Original Article

Cukurova Anestezi ve Cerrahi Bilimler Dergisi

The Effect of Buffered Prilocaine on Injection Pain During Central Venous Port Catheter Placement

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Abstract

Objective: This study aimed to assess whether alkalinization of 2% prilocaine with sodium bicarbonate reduces injection-related pain during central venous port catheter placement. **Methods:** A total of 67 patients who underwent central venous port catheter placement under local anesthesia between January and December 2021 were retrospectively evaluated. In all cases, non-buffered prilocaine was applied at the jugular vein access site, and injection-related pain was assessed using a 0–10 numeric pain rating scale. Patients were categorized into two groups based on the anesthetic solution used for port pocket (pectoral region) anesthesia. Group A consisted of patients who received buffered prilocaine (n = 37), whereas Group B included those who received non-buffered prilocaine (n = 30). **Results:** The two groups showed no significant differences regarding age, sex distribution, smoking history, body mass index, or pectoral subcutaneous tissue thickness (all $p > 0.05$). Jugular injection pain scores were similar between groups (2.9 ± 1.4 vs. 2.9 ± 1.3; $p > 0.05$). In contrast, the pectoral injection pain score was significantly lower in Group A compared with Group B (2.6 ± 1.5 vs. 3.5 ± 1.6; $p = 0.011$). No local anesthesia–related complications or allergic reactions were observed. **Conclusion:** Buffering prilocaine with sodium bicarbonate significantly reduces injection pain during local anesthesia in central venous port catheter placement.

Keywords: Injection pain, Local anesthesia, Central venous port catheter, Sodium bicarbonate

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1. Introduction

Central venous port catheter placement is commonly used to ensure safe and comfortable venous access in patients who require long-term intravenous therapy. In clinical contexts including chemotherapy administration, intermittent blood transfusions, and long-term medication delivery, central venous ports provide significant advantages over

alternative catheterization techniques with respect to patient comfort and procedural safety.

During these procedures, local anesthetic infiltration represents a critical step that directly influences patient comfort. Among the procedural steps, needle puncture of the internal jugular vein and blunt dissection of the subcutaneous pocket for port reservoir placement at the infraclavicular level are the stages most commonly associated with pain. Accordingly, local anesthetic infiltration is routinely administered at the supraclavicular needle entry site and along the pectoral muscle surface in the infraclavicular region. Paradoxically, pain may still occur during the injection of local anesthesia itself, adversely affecting both patient and operator comfort.

Needle puncture through the skin, tissue distension caused by the injected anesthetic volume, and the acidic pH of local anesthetic solutions have been identified as potential contributors to injection-related pain[1]. Reducing solution acidity may therefore represent a feasible strategy to alleviate this discomfort.

This study aimed to assess whether alkalinization of a 2% prilocaine solution with sodium bicarbonate reduces injection pain in patients undergoing central venous port catheter placement under local anesthesia.

2. Materials and Methods

A total of 67 patients who underwent central venous port catheter placement under local anesthesia in our clinic between January and December 2021 were evaluated. Before the procedure, all patients were verbally informed and provided written informed consent. Ethical approval for the study was granted by the institutional ethics committee (date: May 9, 2022; No: 137/12), and the study was conducted in accordance with the principles of the Declaration of Helsinki. Patients with a history of hemiparesis or hemiplegia, head and neck or breast surgery, or known central or peripheral neuropathy were excluded. Periprocedural anticoagulation management was performed in accordance with CIRSE guidelines[2,3].

Prior to the procedure, skin thickness at the site of port reservoir placement was measured under ultrasound guidance as the distance from the skin surface to the pectoral muscle. In all patients, 3 mL of a solution consisting of 9 mL of prilocaine hydrochloride (Priloc® 2%) and 1 mL of 0.9% sodium chloride was injected into the jugular venous access site. Immediately after the injection, patients rated their injection-related pain on a 0–10 numeric pain rating scale (jugular pain score).

For pectoral anesthesia, Group A received a buffered solution consisting of 9 mL of prilocaine hydrochloride and 1 mL of 8.4% sodium bicarbonate, while Group B received a non-buffered solution (9 mL prilocaine + 1 mL 0.9% NaCl). Group allocation was based on procedure date, as routine use of buffered prilocaine began in July 2021. In all cases, the skin was first punctured with a 21-gauge needle, a brief pause of several seconds was observed before anesthetic injection, and the solution was injected slowly and steadily over approximately 5–10 seconds. Patients then rated pectoral injection pain on the numeric scale (pectoral pain score).

Statistical analysis was performed using SPSS version 22.0. Descriptive statistics were expressed as percentage, frequency, mean, standard deviation, median, and minimum–maximum values. The Mann–Whitney U test was used for quantitative variables, and the chi-square test for categorical variables. A p value of <0.05 was considered statistically significant.

3. Results

A total of 67 patients were included, comprising 42 men (62.7%) and 25 women (37.3%). The mean age was 60.8 ± 11.6 years (range, 26–89 years). In all patients, the right internal jugular vein was used as the primary access site. Thirty-seven patients were assigned to Group A and 30 to Group B.

