RESEARCH ARTICLE

A Comparison between Pre-Incisional and Intraoperative Lidocaine Infiltration on Post-Incisional Surgical Pain in Microdiscectomy Surgery: A Randomized Clinical Trial Study

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Received: 16 February 2022 *Accepted: 12 August 2023*

Abstract

Objectives: Effective postoperative pain control in microdiscectomy surgery is crucial to managing the disease and improving the patient's quality of life. Therefore, this study aimed to assess the potential effectiveness of 2% lidocaine in reducing pain immediately after discectomy surgery.

Methods: A total of 60 patients who underwent microdiscectomy surgery were enrolled in this randomized clinical trial study. They were randomly assigned to three groups: one group received lidocaine just before the incision, another group received lidocaine just before closing the incision, and the third group served as the control. Pain scores were measured at 1, 2, 3, 4, 8, and 12 h after the surgery using a Visual Analogue Scale.

Results: The demographic and clinical characteristics of the study population, including age, weight, length of surgery, gender, and history of diabetes, hypertension, and previous surgery, were comparable across all three groups (P>0.05). There was a significant reduction in pain scores over time in the groups that received lidocaine before (P<0.001) and during surgery (P=0.002). Moreover, there were significant differences in pain scores at all time points among the three groups. Both groups receiving lidocaine showed significantly lower pain scores than the control group (Pbefore surgery=0.005 and Pduring surgery<0.001). However, no significant difference was observed between the groups receiving lidocaine (P=0.080).

Conclusion: These findings highlight the effectiveness of a local injection of 2% lidocaine either before or during the surgery in managing post-incisional surgical pain after discectomy.

Level of evidence: II

Keywords: Discectomy surgery, Lidocaine, Pain, Postoperative pain

Introduction

The intervertebral disc is consistently subjected to significant pressure throughout one's lifetime, which can result in injuries and tears in the annulus. Although the disc can self-repair, repeated damage and repairs gradually weaken the annulus. Consequently, the annulus can rupture under sudden pressure, leaving the central part, or nucleus pulposus, vulnerable. This condition leads to the protrusion of the gelatinous nucleus, commonly referred to as a hernia or disc herniation.[1] Approximately 95% of disc herniation cases occur in the intervertebral region between the 4th and 5th lumbar vertebrae (L4-L5) or between the 5th lumbar and sacral vertebrae (L5-S1).[2]

In lumbar discectomy surgery, the typical approach involves the removal of the protruding part of the lumbar disc. However, in rare cases, complete disc removal may be necessary, followed by artificial disc replacement.[3] Lumbar disc surgery is associated with certain risks and potential complications, such as nerve root damage, spinal cord injury, bleeding, infection, cerebrospinal fluid leakage, persistent pain, and the possibility of the condition reoccurring.[4-7]

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THE ONLINE VERSION OF THIS ARTICLE ABJS.MUMS.AC.IR

Pain, acting as a stressor, stimulates and triggers both psychological and physiological responses. Consequently, it can directly influence factors such as mortality rate, postoperative complications, recovery time, and patient satisfaction with the medical system.[8,9] Lidocaine is a commonly used anesthetic for various procedures, including local, regional, superficial, spinal, epidural, and peripheral nerve blocks.[10,11] While its use in spinal anesthesia has become limited according to recent reports, lidocaine remains widely utilized for other types of anesthesia, such as epidural anesthesia.[12,13] The use of lidocaine to alleviate postoperative pain has been an area of interest for a long time. It has been observed that administering a low-dose lidocaine injection is uncomplicated and can reduce postoperative pain, prevent peripheral nerve damage, and mitigate flare formation and secondary hypersensitivity through central and peripheral mechanisms, respectively.[14-16] Moreover, applying topical lidocaine 30 min before and up to one hour after surgery has been associated with notable benefits, including reduced postoperative pain, enhanced recovery of bowel function, decreased duration of hospitalization, and improved overall patient well-being during the later stages.[16,17]

To the best of our knowledge, the potential of topical lidocaine to alleviate postoperative pain in microdiscectomy surgery, which is fundamentally different from other procedures in terms of technique and surgical position, has not been investigated. Therefore, the purpose of this study was to evaluate the effects of preoperative and intraoperative lidocaine injections on post-incisional surgical pain in microdiscectomy surgery.

Materials and Methods

Study design and patients selection

This study was conducted as a double-blind, randomized, controlled clinical trial on 60 patients who were referred to Imam Ali Hospital, a tertiary referral hospital in Bojnurd, Iran, and met the criteria for microdiscectomy surgery in 2019. The trial was registered in the Iranian Registry of Clinical Trials (IRCT) with the clinical trial code IRCT20150930024277N3. The protocol was approved by the Research Ethics Committees of the North Khorasan University of Medical Sciences in Bojnurd, Iran, with an identification number of IR.NKUMS.REC.1397.120.

