Analgesic Comparison of Perineural With Intravenous Dexamethasone on Interscalene Block for Shoulder Arthroscopy: a Meta-analysis of Randomized Controlled Trials

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Research article

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Abstract

Introduction: The analgesic comparison of perineural with intravenous dexamethasone on interscalene block for pain management of shoulder arthroscopy remains controversial. We conduct a systematic review and meta-analysis to explore the influence of perineural with intravenous dexamethasone on interscalene block on the postoperative pain intensity of shoulder arthroscopy.

Methods: We have searched PubMed, EMbase, Web of science, EBSCO, and Cochrane library databases through April 2021 for randomized controlled trials (RCTs) assessing the effect of perineural with intravenous dexamethasone on interscalene block for pain control of shoulder arthroscopy. This meta-analysis is performed using the random-effect model.

Results: Five RCTs are included in the meta-analysis. Overall, compared with intravenous dexamethasone for shoulder arthroscopy, perineural dexamethasone leads to similar block duration (SMD=0.12; 95% CI=-0.12 to 0.35; P=0.33), pain scores at 12 h (SMD=-0.67; 95% CI=-1.48 to 0.15; P=0.11), pain scores at 24 h (SMD=-0.33; 95% CI=-0.79 to 0.14; P=0.17), opioid consumption (SMD=0.01; 95% CI=-0.18 to 0.19; P=0.95) and nausea/vomiting (OR=0.74; 95% CI=0.38 to 1.44; P=0.38).

Conclusions: Perineural and intravenous dexamethasone demonstrated comparable pain control after shoulder arthroscopy when supplemented to interscalene block.

Introduction

Arthroscopy has been widely accepted to diagnose and treat shoulder diseases [1–3]. However, significant postoperative pain is a main concern after this surgery and effective analgesia is required for this successful day-case surgery [3–5]. Interscalene brachial plexus block (ISB) is the standard care for analgesia after shoulder surgery in terms of providing superior analgesia and reducing opioid consumption [6–8]. Single-injection ISB is limited by analgesic maintenance for several hours, and especially moderate to severe pain of this surgery requires opioid analgesia [9].

The increase in the dose of local anesthetic is used to prolong ISB, and has the limitation of narrow therapeutic window and volume/concentration. Volumes of 10 ml or greater injected into the interscalene groove is associated with a high risk of ipsilateral hemi-diaphragmatic paresis [10]. Several adjuvants have been developed to prolong ISB. Especially, dexamethasone by perineural approach showed the potential in prolonging the duration of peripheral nerve blocks when in conjunction with local anesthetics [11].

Recently, several studies have explored the analgesic efficacy of perineural with intravenous dexamethasone for the pain management of shoulder arthroscopy, but the results are conflicting [10, 12, 13]. With accumulating evidence, we therefore perform this meta-analysis of RCTs to compare perineural with intravenous dexamethasone in patients with shoulder arthroscopy.

Materials And Methods

Ethical approval and patient consent are not required because this is a systematic review and meta-analysis of previously published studies. The systematic review and meta-analysis are conducted and reported in adherence to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [14, 15].

Search strategy and study selection

Two investigators have independently searched the following databases (inception to April 2021): PubMed, EMbase, Web of science, EBSCO, and Cochrane library databases. The electronic search strategy is conducted using the following keywords: dexamethasone, and interscalene block, and arthroscopy, and shoulder. We also check the reference lists of the screened full-text studies to identify other potentially eligible trials.

The inclusive selection criteria are as follows: (i) patients undergo shoulder arthroscopy; (ii) intervention treatments are perineural versus intravenous dexamethasone supplemented to interscalene block; (iii) study design is RCT.

Data extraction and outcome measures

We have extracted the following information: author, number of patients, age, female, body weight, American Society of Anesthesiologists (ASA) physical status and detail methods in each group etc. Data have been extracted independently by two investigators, and discrepancies are resolved by consensus. We also contact the corresponding author to obtain the data when necessary. The primary outcome is block duration. Secondary outcomes include pain scores at 12 h, pain scores at 24 h, opioid consumption, nausea/vomiting.

