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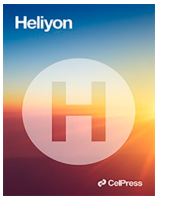

Research article

The effect of perineural dexamethasone on nerve injury and recovery of nerve function after surgery: A randomized controlled trial

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ABSTRACT

Background: While numerous studies have examined the influence of perineural dexamethasone on nerve block duration, its potential impact on postoperative nerve injury has not been adequately addressed.
Objective: This study aims to elucidate the effect of perineural dexamethasone on nerve injury and nerve function recovery after surgery.
Design: A prospective randomized double-blinded trial.
Setting: The First Affiliated Hospital of Chengdu Medical College, Chengdu, China. The study was conducted between 14 June and 30 December 2022.
Participants: Patients aged 18 – 80 years, ASA I - II, scheduled for elective orthopedic or burn and plastic surgery.
Interventions: Patients were randomized to receive either perineural dexamethasone (D group) or no dexamethasone (ND group).
Main outcome measures: Primary outcomes were the incidence and recovery of nerve injury. Secondary outcomes included postoperative pain scores, analgesic consumption, and adverse events.
Results: Initial postoperative nerve injury rates were similar between groups (D: 30.4 %, ND: 33.3 %, $P > 0.05$). At 12 weeks post-discharge, significantly more patients in the ND group recovered from nerve deficits (78.8 % vs 60.3 %; OR = 2.45, 95 % CI = 1.05 – 5.72, $P < 0.05$). No significant differences were observed in postoperative hyperglycemia or surgical site infection rates.
Conclusion: Perineural dexamethasone may impede nerve function recovery, suggesting caution in its use, particularly for patients with pre-existing nerve damage or diabetes. Further research is needed to elucidate the long-term effects of dexamethasone on nerve tissue recovery.
Trial registration: chictr.org.cn, ChiCTR2200059424.

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1. Introduction

Peripheral nerve blocks (PNBs) are widely used in clinical practice, but their potential postoperative complications are gaining attention [1,2]. Postoperative nerve injury can significantly impact patient outcomes, increasing psychological burden, prolonging hospital stays, and reducing quality of life [3,4]. Consequently, understanding and mitigating postoperative nerve injury, particularly in terms of neurological function recovery, is crucial.

Dexamethasone is commonly used as a local anesthetic adjuvant to prolong nerve blockade and enhance patient recovery [5–8]. However, its use as a perineural adjuvant remains off-label and carries potential neurotoxicity risks [9,10]. Gagne et al. [11] reported that perineural dexamethasone might delay nerve recovery after foot and ankle surgery, highlighting the need for caution. Given the lack of conclusive evidence on dexamethasone's safety as a local anesthetic adjuvant [12], its use as a perineural adjunct warrants careful consideration.

This study aims to evaluate the impact of perineural dexamethasone on nerve injury and recovery following upper and lower limb surgery. We hypothesized that perineural dexamethasone might increase nerve injury incidence and delay recovery.

2. Methods

2.1. Ethics

Ethical approval for this study (2022CYFYIRB-BA-May02) was provided by the Ethical Committee of the First Affiliated Hospital of Chengdu Medical College, chengdu, China (Chairperson Wantai Dang) on 13 June 2022. This prospective randomized double-blinded trial was registered prior to patient enrollment at chictr. org.cn (ChiCTR2200059424, Date of registration: April 24, 2022). We adhered to the Consolidated Standards of Reporting Trials guidelines. Written informed consent was obtained from all the participants before surgery.

2.2. Sample size estimation

We conducted a randomized controlled trial to compare the incidence of nerve injury between two groups of patients (D group 12/40; ND group 7/40). The effect measure was the odds ratio (OR) of nerve injury. We estimated the sample size using the normal approximation method in PASS15 software, with a power of 80 %, a significance level of 0.05, and a 1:1 allocation ratio. Considering a 90 % compliance rate, we included 350 patients in total, with 175 patients in each group.

2.3. Patient recruitment

We enrolled 350 patients at the First Affiliated Hospital of Chengdu Medical College between June and December 2022. Patients between 18 and 80 years of age, with an American Society of Anesthesiologists physical status of I – II, who were scheduled for an elective orthopedic surgery and burn and plastic surgery were enrolled. The exclusion criteria were as follows: (1) contraindications to PNB; (2) a history of mental and neurological disorders, alcoholism, drug abuse, and long-term use of opioids or antipsychotic drugs; (3) preoperative nerve injury; (4) hepatic or renal insufficiency; (5) preoperative chemoradiotherapy, chronic pain, neuromuscular disease, or pregnancy; (6) New York Heart Association class $\geq$ II; (7) body mass index $\geq$30 kg/m^2 or $\leq$18 kg/m^2; (8) refusal to participate in the study; (9) withdrawal of consent; (10) inability to cooperate with the postoperative follow-up for various reasons.