Participants were selected using convenience sampling, which involved referring to patient records or a designated list for lumbar microdiscectomy. From this pool, individuals who met the inclusion criteria were selected and provided with a clear explanation of the study procedure. The inclusion criteria consisted of a confirmed diagnosis of lumbar microdiscectomy, no prior history of spinal surgery, absence of liver, kidney, or thyroid problems, a weight range of 50 to 80 kg, and no history of drug abuse. On the other hand, the exclusion criteria were surgeries lasting longer than an hour and recovery times exceeding 45 min.

Randomization and blinding

All eligible subjects were randomly assigned to three groups (Groups A, B, and C) using the permuted block randomization method. Group A, referred to as the pre-incision group, received a percutaneous injection of 4 mg/kg of 2% lidocaine in the muscles surrounding the lumbar discectomy site at 3, 6, 9, and 12 o'clock positions five minutes before making a skin incision. Group B, known as the post-incision group, received the same dosage of lidocaine in the paraspinal muscles on either side of the incision, immediately after the skin incision during the surgery. Group C, the control group, received routine intraoperative care at the surgical site without any lidocaine injections. The same basal anesthetic and analgesic drugs were used throughout the study to ensure consistency across all study groups. Furthermore, the method of disc surgery and the number of surfaces involved were standardized for all patients. Neither the coworker responsible for collecting the pain measures nor the patients were aware of the type of medications administered.

Outcome measures

The postoperative pain scores were assessed at hourly intervals during the first four hours following surgery and, subsequently, every four hours (at 4, 8, and 12 h) utilizing the Visual Analog Scale (VAS). The VAS is a widely recognized pain measurement tool used globally due to its validity, reliability, and ease of use. A score of 1 to 3 indicates mild pain, 4 to 7 represents moderate pain, and 8 to 10 indicates severe pain.[18] The VAS measures pain intensity using a 10-cm calibrated line, with a score of 10 representing the most severe pain and a score of zero indicating the absence of pain, as self-determined by the patient on the line.[19] Numerous studies have confirmed the validity and scientific reliability of this tool.[20] In Iran, the reliability of the VAS has been confirmed with a correlation coefficient of 88%.[21]

Statistical analysis

The sample size for the study was determined based on a previous investigation that examined the effectiveness of pre-incisional and post-incisional wound infiltration with 1% lidocaine on postoperative pain in patients undergoing elective inguinal herniotomy.[22] With a power of 80% and a type I error rate of 0.05, a minimum sample size of 18 patients per group was calculated. To accommodate potential dropouts, the number of patients in each group was increased to 20. Statistical analysis was performed using SPSS software (version 16 for Windows, SPSS, Chicago, IL, USA). The normal distribution of quantitative data was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Quantitative variables were presented as mean±standard deviation (SD) or the median and interquartile range (IQR). Qualitative data was described using frequency and percentage. The Chi-squared test was used to compare qualitative variables between groups, while one-way analysis of variance (ANOVA) was used to compare quantitative variables among the three study groups. Furthermore, a repeated measure ANOVA was employed to compare the mean pain scores within each study group (pre-incision group, post-incision group, and control group) throughout the trial. A P-value of less than 0.05 was considered statistically significant.

Results

The baseline demographic and clinical characteristics of the patients enrolled in this study are presented in [Table 1].

Out of the total 60 patients, 44 (73.3%) were men. The mean age and weight of the participants were 41.45±13.48 years and 71.82±23.19 kg, respectively. Statistical analysis revealed no significant differences in age (P=0.738), weight (P=0.694), gender distribution (P=0.330), or educational levels (P=0.05) among the three study groups. Additionally, the three groups were statistically similar in the length of surgery (P=0.113), history of hypertension (P=0.153), history of diabetes (P=0.126), history of surgery (P=0.281), and family history (P=0.517).