Jugular injection pain scores were similar between Group A and Group B (2.9 ± 1.4 vs. 2.9 ± 1.3; $p > 0.05$). Pectoral injection pain scores were significantly lower in Group A (2.6 ± 1.5 [range, 1–8] vs. 3.5 ± 1.6 [range, 1–7]; $p = 0.011$). No significant differences in pain scores were observed between smokers and non-smokers ($p > 0.05$). The mean subcutaneous tissue thickness was 11.25 ± 4.3 mm, with no significant difference between groups ($p > 0.05$). No complications or allergic reactions related to local anesthetic injection were observed. Selected patient characteristics are presented in Table 1.

Table 1. Demographic and clinical characteristics of the study groups

	Group A (n=37)		**Group B (n=30)**		**p value**
	n	%	n	%	
Gender - Male	22	59.5	20	66.7	0.368
Gender - Female	15	40.5	10	33.3	
Smoking history - Yes	21	56.8	12	40	0.172
Smoking history - No	16	43.2	18	60	
	Mean ± SD		**Mean ± SD**		
Height (cm)	165.89 ± 7.64		167.96 ± 7.81		0.278
Age (years)	62.1 ± 11.25		59.2 ± 11.98		0.320
Weight (kg)	73.70 ± 14.80		71.03 ± 13.13		0.443
Body Mass Index (BMI)	26.68 ± 4.25		25.16 ± 4.31		0.155
Subcutaneous tissue thickness (mm)	11.70 ± 4.11		10.73 ± 4.60		0.363
Preoperative systolic BP (mmHg)	138.02 ± 22.07		130.54 ± 20.21		0.178
Preoperative diastolic BP (mmHg)	87.11 ± 12.83		82.03 ± 10.24		0.214

4. Discussion

In the present study, no significant difference in numeric pain scale scores was observed between the patient groups for jugular region anesthesia, which was applied in a standardized manner in all patients. In contrast, injection-related pain during pectoral region anesthesia was significantly lower in Group A than in Group B. These findings indicate that alkalinization of a 2% prilocaine hydrochloride solution with sodium bicarbonate effectively reduces infiltration-related pain during central venous port catheter placement.

The use of standardized jugular anesthesia in all patients provided an internal reference for interindividual pain perception. The absence of a difference in jugular pain scores supports baseline comparability between groups.

Vossinakis et al. emphasized that pain experienced during local anesthesia is primarily attributable to needle penetration through the skin, increased tissue tension from the injected volume, and the acidic nature of the anesthetic solution[1]. Similarly, a recent review reported that increasing the pH of lidocaine reduces injection-related pain and improves patient comfort and satisfaction[4].

In the present study, needle-related pain was minimized by allowing a brief waiting period before local anesthetic infiltration, and tissue distension was standardized by administering the same volume to all patients, allowing specific focus on pain attributable to the anesthetic solution itself. Lee et al. reported that buffered lidocaine may be effective in reducing injection pain, though injection technique and rate of administration may also influence outcomes[5]. Several studies have demonstrated that buffered local anesthetic

solutions are associated with reduced injection pain[6,7,8,9], while other studies have reported no significant difference between buffered and non-buffered solutions[10,11,12].

In the existing literature, alkalinization of local anesthetics has predominantly been evaluated in dental anesthesia, carpal tunnel decompression, and blepharoplasty[5,10,13]. To the best of our knowledge, no study has specifically investigated anesthetic alkalinization during central venous port catheter placement. Moreover, while the majority of available studies have focused on lidocaine, data regarding prilocaine alkalinization remain limited. A study comparing 2% prilocaine, 1% lidocaine, and 1% buffered lidocaine for laceration repair reported significantly higher injection pain scores in the prilocaine group[14], supporting the clinical relevance of buffering this agent.

Several limitations should be acknowledged: the retrospective design, use of numeric rather than visual analog scale (due to surgical sterile conditions), the inherent anatomical differences between jugular and pectoral regions limiting the internal control approach, the absence of formal patient satisfaction assessment, and potential temporal bias from the group allocation method based on procedure date. Although no significant baseline differences were found, unmeasured confounding factors cannot be entirely excluded.

5. Conclusion

Local anesthesia represents one of the most critical determinants of patient comfort during minimally invasive procedures. In this context, the use of buffered prilocaine has the potential to reduce injection pain and thereby improve patient comfort in clinical practice. Buffering prilocaine with sodium bicarbonate significantly reduces injection pain during local anesthesia in central venous port catheter placement. Nevertheless, further randomized controlled studies are needed to more clearly establish the efficacy and safety of buffered prilocaine in reducing injection-related pain.

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Conflict of Interest: The authors declared no potential conflicts of interest.

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Ethical Approval: Ethics committee approval was obtained from the institutional ethics committee (date: May 9, 2022; No: 137/12). The study was conducted in accordance with the Declaration of Helsinki.

Informed Consent: Written informed consent was obtained from all patients.

Data Availability: The datasets analyzed during the current study are available from the corresponding author on reasonable request.

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