2.4. Randomization and blinding

A single investigator was responsible for randomizing and implementing the intervention. The investigator used a web-based random-number generator (available at www.random.org) to randomly assign all patients to one of two groups: those who received dexamethasone (D group) and those who did not (ND group) in a 1:1 ratio. The other researchers and attending anesthesiologists were blind to group assignment.

2.5. Study interventions

When patients entered the operating room, the investigator, who was responsible for randomizing and implementing the intervention, prepared the local anesthetic. All patients received 0.33 % ropivacaine hydrochloride solution. The solution for the D group contained 1 mg dexamethasone per 10 mL, and no other drugs were added to the solution for the ND group. Intraoperative and postoperative antiemetics included intravenous ondansetron (8 mg). Intraoperative and postoperative analgesics included intravenous ketorolac tromethamine. All patients used a patient-controlled analgesia pump (total 150 mL: sufentanil [150 μg], ondansetron [24 mg], dezocine [5 mg], and normal saline [134 mL]; parameter setting: initial dose [2 mL], maintenance [2 mL/h], and patient-controlled [2 mL/time]).

2.6. Block procedure

All the patients were admitted to the operating room in advance and received nerve block procedures in a dedicated room. All block

procedures were performed under the guidance of an ultrasound and neurostimulator by an experienced regional anesthesiologist. Sensory and motor block onset and degree were checked every 5 min for 30 min. No patients received a second injection of local anesthetic, if no complete sensory block after 30 min and pain was felt, the patient underwent tracheal intubation or laryngeal mask general anesthesia. We will evaluate the nerve block effect again for these patients after they are fully awake in the Postanesthesia care unit (PACU), if they still had incomplete sensory block or pain was felt, they excluded from this clinical study. The pin-prick method tested the those nerves: radial, median, musculocutaneous, ulnar, medial cutaneous, superficial cervical plexus, femoral nerve, sciatic nerve, lateral femoral cutaneous nerve [8]. The sensory block score was from Koscielniak-Nielsen et al. (0: sharp pain, 1: touch sensation only, 2: no sensation) [13]. Sensory block onset was from drug injection to no pin-prick sensation. The motor block score was from Lahori et al.: 0—Flexion and extension against resistance, 1—Flexion and extension against gravity but not against resistance, 2—Flexion and extension movements in the hand or foot only, and 3—No movement in the entire upper or lower limb. Motor block onset was from drug injection to no motor movement [8,14]. Depending on the surgical site and procedure, some patients receive multiple nerve blocks. For instance, patients undergoing lower limb surgery may receive both femoral and sciatic nerve blocks, or a combination of femoral and lateral femoral cutaneous nerve blocks. The dosage of ropivacaine according to the site of nerve block was as follows: brachial plexus (20 mL), superficial cervical plexus (10 mL), femoral nerve (20 mL), sciatic nerve (20 mL), and lateral femoral cutaneous nerve (10 mL).

2.7. Study outcomes

The primary outcome was the incidence and recovery of nerve injury. We used the Wound, Nerve, and Systemic Classification System (WNS) (Fig. 1) as a clinical tool [11,15] to evaluate the patients on the first and second day after surgery, and considered any sensory paresthesia (N1 – N4) in the corresponding nerve innervation areas in second day follow-up as nerve injury. We re-evaluated all patients with the WNS tool on the day of discharge. For those who still had nerve injury from the previous assessment, we conducted phone follow-ups at two, six, and twelve weeks after discharge. If the phone assessment indicated that the patients had nerve damage levels of N2 – N4, we scheduled further outpatient visits and referred them to neurologists for additional treatment. We documented wound complications and systemic adverse events using the validated WNS tool in the same manner during follow-up visits. We also recorded blood glucose, duration of nerve block (the time interval from 30 min after nerve block to the first onset of wound pain), numeric rating scales at rest and dynamic (NRS–R, NRS-D) scores within 72 h after surgery, incidence of postoperative nausea and vomiting (PONV), and postoperative hospital stay.

2.8. Statistical analyses

All analyses were performed using the IBM SPSS Statistics version 25.0. The Shapiro–Wilk test was used to assess the normal

