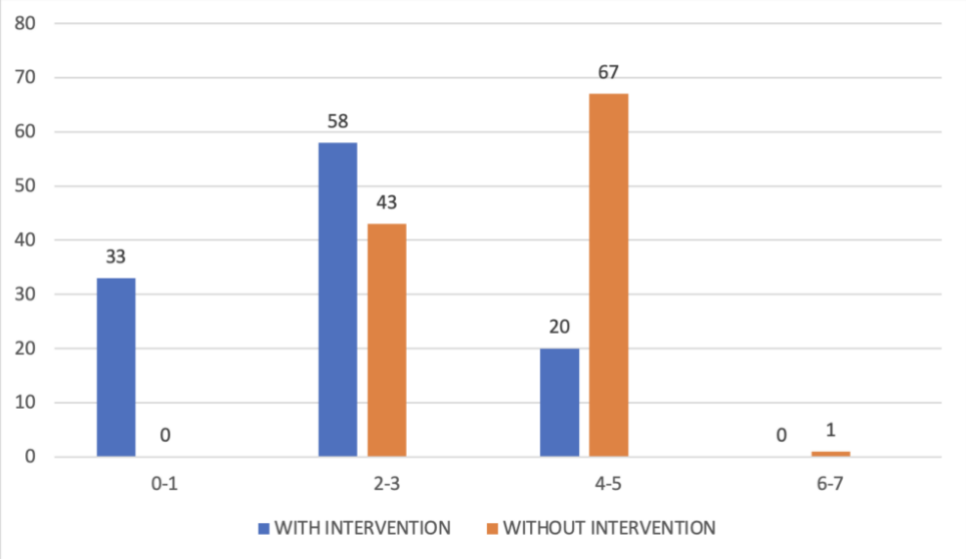

Figure 2. Ratio of Wong-Baker Faces Pain Rating Scale.

Discussion

This non-randomized crossover study found that among stable patients on maintenance hemodialysis, a short period of cryotherapy applied to the contralateral arm during AVF cannulation significantly reduced patient-reported pain scores (median difference = 1.532, p = 0.001), and the confidence interval between the intervention and non-intervention conditions was - 1.81 and - 1.25.

This finding has been observed in previous studies. In a study conducted by Al Amer et al. [7], 62 patients were randomly assigned to two groups: 31 in the experimental group (received cryotherapy) and 31 in the control group (no cryotherapy). Pain scoring was performed on all three HD sessions per week for two weeks. The pain score was calculated using the Arabic version of the

Wong-Baker pain rating scale and they concluded that the experimental group's pain scores before and after the intervention showed a significant difference, but the control group showed no such difference. Sabitha et al. [5] in a similar study involved 60 patients (30 in the experimental group and 30 in the control group). They used a numerical rating scale for subjective pain evaluation, an observation checklist and a questionnaire that looked at clinical and demographic variables for objective pain behaviour assessment. According to the findings, the experimental group's objective and subjective pain scores were significantly ($p = 0.001$) lower. In our study we used the same patients for both groups; it also showed the significant difference.

The limitations of our study are the limited sample size, the single-centre research site, and the selection of stable, asymptomatic patients on maintenance hemodialysis.

Conclusion

This study demonstrates a beneficial efficacy of cryotherapy on patient-perceived pain during Arteriovenous fistula cannulation.

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