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## **Impact of cryotherapy on arteriovenous fistula cannulation - oriented discomfort in hemodialysis patients at designated dialysis centres in Solapur, Maharashtra**

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### **Abstract**

Pain during arteriovenous fistula (AVF) cannulation continues to be a significant issue in hemodialysis (HD) patients, leading to non-compliance with lifetime maintenance HD. The purpose of this study was to see if cryotherapy could reduce discomfort during AVF cannulation in HD patients at a tertiary care hospital in Solapur, Maharashtra. This is experimental research involving 63 patients undergoing HD by AVF. The patients were randomly assigned to two groups: experimental (got cryotherapy) or control (did not get cryotherapy). Used the Wong-Baker pain rating scale version to calculate the pain score. The experimental group had a significant difference in pre-and post-intervention pain levels, but the control group had no difference. Based on a P 0.05. Rejected the null hypothesis. Our findings imply that cryotherapy is an effective treatment for AVF cannulation-related discomfort in adult patients undergoing HD. As a result, cryotherapy is suggested to be investigated as a supplementary technique to alleviate pain associated with AVF cannulation.

**Keywords:** Pain arteriovenous fistula, hemodialysis, pain score, AVF cannulation

### **Introduction**

During the last 30 years, the prevalence and incidence of end-stage renal disease (ESRD) have skyrocketed in Solapur, Maharashtra, outperforming many other nations <sup>[1, 2]</sup>. In India, 5.7 percent of the public has chronic kidney disease (CKD), opposed to 1.9 percent in the United States. [As per the Center for Organ Transplantation, 17,000 CKD cases were diagnosed in hospitals in 2018, with 15,600 receiving regular hemodialysis (HD) <sup>[5]</sup>. For 9000 patients, HD cost roughly US\$ 224 million in 2008 <sup>[6]</sup>. HD needs a properly functional angioaccess, blood is extracted from the patient via a syringe, circulating in an artificial kidney apparatus, and given to the patient after extra water, electrolytes, and waste substances have been removed. Each dialysis cycle is 3 times a week and lasts 3–4 hours <sup>[7]</sup>. An arteriovenous fistula (AVF), established by surgical anastomosis of an artery and a vein, is the most prevalent angio approach utilised in Solapur, Maharashtra <sup>[8, 9]</sup>. Pain is inevitable during AVF cannulation in HD sufferers <sup>[9, 10]</sup>. Although local anaesthetics are one option for pain treatment during AVF cannulation, they may be unsuccessful due to vasoconstriction, burning sensations, scars, and infections <sup>[13, 14]</sup>. The patient on upkeep HD is subjected to 10 AVF puncture wounds every month, which will remain until the patient has a satisfactory kidney transplant <sup>[5]</sup>. It is vital to examine their pleasure with the procedure in order to ensure long-term adherence with the therapy <sup>[9]</sup>. Pain relief during cannulation influences procedure acceptance and has an impact on HD patients' quality of life <sup>[11]</sup>. Cryotherapy has been used as an adjuvant therapy in HD patients to relieve pain during AVF cannulation.

Cryotherapy is defined as the application of any material that removes heat from the body, leading to reduced tissue temperature, as per an assessment <sup>[12]</sup>. Vasoconstriction, tissue metabolism, and muscle cramps all restrict tissue blood flow <sup>[12]</sup>. Cold-induced neuropraxia is a local anaesthetic effect caused by these substances. The process of cryotherapy, as per Barnard <sup>[13]</sup>, relies on severe cold (20 °C) to cause short-term disintegration of nerve axons and disintegration of sheath construction. In a few months, the axons will regrow gradually <sup>[24]</sup>.

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Cryotherapy has been shown in several studies to be beneficial in relieving pain produced by venipunctures in various situations [23]. They discovered that using cryotherapy reduced patients' objective and subjective pain levels significantly [9, 14-16, 15]. Found that when on the same part of the troublesome area, they massaged the web between the thumb and index finger with ice. The number of patients reported a significant reduction in the severity of their tooth discomfort. Waters and Raisler's [16] findings also agreed that administering cold massage resulted in a considerable reduction in labour discomfort [27, 26]. Cryotherapy was used as an intervention in an interventional trial to detect disparities in discomfort during AVF cannulation in kids; the results showed that children who received cryotherapy experienced much less pain than those who did not [28]. AVF perforations are done 2 to 3 times a week on HD sufferers. As a result, these patients feel pain from AVF cannulation roughly ten times each month [29]. As a result, this study was carried out to investigate the prospect of providing a cheap, non-invasive, nonpharmacologic option to reduce discomfort caused by AVF cannulation, enhancing adherence to therapy and improving patients' quality of life [21].

### **Aim and Objective**

The purpose of this study is to analyze baseline demographic and HD use data for CKD patients, specifically in a tertiary care hospital in Solapur, Maharashtra, and to determine the effectiveness of cryotherapy in reducing discomfort due to AVF cannulation in these patients.