Grade	Definition
W-Parameter	
W0	No wound complication
W1	Minor woundерythema or minor dehiscence not requiring antibiotics
W2	Wound erythema or minor dehiscence requiring antibiotics
W3	Wound erythema or minor dehiscence,and minor serous drainage
W4	Wound erythema,with moderate serous drainage,or purulent drainage,or moderate dehiscence requiring I&D reoperation
W5	Wound erythema,with moderate serous drainage,or purulent drainage,or moderate dehiscence requiring I&D reoperation and hardware removal
W6	Wound erythema,with moderate serous drainage,or purulent drainage,or moderate dehiscence requiring I&D reoperation and hardware removal,and soft tissue plastic coverage (eg skin graft or Vac dressing)
W7	Wound erythema,with moderate serous drainage,or purulent drainage or moderate dehiscence,requiring I&D reoperation and hardware removal and involved soft tissue plastic coverage (eg.flap)
W8	Amputation
N-Parameter	
N0	No nerve damage after surgery
N1	Minor: Sensory paresthesia
N2	Major: Complete sensory anesthesia
N3	Complete: Complete motor defect with or without complete sensory paresthesia
N4	CRPS: Complex Regional Pain Syndrome
S-Parameter	
S0	No systemic complications
S1	Superficial Venous Thrombosis (SVT)not requiring treatment
S2	DVT requiring treatment
S3	Cardiac event or PE or stroke or pneumonia or systemic bacteremia or GI requiring treatment
S4	Cardiac event or PE or stroke or pneumonia or systemic bacteremia or GI requiring treatment with ICU admission
S5	Death

Fig. 1. Description of the wound, nerve, and systemic classification system.
CRPS, complex regional pain syndrome; DVT, deep venous thrombosis; GI, gastrointestinal adverse event; ICU, intensive care unit; I&D, irrigation and debridement; PE, pulmonary embolism.

distribution of data. Normally distributed data were analysed using the *t*-test. Non-normally distributed data between the groups were analysed using the Mann – Whitney *U* test. Categorical variables were compared using the chi-squared test and a logistic regression model. Adjustments to the logistic regression model were made with the potential confounding variables. Differences were considered statistically significant at $P < 0.05$.

3. Results

3.1. Patient characteristics

From June 14 to December 30, 2022, we enrolled 350 patients, randomly assigning them to the D (n = 175) or ND (n = 175) group. After excluding five patients due to failed blocks or consent withdrawal (Appendix 1), 345 patients completed the study. Demographic characteristics were comparable between groups (P > 0.05, Table 1).

3.2. Primary outcome

We observed that 58 patients in group D developed nerve injury, of which 47, 10, and 1 had N1, N2, and N3 grades, respectively. In group ND, 52 patients had nerve injury symptoms, of which 42, 8, and 2 had N1, N2, and N3 grades, respectively. There was no significant difference between the groups in nerve injury incidence ($P > 0.05$, Fig. 2). At the 12th week, 35 (60.3 %) patients in group D recovered from nerve injury symptoms, while 23 (39.7 %) patients still had mild (N1) persistent nerve injury symptoms. In group ND, 41 (78.8 %) patients recovered from nerve injury symptoms, and only 11 (21.2 %) patients still had mild (N1) persistent nerve injury symptoms. There was a significant difference between the groups in nerve injury recovery (OR = 2.45, 95%CI = 1.05 – 5.72, $P < 0.05$, Fig. 2, Appendix 2, Appendix 3). No patients developed Complex Regional Pain Syndrome (CRPS, N4) during the observation period.

3.3. Secondary outcomes

The mean duration of nerve block was significantly different ($P < 0.05$) (Table 2): 11.63 h and 9.17 h in the D and ND group, respectively. The timing of first use of ketorolac tromethamine was significantly different between the two groups (D group vs ND group, 27.27 h ± 8.20 vs 22.81 h ± 5.58, $P < 0.05$) (Table 2), however, the consumption of ketorolac tromethamine within 72 h after surgery (D group vs ND group, 90 mg [60, 90] vs 90 mg [60, 90], $P > 0.05$) and the number of patients requiring additional analgesics between the two groups (D group vs ND group, 41 (23.6 %) vs 54 (31.6 %), $P > 0.05$) were not significantly different (Table 2). There was significant differences in PONV (D group vs ND group, 32 [18.4 %] vs 47 [27.5 %], $P < 0.05$) between the groups. Postoperative hospital stay was not significantly different between the groups ($P > 0.05$) (Table 2). NRS-R ($P < 0.05$) and NRS-D ($P < 0.05$) scores at 12 h were significantly higher in the ND group than those in the D group. There was no significant difference in the NRS-R ($P > 0.05$) and NRS-D ($P > 0.05$) scores at 24, 48, and 72 h (Fig. 3, Appendix 4). We observed no significant differences in blood glucose changes ($P > 0.05$, Fig. 3, Appendix 5), postoperative hospital stay, and surgical site infection rates ($P > 0.05$, Table 2) between the groups.

Additionally, Logistic regression analysis identified diabetes, tourniquet pressure, and duration as significant risk factors for postoperative nerve injury. Diabetic patients had a 4.2-fold higher risk of nerve injury (OR = 4.18, 95 % CI = 1.62 – 10.79, P < 0.05).

Table 1
Patients characteristics and intraoperative details between groups.

