

The Analgesic Comparison of Supraclavicular and Interscalene Brachial Plexus Block for Shoulder Arthroscopy: A Meta-Analysis of Randomized Controlled Trials

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Research article

Keywords: SCBB, ISBB, shoulder arthroscopy, pain management, randomized controlled trials, meta-analysis.

Posted Date: April 27th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-428692/v1>

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Abstract

Introduction:

The analgesic comparison of supraclavicular versus interscalene brachial plexus block (SCBB versus ISBB) for pain management of shoulder arthroscopy remains controversial. We conduct a systematic review and meta-analysis to explore the influence of SCBB versus ISBB on the postoperative pain intensity of shoulder arthroscopy.

Methods

We have searched PubMed, EMBase, Web of science, EBSCO, and Cochrane library databases through March 2021 for randomized controlled trials (RCTs) assessing the effect of SCBB versus ISBB on pain control of shoulder arthroscopy. This meta-analysis is performed using the random-effect model.

Results

Six RCTs are included in the meta-analysis. Overall, compared with ISBB for shoulder arthroscopy, SCBB leads to similar pain scores at 24 h (SMD = 0.07; 95% CI = -0.14 to 0.28; P = 0.52) and additional analgesic requirement (SMD = -0.22; 95% CI = -0.52 to 0.09; P = 0.16), but results in increased onset time of block (SMD = 1.77; 95% CI = 0.21 to 3.34; P = 0.25), decreased incidence of horner's syndrome (OR = 0.25; 95% CI = 0.10 to 0.64; P = 0.003) and adverse events (OR = 0.25; 95% CI = 0.11 to 0.58; P = 0.001).

Conclusions

SCBB demonstrated comparable pain control after shoulder arthroscopy compared to ISBB, with lower incidence of adverse events.

Introduction

The number of patients requiring shoulder arthroscopy has been increasing annually [1, 2]. Significant postoperative pain is a main concern after shoulder arthroscopy and effective analgesia is required for this successful day-case surgery [3, 4]. This pain is mainly derived from insertion of arthroscopic instruments into the joint, soft tissue dissection and distention [5–9]. Postoperative pain seriously affects patients' early mobilization and rehabilitation [10–12]. Although interscalene brachial plexus block (ISBB) is widely accepted as the most effective analgesic technique for this surgery, it frequently induces phrenic nerve block even with the use of ultrasound and low volumes of local anaesthetic [13–16].

The alternatives to ISBB should be developed to decrease the related adverse events [16]. Supraclavicular brachial plexus block (SCBB) was reported to have the potential in decreasing the risk of adverse events, particularly when guided by ultrasound [17, 18]. Previous studies compared the analgesic efficacy of SCBB with ISBB for ambulatory shoulder surgery, and the results revealed comparable efficacy of pain control between SCBB and ISBB [19]. In addition, many studies showed that SCBB is a safe technique in terms of respiratory complications [20–22].

Recently, several studies have explored the analgesic efficacy of SCBB with ISBB for the pain management of shoulder arthroscopy, but the results are conflicting [1, 23, 24]. With accumulating evidence, we therefore perform a systematic review and meta-analysis of RCTs to explore the efficacy of SCBB versus ISBB 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) [25, 26].

Search strategy and study selection

Two investigators have independently searched the following databases (inception to March 2021): PubMed, EMBase, Web of science, EBSCO, and Cochrane library databases. The electronic search strategy is conducted using the following keywords: supraclavicular, and interscalene, and brachial plexus 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 undergoing shoulder arthroscopy; (ii) intervention treatments are SCBB versus ISBB; (iii) study design is RCT.

Data extraction and outcome measures

We have extracted the following information: author, number of patients, age, female, body weight, duration of surgery 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 are pain scores at 24 h. Secondary outcomes include additional analgesic requirement, onset time of block, horner's syndrome and adverse events.

Quality assessment in individual studies

Methodological quality of the included studies is independently evaluated using the modified Jadad scale [27]. 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 [28].

Statistical analysis

We estimate the standard mean difference (SMD) with 95% confidence interval (CI) for continuous outcomes (pain scores at 24 h, additional analgesic requirement, and onset time of block) and odd ratios (ORs) with 95% CIs for dichotomous outcomes (horner's syndrome and adverse events). The random-effects model is used regardless of heterogeneity. Heterogeneity is reported using the I^2 statistic, and $I^2 > 50\%$ indicates significant heterogeneity [26, 29]. 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 Figure 1. 102 potentially relevant articles are identified initially. Finally, six RCTs that meet our inclusion criteria are included in the meta-analysis [1, 23, 24, 30-32].