Quality assessment in individual studies

Methodological quality of the included studies is independently evaluated using the modified Jadad scale [16]. There are 3 items for Jadad scale: randomization (0-2 points), blinding (0-2 points), dropouts and withdrawals (0-1 points). The score of Jadad Scale varies from 0 to 5 points. An article with Jadad score ≤ 2 is considered to be of low quality. If the Jadad score ≥ 3, the study is thought to be of high quality [17].

Statistical analysis

We estimate the standard mean difference (SMD) with 95% confidence interval (CI) for continuous outcomes (block duration, pain scores at 12 h, pain scores at 24 h and opioid consumption) and odd ratios (ORs) with 95% CIs for dichotomous outcomes (nausea/vomiting). The random-effects model is used regardless of heterogeneity. Heterogeneity is reported using the I^2 statistic, and $I^2 > 50\%$ indicates significant heterogeneity [15, 18]. Whenever significant

heterogeneity is present, we search for potential sources of heterogeneity via omitting one study in turn for the meta-analysis or performing subgroup analysis. All statistical analyses are performed using Review Manager Version 5.3 (The Cochrane Collaboration, Software Update, Oxford, UK).

Results

Literature search, study characteristics and quality assessment

A detailed flowchart of the search and selection results is shown in Fig. 1. 78 potentially relevant articles are identified initially. Finally, five RCTs that meet our inclusion criteria are included in the meta-analysis [10, 12, 13, 19, 20].

The baseline characteristics of five eligible RCTs in the meta-analysis are summarized in Table 1. The five studies are published between 2016 and 2020, and total sample size is 585. The doses of perineural or intravenous dexamethasone supplemented to interscalene block range from 1 mg to 5 mg. Among the five studies included here, three studies report block duration [10, 12, 13], three studies report pain scores at 12 h [10, 19, 20], four studies report pain scores at 24 h [10, 12, 19, 20], three studies report opioid consumption [10, 12, 13], and three studies report nausea/vomiting [10, 19, 20]. Jadad scores of the five included studies vary from 3 to 5, and all five studies are considered to have high quality according to quality assessment.

Table 1
Characteristics of included studies

NO.	Author	Perineural dexamethasone group						Intravenous dexamethasone group					
		Number	Age (years)	Female (n)	Weight (kg)	ASA physical status (I/II/III)	Methods	Number	Age (years)	Female (n)	Weight (kg)	ASA physical status (I/II/III)	Meth
1	McHardy 2020	92	51.6 (18–73), median (IQR)	25	-	25/49/18	interscalene block analgesia supplemented with perineural dexamethasone 4 mg	90	52.8 (22–76), median (IQR)	21	-	18/57/15	inter bloc supp with intra dexa 4 mg
2	Kahn 2018	63	50 ± 14	26	-	22/38/3	interscalene block supplemented with perineural dexamethasone 2 mg	62	47 ± 15	23	-	26/33/3	inter bloc supp with intra dexa 1 mg
3	Holland 2018	70	54 ± 12	21	87 ± 16	24/40/6	interscalene block analgesia supplemented with perineural dexamethasone 4 mg	69	53 ± 14	16	89 ± 17	21/44/5	inter bloc supp with intra dexa 4 mg
4	Sakae 2017	20	53.2 ± 9.8	8	63.2 ± 5.1	9/11/0	interscalene block analgesia supplemented with perineural dexamethasone 4 mg	20	52.1 ± 12.3	6	65.3 ± 4.2	8/12/0	inter bloc supp with intra dexa 4 mg
5	Chun 2016	50	50.8 ± 17.5	17	69.6 ± 12.9	24/26/0	interscalene block analgesia supplemented with perineural dexamethasone 5 mg	49	53.0 ± 14.2	15	68.0 ± 11.6	17/32/0	inter bloc supp with intra dexa 5 mg

Primary outcome: block duration

This outcome data is analyzed with the random-effects model, and compared to intravenous dexamethasone for shoulder arthroscopy, perineural dexamethasone results in similar block duration (SMD = 0.12; 95% CI=-0.12 to 0.35; P = 0.33) with low heterogeneity among the studies (I^2 = 37%, heterogeneity P = 0.33) (Fig. 2).