	D Group (n = 174)	ND Group (n = 171)	*P* Value
Male, n (%)	107 (61.5 %)	96 (56.1 %)	0.312
Age (years)	51.0 ± 16.71	50.5 ± 17.49	0.789
BMI (kg/m^2)	24.18 ± 2.96	24.91 ± 3.06	0.340
Hypertension, n (%)	31 (17.8 %)	34 (19.9 %)	0.624
Diabetes, n (%)	29 (16.7 %)	26 (15.2 %)	0.711
ASA physical status			
I, n (%)	139 (79.9 %)	130 (76.0 %)	0.387
II, n (%)	35 (20.1 %)	41 (24.0 %)	
Operative time (min)	97.52 ± 64.22	107.12 ± 70.82	0.188
Nerve block anesthesia only, n (%)	37 (21.3 %)	32 (18.7 %)	0.554
Combined general anesthesia, n (%)	137 (78.7 %)	139 (81.3 %)	
Tourniquet, n (%)	107 (61.5 %)	105 (61.4 %)	0.986
Tourniquet time (min)	70.65 ± 44.17	72.70 ± 44.83	0.739
Tourniquet pressure (mmHg)	202.34 ± 21.74	206.39 ± 23.21	0.191
Tourniquet location			
Upper limb, n (%)	48 (44.9 %)	58 (56.3 %)	0.097
Upper limb, n (%)	59 (55.1 %)	45 (43.7 %)	
Surgery location			
Upper limb, n (%)	85 (48.9 %)	67 (39.2 %)	0.07
Lower limb, n (%)	89 (51.1 %)	104 (60.8 %)	

Note: Data are expressed as mean ± SDs, number of patients (%) as appropriated. D group: Dexamethasone group, ND group: None - Dexamethasone group. ASA: American Society of Anesthesiologists, BMI: Body mass index.

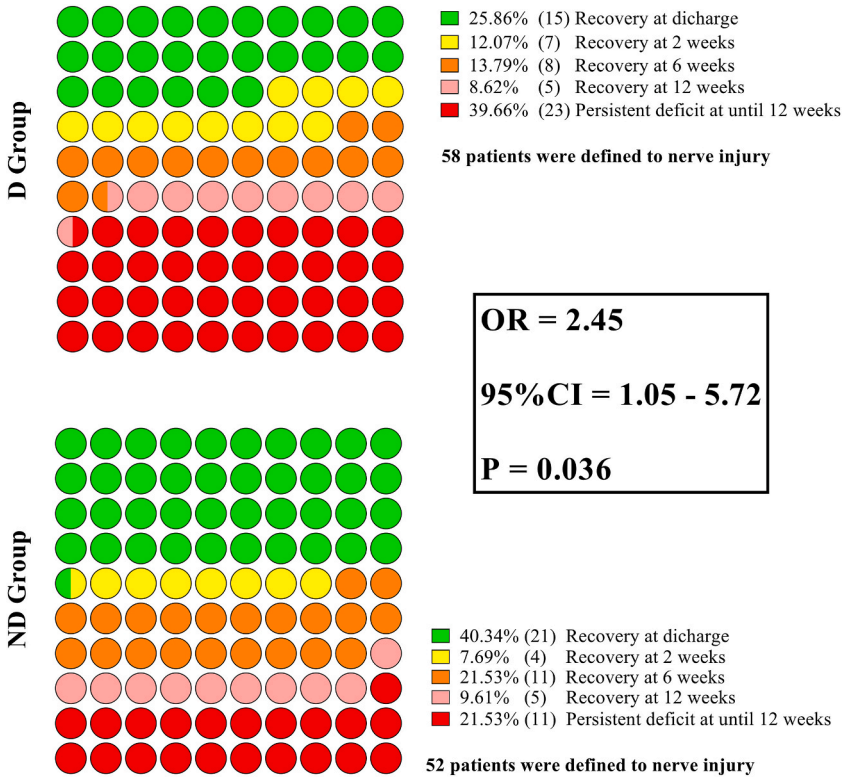

Fig. 2. Nerve injure and recovery between groups. Data are expressed as number of patients (%) as appropriated. D group, Dexamethasone group; ND group, None-Dexamethasone group.

Table 2
Postoperative data and adverse events comparisons between groups.

	D Group (n = 174)	ND Group (n = 171)	*P* Value
Duration of nerve block, (h)	11.63 ± 2.17[a]	9.17 ± 1.52	0.00
Time to first rescue analgesia with ketorolac tromethamine, (h)	27.27 ± 8.20[a]	22.81 ± 5.58	0.004
ketorolac tromethamine consumption within 72 h, mg	90 (60, 90)	90 (60, 90)	0.705
Patients required ketorolac tromethamine within 72 h, n (%)	41 (23.6 %)	54 (31.6 %)	0.096
Surgical-site infection, n (%)	9 (0.6 %)	12 (1.2 %)	0.474
PONV, n (%)	32 (18.4 %)[a]	47 (27.5 %)	0.044
Systemic complications, n (%)	32 (18.4 %)	28 (16.4 %)	0.621
Postoperative hospital stay (day)	5.98 ± 1.90	6.09 ± 1.95	0.593

Data are expressed as mean ± SDs, M (IQR) or number of patients (%) as appropriated. D group: Dexamethasone group, ND group: None - Dexamethasone group. NRS-R:Numeric Rating Scales at rest, NRS-D: Numeric Rating Scales atdynamic, PONV: postoperative nausea and vomiting.
[a] Compared with ND group the difference was significant at 0.05 level.