### **Materials and Procedures**

#### **Design of the study**

This study employed experimental, descriptive, and retrospective approaches. Employed an experimental approach to evaluate the effect of cryotherapy on pain severity. Demographic data, the annual AVF generation rate, the incidence of acute and chronic renal failure, and the rate of renal transplantation were all evaluated using descriptive and retrospective methods.

#### **Sample and setting**

A total of 63 people who were experiencing HD via AVF were selected. Slovin's technique was used to determine the representative sample. The individuals were divided into two categories using randomization; 32 sufferers in the research group received cryotherapy, while 31 others did not. Patients aged 16 and above who could accurately report discomfort and had no other cause of pain were eligible to participate. Chronic diabetes, cardiovascular dysfunction, cold allergy, Reynaud's syndrome, and nerve and tissue damage were all eliminated from the research.

#### **Consideration of ethics**

The Institutional Ethical Committee (IEC) evaluated the benefits and risks examined in this work. The experiment had no risks because the procedure was non-invasive, and patients were carefully screened against the eligibility requirements, with any patients who did not meet the requirements being eliminated. Throughout the experiment, all subjects gave their expressed permission. Maintained the confidentiality of information obtained through the AKU, as well as the privacy of the patients.

### **Instrument**

In this study, the patient's suffering following AVF cannulation was assessed using the Wong-Baker facial agony ratings system. This measure is used all around the world and has been transcribed into other dialects. The version was collected from the Wong-Baker Faces organization after acquiring official permission and utilized in this research. Picked this scale since it is routinely used by medical staff as the primary technique of pain assessment. There are six faces on the scale, ranging from no discomfort to severe agony. In this investigation, we used the following scoring procedure: 0–1 means no pain, 2–3 means a little pain, 4–5 means a bit more pain, 6–7 means considerably more pain, 8–9 means a lot of pain, and 10 means the greatest suffering. The reliability of this device has been evaluated in a number of situations and different ages.

### **Procedure/Data gathering**

The first portion of the research, which was observational in nature, involved compiling and evaluating all data of patients hospitalized to hospitals for kidney disorders between 2018 and 2021. It looked at demographic factors like age, gender, and dialysis usage. Utilization of data from these individuals on routine upkeep HD to determine a range of other parameters like transplantation rate, new AVF production rate, new incidences of renal insufficiency (ARF), and chronic kidney disease (CKD). The data acquired in this portion of the research was analyzed using simple descriptive metrics. In order to find out, the effect of cryotherapy on the pain reported by HD patients during AVF cannulation I used an experimental design. A total of 63 patients were randomly assigned to one of two communities: 32 in the intervention class who had cryotherapy, and 31 in the control team who did not. All of these patients were getting HD treatments three times per week. Random sampling was utilized to adjust for possible confounding. The gender proportions in both categories were identical, and no other adjustments were performed to account for any confounders. To avoid cross-contamination, the AVF cannulation on the patients was done by the same nurses working throughout the study for two weeks. The Scored pain at all three HD sessions per week. Both the experimental and control groups had baseline subjective pain scores (pretest scores). This week, neither group received cryotherapy. The experimental sample received cryotherapy during the three HD periods during the second week, but the control subjects did not. Both categories' subjective pain ratings (posttest ratings) were collected over the week.

The usage of ice packets to administer cold to the web between the thumb and index finger of the contra-lateral arm is recommended.

The approach was initiated five minutes before to venipuncture and continued throughout the process (approx. two minutes). The ice massage was performed by hospital staff nurses, while another nurse performed the AVF cannulation. In all sessions, the patients' cannulation was conducted by the same staff nurses. To assess patients' subjective pain levels during cannulation, an Arabic version of the Wong-Baker faces. They utilized a pain rating scale.

### **Examination of the data**

The data was coded and computerized after, obtained. The

IBM Statistics Program for the Social Studies for Windows version 21.0 was used to analysis the information (SPSS Inc., Chicago, IL, USA). The demographic data acquired from the AKU records were analyzed using frequency and percentage. The T-test was employed to compare and contrast the groups' subjective pain scores.