Table 1. Comparison of study population characteristics between groups

Characteristics		Before surgery N=20	During surgery N=20	Control N=20	P-value
Age		42.35±13.52	39.55±13.95	42.45±12.48	0.738
Weight		71.70±25.46	68.75±24.22	75.00±19.00	0.694
Length of surgery		67.50±19.57	63.00±9.23	74.75±21.55	0.113
Gender	Female	7 (35.0%)	3 (15.0%)	6 (30.0%)	0.330
	Male	13 (65.0%)	17 (85.0%)	14 (70.0%)	
Education	Under diploma	12 (60.0%)	2 (10.0%)	11 (55.0%)	0.052
	Diploma	6 (30.0%)	14 (70.0%)	7 (35.0%)	
	Associated degree	1 (5.0%)	2 (10.0%)	1 (5.0%)	
	BSC, MSc, Ph.D.	1 (5.0%)	2 (10.0%)	1 (5.0%)	
History of hypertension	No	15 (75.0%)	19 (95.0%)	18 (90.0%)	0.153
	Yes	5 (25.0%)	1 (5.0%)	2 (10.0%)	
History of diabetes	No	20 (100.0%)	20 (100.0%)	18 (90.0%)	0.126
	Yes	0 (0.0%)	0 (0.0%)	2 (10.0%)	
History of surgery	No	7 (35.0%)	12 (60.0%)	10 (50.0%)	0.281
	Yes	13 (65.0%)	8 (40.0%)	10 (50.0%)	
Family history	No	14 (70.0%)	16 (80.0%)	17 (85.0%)	0.517
	Yes	6 (30.0%)	4 (20.0%)	3 (15.0%)	

The impact of pre-incisional and post-incisional lidocaine injections on postoperative pain is presented in [Table 2]. Within-group analyses revealed a significant reduction in pain scores over time for the groups that received lidocaine before surgery (P<0.001) and during surgery (P=0.002). However, the control group did not show significant changes in pain scores during the same periods (P=0.06). Furthermore, between-group analyses revealed significant differences in pain scores at all time points among the three groups. Both lidocaine-receiving groups had significantly lower pain scores than the control group ($P_{\text{before surgery}}$=0.005 and $P_{\text{during surgery}}$<0.001). However, no significant difference was observed between the two lidocaine-receiving groups.

Table 2. Comparison of pain values between groups

Characteristics	Before surgery	During surgery	Control	P-value
1 hour	6.55±.731	4.45±0.945	7.30±2.677	<0.001
2 hours	5.60±1.314	4.20±1.005	7.20±2.648	<0.001

Table 2. Continued

3 hours	5.65±0.988	4.25±0.910	6.45±2.373	<0.001
4 hours	4.80±0.951	4.05±0.999	6.15±2.581	<0.001
8 hours	3.70±0.801	3.70±0.865	5.55±2.064	<0.001
12 hours	3.45±0.945	3.35±0.671	5.45±1.932	<0.001
P-value	<0.001	0.002	0.062	

The group that received a lidocaine injection before surgery showed significant differences at 2, 4, 8, and 12 h, compared to the control group. However, the group that received an injection during surgery showed significant differences at all time points, compared to the controls. Furthermore, the impact of the injection before surgery was similar to the injection during surgery, except for the first three time points after surgery [Figure 1].

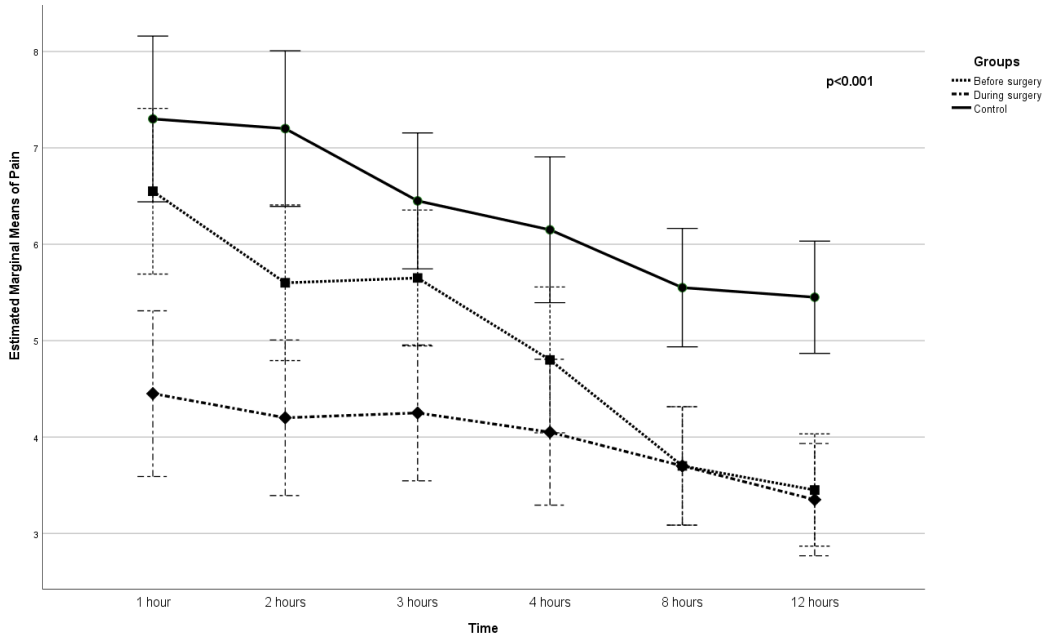

Figure 1. Comparison of mean pain scores among study groups using the GEE approach for repeated measurements analysis. Two groups receiving lidocaine injection before (dotted line) and during (dotdash line) surgery showed significant difference in the trend of pain compared to the control group (solid line)