Each minute increase in tourniquet duration and each mmHg increase in pressure raised the risk by 2.4 % (OR = 1.02, 95 % CI = 1.02 – 1.03, P < 0.05) and 5.3 % (OR = 1.05, 95 % CI = 1.01 – 1.09, P < 0.05), respectively (Table 3).

4. Discussion

This randomized, double-blind study investigated the effects of perineural dexamethasone on postoperative nerve injury incidence and recovery. While we found no significant difference in initial nerve injury rates between groups, patients receiving dexamethasone showed slower recovery from nerve injury symptoms. At 12 weeks post-discharge, significantly fewer patients in the dexamethasone group had fully recovered, suggesting that perineural dexamethasone might delay nerve injury recovery.

The safety profile of dexamethasone as a local anesthetic adjuvant remains inconclusive, and its off-label use as a perineural adjuvant raises concerns. Several studies have reported dexamethasone-induced neurotoxicity, though the underlying mechanisms are not fully understood [9,10]. Moreover, in vitro studies have demonstrated the risk of dexamethasone-induced peripheral neurotoxicity. In a mouse model, dexamethasone increased neuronal death incidence [16]. Gagne et al. [11] also reported that perineural dexamethasone added to PNB may be associated with delayed nerve recovery after foot and ankle surgery. Therefore, it may be

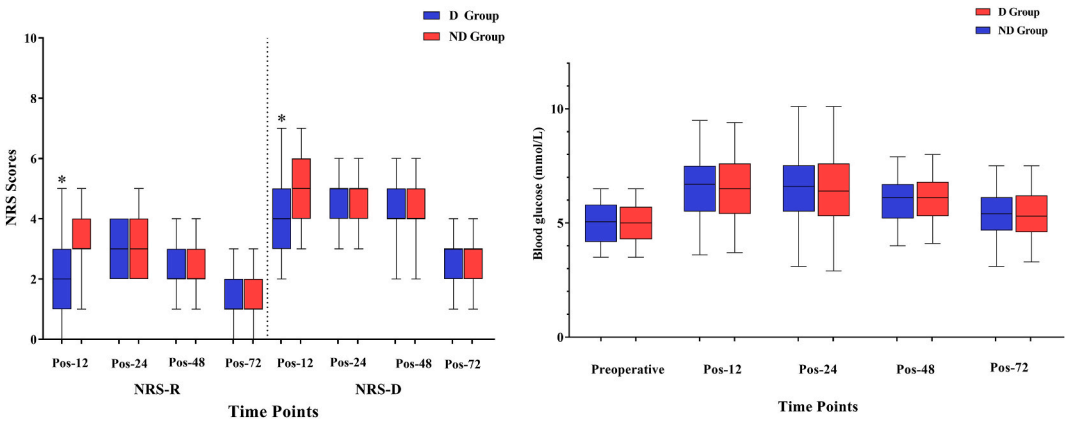

Fig. 3. Comparison of NRS scores and blood glucose at different time points between groups. NRS-R: NRS scores at rest, NRS-D: NRS scores at dynamic. D group: Dexamethasone group, ND group: None - Dexamethasone group. Pos-12: Postoperative 12 h. Pos-12: Postoperative 12 h * Compared with ND group the difference was significant at 0.05 level.

Table 3
Factors associated with nerve injury.

Factors	Nerve injury		
	OR	95 % CI	*P* value
Sex (F vs M)	1.33	0.60–2.93	0.478
Age (years)	0.98	0.96–1.00	0.086
Diabetes mellitus (Y vs N)	4.18	1.62–10.79	0.003
Dexamethasone (Y vs N)	1.06	0.52–2.15	0.883
Surgery location(Upper limb vs Lower limb)	3.88	0.73–20.54	0.111
Tourniquet time (min)	1.02	1.02–1.03	0.000
Tourniquet pressure (mmHg)	1.05	1.01–1.09	0.007

Note: Differences were considered statistically significant at $P < 0.05$.

prudent to avoid the use of dexamethasone until its complete safety profile has been established in large-scale prospective trials.