### Results and Discussion

Males made up more than half of those polled ( $n = 36$ , or 59%). Their ages ranged from 16 to 65 years, with the majority ( $n = 31$ , 49.20 per cent) in the 45–64 year age range, followed by 33.33%,  $n = 21$  in the 26–44 year age range, 12.69%,  $n = 8$  >65 years and above, and 5%,  $n = 3$  in the 16–25 year age range. It depicts the annual number of AVF produced from 2018 to 2021. During the three years. They generated an average of 38.33 AVFs. Except for a modest increase in 2017, the figure shows a downward trend

in AVF manufactured. As per hospital statistics, the percentage of freshly patients diagnosed of ARF, CKD, and post-kidney transplants increased between 2015 and 2018. Table 1 shows the degree of suffering associated with cannulation that the control subjects encountered during the three-session pre-test and three-session post-test, both without cryotherapy, over a two-week evaluation time frame, with grand average Scores of 3.12 and 2.83 out of ten, denoting that the clients' encounter during cannulation 'hurts a littlebit' Observation period: During the first week without cryotherapy, the experimental group reported a pain level grand mean score of 2.81, indicating that cannulation "hurts a little." The table also indicates the intensity of pain experienced by the experimental group during annulation when cryotherapy was applied before cannulation. A grand mean score of 1.01 implies that the cannulation caused "no pain."

**Table 1:** Mean Score of the Control Per observation

Pre-Test Group			Post-test Group		
Observation	Mean	Qualitative Description	Observation	Mean	Qualitative Description
Pre Test -1	3.02	It hurts a little bit	Post Test-1	2.84	It hurts a little bit
Pre Test -2	3.18	It hurts a little bit	Post-test -2	2.85	It hurts a little bit
Pretest -3	3.08	It hurts a little bit	Post test-3	2.72	It hurts a little bit
Grand Mean	3.12	It hurts a little bit	Grand Mean	2.83	It hurts a little bit

Table 2 depicts the intensity of discomfort associated with cannulation experienced by the experimental group throughout six sessions over a two-week

**Table 2:** Mean score of the experimental group per observation

Pre-test Group			Post-test group		
Observation	Mean	Qualitative Observation	Observation	Mean	Qualitative Observation
Pre- test-1	2.81	It hurts a little bit	Post-test -1	1.32	It hurts a little bit
Pre Test 2	2.86	It hurts a little bit	Post Test-2	0.85	It hurts a little bit
Pretest -3	2.72	It hurts a little bit	Post-test-3	0.82	It hurts a little bit
Grand mean	2.81	It hurts a little bit	Grand mean	1.01	It hurts a little bit

Observation period: During the first week without cryotherapy, the experimental group reported a pain level grand mean score of 2.81, indicating that cannulation "hurts a little." The table also indicates the intensity of pain experienced by the experimental group during annulation when cryotherapy was applied before cannulation. A grand mean score of 1.01 implies that the cannulation caused "no pain."

The pain caused by AVF cannulation in the control group was the same in three sessions over two weeks. At the 0.05 threshold of assurance, the test results revealed no substantial differences, with  $P = 0.476$ , 0.202, and 0.103, correspondingly. This demonstrates that for each AVF cannulation, the control subjects, who did not get cryotherapy, exhibited the same band of pain intensity. In the intervention class, however, there was a significant difference in pain intensity before and after cryotherapy. The three-paired findings showed a considerable variation in T-test findings, with  $P = 0.001$ , 0.001, and 0.001 at the 0.05 level of confidence. The findings imply that cryotherapy delivered before the surgery helps lower the pain experienced by patients undergoing HD during AVF cannulation. Between 2018 and 2021, the average number of AVFs generated in hospitals was 38.33%, consistent with literature showing that the vast majority of angio-access was AVF under the National Kidney Foundation standards in the United States. Compared to venous catheters or artificial

grafts, AVF has a lower cost, a higher patency rate, and fewer problems.

It is, however, linked to a number of issues, including discomfort, which reduces patients' adherence to medication and lowers their standard of living. The great majority of renal patients were men. With the exception of one research that proved the opposite, this supports previous findings that males are more dominant than females. The participants' average lifespan was 48 years, which is similar to the average age of renal failure patients reported in two previous researches. In terms of age and gender, most patients undergoing HD are members of the productive workforce, implying a considerable impact on the human resource workforce. As a result, during the last 30 years, there has been a huge growth in the occurrence and frequency in Solapur Maharashtra, which has outperformed that of other civilizations. This upsurge has been associated with the rapid behavioral modifications, population expansion, mortality rate advances, and widespread urbanization. In this study, cryotherapy considerably reduced pain scores in the experimental group ( $P 0.001$ ). Cryotherapy's emergence as a non-pharmacological alternative has numerous advantages, including low cost and ease of usage. Several studies have demonstrated the effectiveness of cryotherapy in relieving pain. 9,17 Furthermore, Cryotherapy has clinical implications because it is a simple procedure that nurses can employ to treat the

pain generated by the AVF puncture in a short period.

### Conclusion

Cryotherapy is strongly recommended as adjunctive therapy to reduce discomfort in patients undergoing AVF cannulation for HD. It is non-invasive and low-cost; making it accessible to patients and their families. As a stand-alone intervention, cryotherapy is beneficial in reducing AVF cannulation-related discomfort in patients with chronic renal failure on HD, hence rejecting the null hypothesis. Health programs focusing on kidney disease prevention should be expanded and implemented more thoroughly.

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