The baseline characteristics of the six eligible RCTs in the meta-analysis are summarized in Table 1. The six studies are published between 2015 and 2019, and sample sizes range from 44 to 126. The local analgesics of SCBB or ISBB include bupivacaine, clonidine, ropivacaine and mepivacaine.

Among the six studies included here, four studies report pain scores at 24 h [1, 23, 24, 31], five studies report additional analgesic requirement [1, 23, 24, 30, 31], two studies report onset time of block [23, 30], five studies report horner's syndrome [23, 24, 30-32] and four studies report adverse events [1, 23, 30, 32]. Jadad scores of the six included studies vary from 3 to 5, and all three studies are considered to be high-quality ones according to quality assessment.

Primary outcome: pain scores at 24 h

This outcome data is analyzed with the random-effects model, and compared to ISBB for shoulder arthroscopy, SCBB results in similar pain scores at 24 h (SMD=-0.25; 95% CI=-0.79 to 0.30; P=0.37) with significant heterogeneity among the studies ($I^2=86\%$, heterogeneity P<0.00001) (Figure 2).

Sensitivity analysis

Significant 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. As shown in Figure 2, the study conducted by Karaman shows the results that are almost out of range of the others and probably contributed to the heterogeneity [23]. After excluding this study, the results suggested that SCBB and ISBB are still associated with comparable pain scores at 24 h for shoulder arthroscopy (SMD=0.07; 95% CI=-0.14 to 0.28; P=0.52), and no heterogeneity remained ($I^2=0.60$, P=0.58).

Secondary outcomes

In comparison with ISBB for shoulder arthroscopy, SCBB exhibits similar additional analgesic requirement (SMD=-0.22; 95% CI=-0.52 to 0.09; P=0.16; Figure 3), but is associated increased onset time of block (SMD=1.77; 95% CI=0.21 to 3.34; P=0.25; Figure 4), decreased incidence of horner's syndrome (OR=0.25; 95% CI=0.10 to 0.64; P=0.003; Figure 5) and adverse events (OR=0.25; 95% CI=0.11 to 0.58; P=0.001; Figure 6).

Discussion

Many methods have been developed to control postoperative pain after arthroscopic shoulder surgery, and they include subacromial/intra-articular infiltration of local anesthetic, suprascapular and/or axillary nerve block, and interscalene block [33, 34]. Especially, nerve block has become an important approach supplemental to multimodal approach which is widely applied to improve analgesia and reduce the opioid-related adverse effect [35]. ISBB can provide a blockade at the C5-C6 root level after arthroscopic shoulder surgery, but may result in some serious complications [4, 36]. Numerous alternative techniques have been investigated, but hardly achieve equivalent analgesic methods compared with ISBB [3, 4].

US-guided anterior approach to the suprascapular nerve demonstrated that this nerve was located at an 8-mm (interquartile range, 6 to 9 mm) median distance to the supraclavicular brachial plexus in cadavers. 20 A prospective study documented that SCBB may achieve as equal efficacy as ISBB for shoulder arthroscopy [19]. Our meta-analysis confirms that SCBB and ISBB show the comparable analgesic efficacy for arthroscopic shoulder surgery, as evidenced by the similar pain scores at 24 h and additional analgesic requirement between two groups. However, SCBB may be associated with relatively longer onset time of block than ISBB based on the results of our meta-analysis. The quality of recovery of the patients was reported to be satisfactory with these two techniques [23].

Horner's syndrome may occur and result from the paralysis of the ipsilateral sympathetic cervical chain by the local anesthetic, such as the procedure of ISBB and SCBB. 29,30 Previous studies compared the incidence of Horner's syndrome between ISBB and SCBB, and its incidence may be higher in ISBB than that in SCBB [32, 37]. The results of our meta-analysis concluded that SCBB was associated with lower incidence of Horner's syndrome compared to ISBB after

shoulder arthroscopy. In addition, the adverse events were still found to be lower after SCBB than those in ISBB. Regarding the sensitivity analysis, Significant heterogeneity is observed for the primary outcome. After excluding this study conducted by Karaman with 0.25% bupivacaine [23], no heterogeneity remains. SCBB and ISBB still have comparable pain scores at 24 h for shoulder arthroscopy. These indicate that 0.25% bupivacaine through SCBB may produce better analgesic efficacy than that through ISBB.

This meta-analysis has several limitations. Firstly, our analysis is based on six RCTs, and three 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 significant heterogeneity, which may be caused by different doses, concentration and methods of analgesics. 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

SCBB is recommended for shoulder arthroscopy because it can obtain the comparable analgesic efficacy than ISBB, especially with lower incidence of adverse events.