The systemic effects of dexamethasone may cause hyperglycemia and increase the risk of postoperative infection [17,18], but we did not find significant differences in blood glucose and surgical site infection between groups in our study. This may be related to our route of administration or the relatively low overall dose. Moreover, the application of dexamethasone as a local anesthetic adjuvant to achieve prolonged nerve blockade has become relatively common in recent years, and no serious postoperative adverse events related to it were observed. However, most relevant studies did not investigate the adverse reactions as primary outcomes after surgery, which might result in limitations such as insufficient sensitivity of the diagnostic tools for postoperative adverse outcomes, inadequate observation by the researchers, and short follow-up time, thereby overlooking some postoperative adverse outcome indicators [12, 19–22].

The cause of postoperative nerve injury may vary. According to the current evidence, all local anaesthetics are neurotoxic and cause nerve injury; however, they are not the major factor in nerve injury after nerve block [23,24]. Surgical trauma remains the most common cause of iatrogenic nerve injury. The advent of ultrasound-guided techniques and neurostimulators has likely reduced the risk associated with nerve blocks themselves [1,25]. Timely diagnosis and treatment of nerve injury is extremely important. Appropriate treatment should be selected according to the severity of nerve injury. For peripheral nerve rupture, avulsion, and severe compression ischemia, timely surgical treatment relieves compression and restores nerve continuity. Relatively minor nerve injury is associated with local edema, infection, immunity, inflammation, and other disorders of the microenvironment surrounding the nerve [26–28]. No patients with nerve injury higher than grade N2 were observed in this study, which might be related to the exclusion of patients who might have preoperative nerve injury. We defined sensory impairment that persisted on the second postoperative day as nerve injury, because the duration of nerve block usually does not exceed 48 h according to previous studies and experience [22,29].

We found that dexamethasone, as a local anesthetic adjuvant, prolonged the nerve blockade and the time to first rescue analgesia as well as reduced the number of patients requiring rescue analgesia after surgery. We also found that perineural dexamethasone reduced the incidence of PONV in patients. This is consistent with the results of most previous studies [5,20,30,31]. Despite these supportive findings, further research is needed to determine optimal dosing and administration protocols for different surgeries and nerve blocks. Long-term follow-up studies are also necessary to assess dexamethasone's sustained impact on nerve function recovery, especially in patients with pre-existing nerve damage or diabetes.

Recent studies by Lei et al. [32] and Albrecht et al. [33,34] found that intravenous administration of dexamethasone achieved effects comparable to perineural administration. Both studies highlighted the potential risks of off-label use and perineural

administration, including nerve and muscle damage. Consequently, they recommended the use of intravenous dexamethasone in clinical practice. Therefore, it is necessary to exercise caution when using perineural dexamethasone, especially in patients with diabetes or those at high risk of nerve damage.

Gouda et al. [35] reported that adding low doses of dexamethasone (1, 2, and 4 mg) as an adjuvant to brachial plexus block can prolong the duration of nerve block and enhance the anesthetic effect. Moreover, Bravo et al. [36] found that 2, 5, and 8 mg of perineural dexamethasone in ultrasound-guided infraclavicular brachial plexus block provided clinically equivalent sensorimotor and analgesic durations. The median dosage of dexamethasone used in our study was 3 mg. Therefore, the dosage used in our study was clinically significant and within the range used in previous studies.

4.1. Strengths and limitations

Strengths: This prospective, randomized, double-blind trial offers several strengths. Our large sample size (n = 345) provides robust statistical power. The use of validated assessment tools, including the Wound, Nerve, and Systemic Classification System, enhances outcome reliability. Extended 12-week follow-up allows evaluation of long-term effects. Inclusion of diverse upper and lower limb surgeries broadens applicability. Analysis of potential confounding factors, such as diabetes and tourniquet use, provides comprehensive risk assessment.

Limitations: Our study has some limitations. We excluded patients under 18 years, limiting generalizability to pediatric populations. Follow-up was limited to 12 weeks; longer-term outcomes remain unexplored. While our sample size was substantial, an even larger cohort might detect subtler effects or rare complications.

5. Conclusions

While perineural dexamethasone did not increase the initial incidence of postoperative nerve injury, it appears to delay recovery from nerve injury symptoms.

The benefits of prolonged analgesia and reduced postoperative nausea must be carefully weighed against this potential risk.

Diabetes and tourniquet use emerged as significant risk factors for postoperative nerve injury, highlighting the need for extra vigilance in these patient populations.

These findings emphasize the need for judicious use of perineural dexamethasone, especially in high-risk patients. Future research should focus on optimizing dosing regimens, exploring alternative administration routes, and conducting longer-term follow-up studies to fully understand the impact of dexamethasone on nerve tissue recovery.

Assistance with the article

None.

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Consent for publication

No details on individuals have been reported within the manuscript.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Presentation

None.