Sensitivity analysis

Low heterogeneity is observed among the included studies for the primary outcome, so we do not perform sensitivity analysis via omitting one study in turn to detect the heterogeneity.

Secondary outcomes

In comparison with intravenous dexamethasone for shoulder arthroscopy, perineural dexamethasone exhibits comparable pain scores at 12 h (SMD=-0.67; 95% CI=-1.48 to 0.15; P = 0.11; Fig. 3), pain scores at 24 h (SMD=-0.33; 95% CI=-0.79 to 0.14; P = 0.17; Fig. 4), opioid consumption (SMD = 0.01; 95% CI=-0.18 to 0.19; P = 0.95; Fig. 5) and nausea/vomiting (OR = 0.74; 95% CI = 0.38 to 1.44; P = 0.38; Fig. 6).

Discussion

This serious pain after shoulder arthroscopy commonly occurs and mainly results from the insertion of arthroscopic instruments into the joint, soft tissue dissection and distention [21–25]. Patients' early mobilization and rehabilitation is significantly affected by this postoperative pain [26–28]. Numerous techniques have been studied, and ISB is widely accepted as the most effective analgesic technique for this surgery [3, 29–31]. Furthermore, supplementation with dexamethasone revealed significant role in increasing the duration and analgesic efficacy of ISB for shoulder arthroscopy [13, 19].

In order to study the better approach to use dexamethasone supplementation for ISB, our meta-analysis included five RCTs comparing perineural or intravenous dexamethasone supplementation for shoulder arthroscopy. The results revealed that perineural and intravenous dexamethasone resulted in comparable block duration, pain scores at 12 h, pain scores at 24 h and opioid consumption when in conjunction with local analgesics for shoulder arthroscopy. Although the specific mechanism of dexamethasone remains unclear, it is postulated to reduce ectopic neuronal discharge and inhibit potassium channel-mediated discharge of nociceptive C-fibers [10, 32].

In consistent with our findings, previous study comparing perineural and systemic dexamethasone showed that both routes are associated with prolonged and similar block duration [33–35]. In contrast, one recent meta-analysis studied the dexamethasone supplementation for peripheral nerve block, and reported that perineural dexamethasone had a greater effect than systemic dexamethasone when used in conjunction with bupivacaine (4 h) versus ropivacaine alone (2 h). This meta-analysis studied the postoperative pain of various types of surgeries, and showed extreme heterogeneity of results with I^2 exceeding 90%. Therefore, its results should be interpreted with caution [11].

In addition, the incidence of nausea/vomiting is similar between two groups based on our results. This meta-analysis also has several limitations. Firstly, our analysis is based on five RCTs, and two of them have a relatively small sample size (n < 100). Overestimation of the treatment effect is more likely in smaller trials compared with larger samples. Next, although there is low heterogeneity, different doses, concentration and combination methods of analgesics may produce some bias. Finally, it is not feasible to perform the meta-analysis of some important index such as discharge time and time to first analgesic requirement based on current RCTs.

Conclusions

Perineural and intravenous dexamethasone showed similar efficacy for block duration for shoulder arthroscopy when supplemented to local analgesics.

Abbreviations

randomized controlled trials: RCTs

mean differences: MDs

confidence intervals: CIs

risk ratios: RRs

Declarations

Ethical Approval and Consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of supporting data

Not applicable.

Competing interests

The authors declare no conflict of interest.