Discussion

The management and control of pain in the immediate postoperative period are of utmost importance. Local anesthetics that directly target the affected area have been recognized as a safe approach to perioperative care, avoiding the adverse effects associated with systemic therapies, such as postoperative sedation, nausea, gastrointestinal paralysis, and respiratory suppression. However, the topical application of lidocaine in microdiscectomy surgery was not sufficiently investigated. To address this knowledge gap, a randomized, double-blind, controlled clinical trial was conducted to evaluate the potential efficacy of 2% lidocaine for postoperative pain management in microdiscectomy surgery. Our findings indicated that the use of 2% lidocaine had a positive impact on reducing postoperative pain in patients who received this medication before and during the surgery, compared to the control group. Interestingly, the post-incision group exhibited a more favorable response during the first four hours following the surgery, experiencing lower levels of pain. Furthermore, the pre-incision and post-incision groups showed similar levels of pain reduction.

The findings of our study demonstrated that the topical administration of lidocaine injection effectively alleviated pain in patients who underwent microdiscectomy surgery. Our findings are consistent

with previous studies that also examined the use of lidocaine for pain control in different surgical injecting 4 mg/kg lidocaine 2% topically into different layers of the abdomen, revealing that it significantly reduced postoperative pain and decreased the need for postoperative analgesia.[23] Another study focused on the application of intraperitoneal lidocaine, as well as pre- and post-incisional port site local lidocaine, and reported a significant reduction in abdominal pain eight hours after gynecologic laparoscopic surgery.[24] Moreover, the use of 0.1 ml of 1% lidocaine injected into the anterior chamber of the eye after anesthesia was found to reduce pain in patients undergoing cataract surgery.[25] Furthermore, a comparison between 2% lidocaine gel and 0.5% tetracaine drops revealed that the lidocaine gel was more effective in alleviating pain during phacoemulsification cataract surgery.[26]

To the best of our knowledge, our study is the first to compare the possible analgesic efficacy of site-direct pre- and post-incisional injections of 2% lidocaine in microdiscectomy surgery. Consistent with our findings, the administration of a lidocaine patch one hour before surgery has shown a significant impact on reducing pain levels during percutaneous endoscopic lumbar microdiscectomy; however, it did not demonstrate any effect on pain experienced during other stages, such as discography, anulotomy, discectomy, and radiofrequency or laser ablation.[27] Other studies have also reported the significant effect of lidocaine patches in reducing postoperative pain and narcotic requirements after knee arthroscopy, gynecological surgery, and laparoscopic appendectomy.[28-30]

In general, the evidence regarding the potential effectiveness of local analgesia in postoperative pain management is conflicting. Some studies have shown that the application of intraperitoneal bupivacaine did not attenuate pain following laparoscopic cholecystectomy, leading to the recommendation against its routine use.[31] Similarly, in another study, the intraperitoneal administration of bupivacaine or lidocaine did not demonstrate any analgesic effects after a total abdominal hysterectomy.[32] These conflicting findings may be attributed to variations in methodology, the specific drugs used for patients, and differences in pain assessment tools.

Conclusion

In conclusion, our study provides compelling evidence supporting the effectiveness of locally injected 2% lidocaine in alleviating postoperative pain in microdiscectomy surgery, especially when administered before or immediately after the incision. Consequently, our findings offer valuable insights into procedures. A previous study investigated the effects of

the existing literature on the topical application of lidocaine for postoperative pain management. Continued research in this area holds promising prospects for improving pain management strategies for patients undergoing similar surgical procedures.

Acknowledgement

The authors would like to express their gratitude to all the study participants for their cooperation. This study was supported by research project No. 970130 at the North Khorasan University of Medical Sciences, Bojnurd, Iran. The authors would also like to show appreciation to the Clinical Research Development Unit of Ghaem Hospital, Mashhad University of Medical Sciences, Mashhad, Iran, for their assistance in this manuscript.

Contribution of authors: Farhad Rahbarian Yazdi, and Hassan Mehrad-Majd contributed equally in this work.

Conflict of interest: None

Funding: None

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