CRediT authorship contribution statement

Na Zhu: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Bingbing Xiang:** Writing – original draft, Visualization, Validation, Methodology, Formal analysis, Data curation, Conceptualization. **Jinghong Shi:** Writing – original draft, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Pingliang Yang:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization. **Yunke Dai:** Writing – review & editing, Writing – original draft, Visualization, Validation, Investigation, Formal analysis, Data curation, Conceptualization. **Shun Wang:** Writing – review & editing,

Writing – original draft, Visualization, Validation, Supervision, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:Pingliang Yang, MD reports financial support was provided by the Science and Technology Department of Sichuan Province. Pingliang Yang, MD reports was provided by Chengdu Science and Technology Bureau. Pingliang Yang, MD reports financial support was provided by West China Hospital, Sichuan University. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

List of Abbreviations

PONV	postoperative nausea and vomiting
WNS	Wound, Nerve, and Systemic Classification System
PACU	Postanesthesia care unit
CRPS	Complex Regional Pain Syndrome
NRS-R, NRS-D	Numeric rating scales at rest and dynamic
PNB	Peripheral nerve block

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e35612.

References

[1] A.B. Lipira, R.F. Sood, P.D. Tatman, et al., Complications within 30 days of hand surgery: an analysis of 10,646 patients, J. Hand Surg. 40 (2015) 1852–1859.
[2] M. Yajnik, A. Kou, S.C. Mudumbai, et al., Peripheral nerve blocks are not associated with increased risk of perioperative peripheral nerve injury in a veterans affairs inpatient surgical population, Reg. Anesth. Pain Med. 44 (2019) 81–85.
[3] W. Droog, D. Lin, J.J. van Wijk, et al., Is it the surgery or the block? Incidence, risk factors, and outcome of nerve injury following upper extremity surgery, Plastic and Reconstructive Surgery - Global Open 7 (2019) e2458.
[4] J.M. Neal, M.J. Barrington, R. Brull, et al., The second asra practice advisory on neurologic complications associated with regional anesthesia and pain medicine: executive summary 2015, Reg. Anesth. Pain Med. 40 (2015) 401–430.
[5] C. Xuan, W. Yan, D. Wang, et al., The facilitatory effects of adjuvant pharmaceutics to prolong the duration of local anesthetic for peripheral nerve block: a systematic review and network meta-analysis, Anesth. Analg. 133 (2021) 620–629.
[6] N. Noori, K. Anand, G. Pfeffer, et al., Dexamethasone addition to popliteal nerve blocks: effects on duration of analgesia and incidence of postoperative nerve complication, Foot Ankle Spec. 14 (2021) 39–45.
[7] Z. Song, S. Pang, G. Wang, et al., Comparison of postoperative analgesic effects in response to either dexamethasone or dexmedetomidine as local anesthetic adjuvants: a systematic review and meta-analysis of randomized controlled trials, J. Anesth. 35 (2021) 270–287.
[8] R. Venkatraman, A. Pushparani, K. Karthik, et al., Comparison of morphine, dexmedetomidine and dexamethasone as an adjuvant to ropivacaine in ultrasound-guided supraclavicular brachial plexus block for postoperative analgesia—a randomized controlled trial, J. Anaesthesiol. Clin. Pharmacol. 37 (2021) 102.
[9] M.A. Kirksey, S.C. Haskins, J. Cheng, et al., Local anesthetic peripheral nerve block adjuvants for prolongation of analgesia: a systematic qualitative review, PLoS One 10 (2015) e137312.
[10] R.M.S.M. Mohamed, E. Ahmad Ahmad, D.M. Amin, et al., Adrenergic receptors blockade alleviates dexamethasone-induced neurotoxicity in adult male wistar rats: distinct effects on β-arrestin2 expression and molecular markers of neural injury, Daru (2023).
[11] O.J. Gagne, A. Cheema, M. Abuhantash, et al., Effect of dexamethasone in peripheral nerve blocks on recovery of nerve function, Foot Ankle Int. 42 (2021) 23–30.
[12] P.G. Krishna, S. Khanna, S.V. Jaishree, Review of adjuvants to local anesthetics in peripheral nerve blocks: current and future trends, Saudi J. Anaesth. 14 (2020) 77–84.
[13] Z.J. Koscielniak-Nielsen, B.S. Frederiksen, H. Rasmussen, et al., A comparison of ultrasound-guided supraclavicular and infraclavicular blocks for upper extremity surgery, Acta Anaesthesiol. Scand. 53 (2009) 620–626.
[14] V.U. Lahori, A. Raina, S. Gulati, et al., A randomized comparative study of efficacy of axillary and infraclavicular approaches for brachial plexus block for upper limb surgery using peripheral nerve stimulator, Indian J. Anaesth. 55 (2011) 253–259.
[15] A. Veljkovic, M. Penner, K. Wing, et al., Vancouver foot and ankle wns (wound, nerve, and systemic) classification system for foot and ankle orthopedic surgery, Foot Ankle Int. 39 (2018) 1056–1061.
[16] C. Dani, V. Vestri, G. Bertini, et al., Toxicity of corticosteroids and catecholamines for mice neuronal cell cultures: role of preservatives, J. Matern. Fetal Neonatal Med. 20 (2007) 325–333.
[17] C. Xiong, C. Han, D. Zhao, et al., Comparing the effects of dexmedetomidine and dexamethasone as perineural adjuvants on peripheral nerve block: a prisma-compliant systematic review and meta-analysis, Medicine (Baltim.) 100 (2021) e27064.
[18] S.E.H. Tsan, J. Dinsmore, Dexamethasone use in perioperative neuroscience: boon or bane, or both? J. Neurosurg. Anesthesiol. 35 (2023) 351–353.
[19] B. Hong, C. Oh, Y. Jo, et al., The effect of intravenous dexamethasone and dexmedetomidine on analgesia duration of supraclavicular brachial plexus block: a randomized, four-arm, triple-blinded, placebo-controlled trial, J. Personalized Med. 11 (2021) 1267.
[20] J. Fang, Y. Shi, F. Du, et al., The effect of perineural dexamethasone on rebound pain after ropivacaine single-injection nerve block: a randomized controlled trial, BMC Anesthesiol. 21 (2021).
[21] H. Sehmbi, R. Brull, K.R. Ceballos, et al., Perineural and intravenous dexamethasone and dexmedetomidine: network meta-analysis of adjunctive effects on supraclavicular brachial plexus block, Anaesthesia 76 (2021) 974–990.
[22] N. Desai, K.R. Kirkham, E. Albrecht, Local anaesthetic adjuncts for peripheral regional anaesthesia: a narrative review, Anaesthesia 76 (2021) 100–109.