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Authors' contributions

Liangku Huang, Peng Li conducted the design, study planning, data analysis and data interpretation. Liangku Huang, Peng Li, Haizhen Zhou and Zandong Zhao wrote and revised the article. All authors read and approved the final manuscript.

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None.

Declaration of conflict of interest

None

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Figures

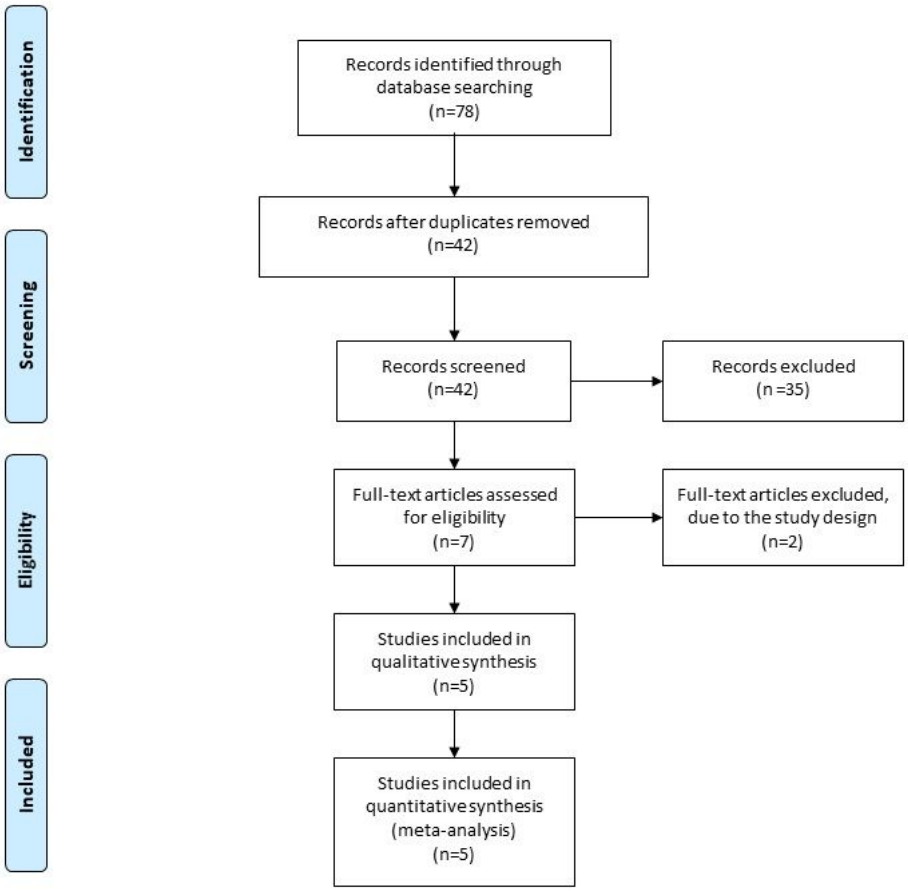

Figure 1

Flow diagram of study searching and selection process.

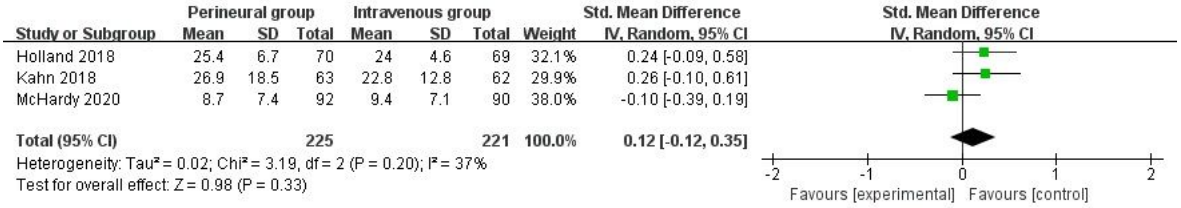

Figure 2

Forest plot for the meta-analysis of block duration.

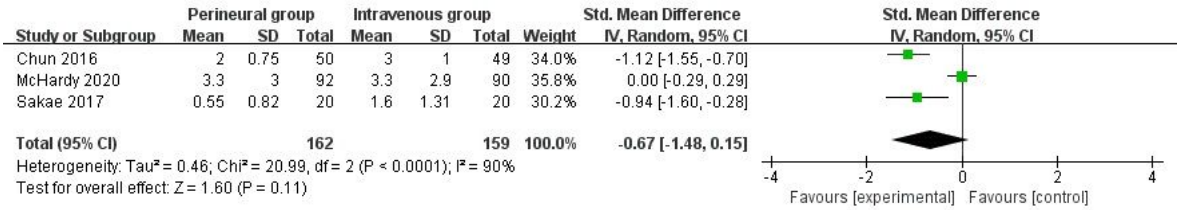

Figure 3

Forest plot for the meta-analysis of pain scores at 12 h.

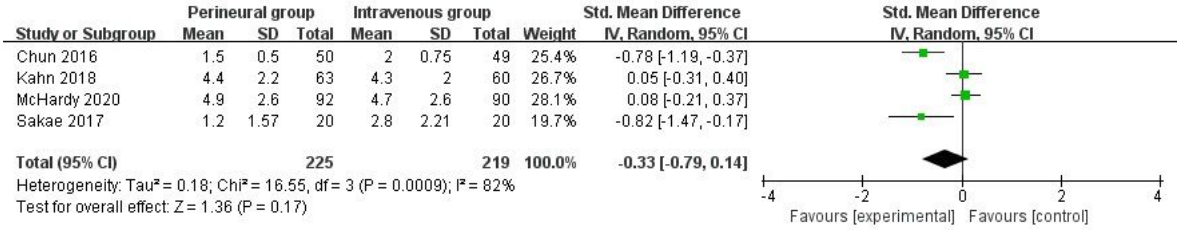

Figure 4

Forest plot for the meta-analysis of pain scores at 24 h.

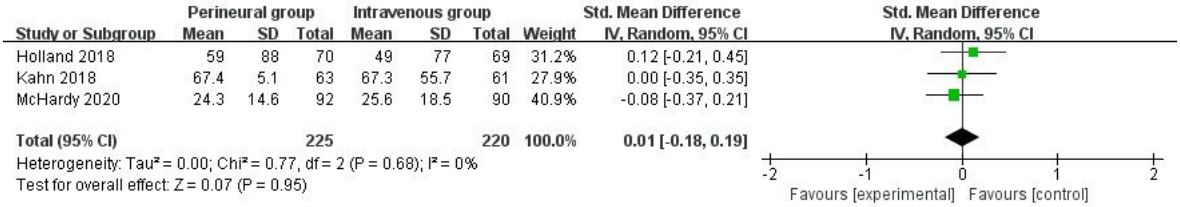

Figure 5

Forest plot for the meta-analysis of opioid consumption.

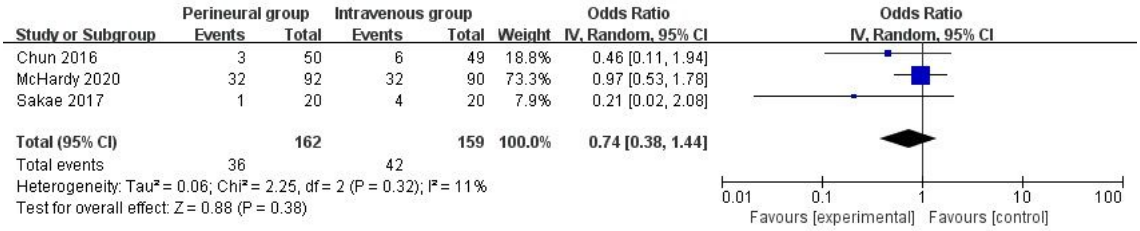

Figure 6

Forest plot for the meta-analysis of nausea/vomiting.