[23] S.C. Byram, S.W. Byram, N.M. Miller, et al., Bupivacaine increases the rate of motoneuron death following peripheral nerve injury, Restor. Neurol. Neurosci. 35 (2017) 129–135.
[24] S.C. Byram, S.E. Bialek, V.A. Husak, et al., Distinct neurotoxic effects of select local anesthetics on facial nerve injury and recovery, Restor. Neurol. Neurosci. 38 (2020) 173–183.
[25] J. Mann, K. Davis, M. Bright, et al., Intravenous dexamethasone to augment peripheral nerve block efficacy: a pooled analysis of infective complications, J. Clin. Anesth. 75 (2021) 110518.
[26] S. Rotshenker, Wallerian degeneration: the innate-immune response to traumatic nerve injury, J. Neuroinflammation 8 (2011) 109.
[27] N. Pulos, E.H. Shin, R.J. Spinner, et al., Management of iatrogenic nerve injuries, J. Am. Acad. Orthop. Surg. 27 (2019) e838–e848.
[28] P.J. Austin, G. Moalem-Taylor, The neuro-immune balance in neuropathic pain: involvement of inflammatory immune cells, immune-like glial cells and cytokines, J. Neuroimmunol. 229 (2010) 26–50.
[29] M. Heesen, M. Klimek, G. Imberger, et al., Co-administration of dexamethasone with peripheral nerve block: intravenous vs perineural application: systematic review, meta-analysis, meta-regression and trial-sequential analysis, Br. J. Anaesth. 120 (2018) 212–227.
[30] R. Margulis, J. Francis, B. Tischenkel, et al., Comparison of dexmedetomidine and dexamethasone as adjuvants to ultra-sound guided interscalene block in arthroscopic shoulder surgery: a double-blinded randomized placebo-controlled study, Anesthesiol. Pain Med. 11 (2021).
[31] P. Marhofer, M. Columb, P.M. Hopkins, et al., Dexamethasone as an adjuvant for peripheral nerve blockade: a randomised, triple-blinded crossover study in volunteers, Br. J. Anaesth. 122 (2019) 525–531.
[32] G. Lei, S. Yang, L. Wu, et al., Intravenous injection of dexamethasone is non-inferior to perineural administration for popliteal sciatic nerve and saphenous nerve blocks: a randomized, controlled, triple-blind study, Heliyon 10 (2024) e28304.
[33] E. Albrecht, Y. Renard, N. Desai, Intravenous versus perineural dexamethasone to prolong analgesia after interscalene brachial plexus block: a systematic review with meta-analysis and trial sequential analysis, Br. J. Anaesth. 133 (2024) 135–145.
[34] N. Desai, E. Albrecht, Local anaesthetic adjuncts for peripheral nerve blockade, Curr. Opin. Anaesthesiol. 36 (2023) 533–540.
[35] N. Gouda, J. Zangrilli, A. Voskerijian, et al., Safety and duration of low-dose adjuvant dexamethasone in regional anesthesia for upper extremity surgery: a prospective, randomized, controlled blinded study, HAND (2021) 44167173.
[36] D. Bravo, J. Aliste, S. Layera, et al., A multicenter, randomized comparison between 2, 5, and 8 mg of perineural dexamethasone for ultrasound-guided infraclavicular block, Reg. Anesth. Pain Med. 44 (2019) 46–51.