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.

Funding

Not applicable.

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.

Acknowledgements

None.

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Declaration of conflict of interest: None;

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Tables

Table 1
Characteristics of included studies

NO.	Author	SCBB group						ISBB group				
		Number	Age (years)	Female (n)	Weight (kg)	Duration of surgery (min)	Methods	Number	Age (years)	Female (n)	Weight (kg)	Duration of surgery (min)
1	Karaman 2019	29	59 (16.5)	14	73.07(8.80)	140 (30)	SCBB with 20 mL of 0.25% bupivacaine	31	52 (20)	20	72.56(8.56)	120
2	Cabaton 2019	54	57 (50,65), median (IQR)	21	-	-	SCBB with a mixture of 100 mg levobupivacaine (20 ml, 0.5%) and clonidine (1 ug/kg)	53	58(54,65)	25	-	-
3	Auyong 2018	63	53 ± 14	24	-	88 ± 25	SCBB with 15 ml, 0.5% ropivacaine	63	54 ± 13	25	-	90 ±
4	Aliste 2018	22	58.0 (14.1)	15	-	75.0 (32.4)	SCBB with 20 mL of levobupivacaine 0.5% and epinephrine 5 ug/mL	22	58.4 (8.7)	10	-	85.1 (44.1)
5	Wiesmann 2016	58	52.7(13)	24	85.7(17)	-	SCBB with an initial bolus of 10 ml of ropivacaine 0.2% followed by continuous infusion of ropivacaine 0.2% (4 ml flow rate, 4 ml bolus, 30 min lockout time)	56	53.0(13)	22	86.1(17)	-
6	Ryu 2015	46	58.5 (53.8–64)	27	64.8 10.8	-	SCBB with a mixture containing 12.5 mL of 1% mepivacaine and 12.5 mL of 0.75% ropivacaine	47	60 (53–65)	19	64.3 10.0	-

Supraclavicular brachial plexus block (SCBB), interscalene brachial plexus block (ISBB).

Figures

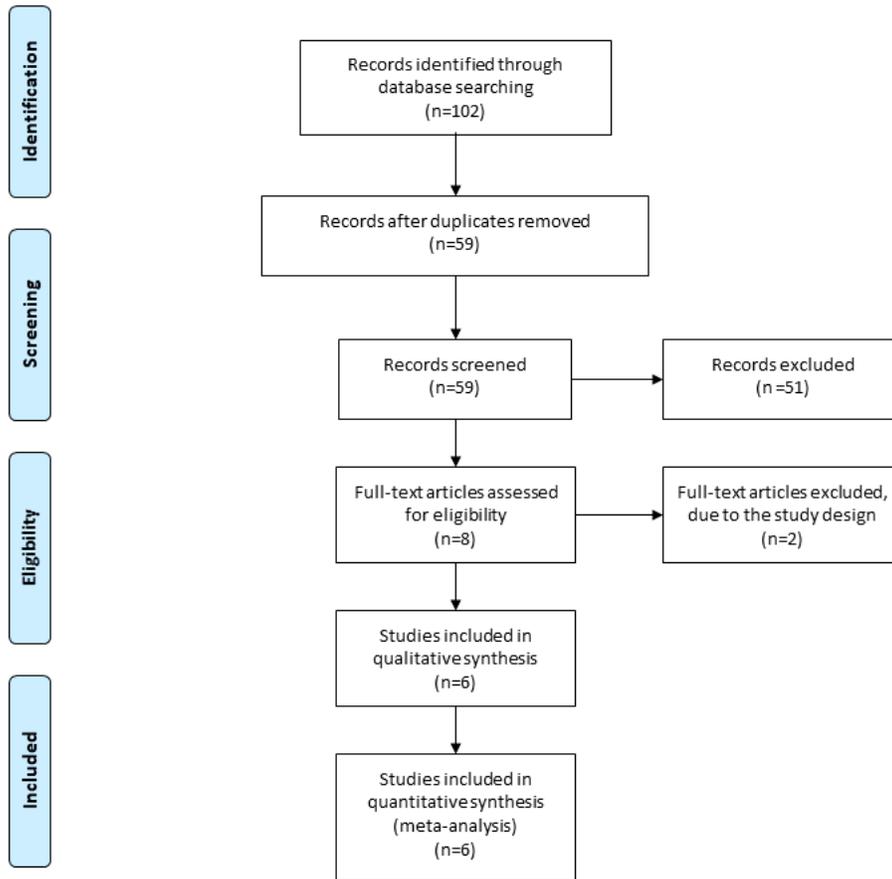


Figure 1

Flow diagram of study searching and selection process.

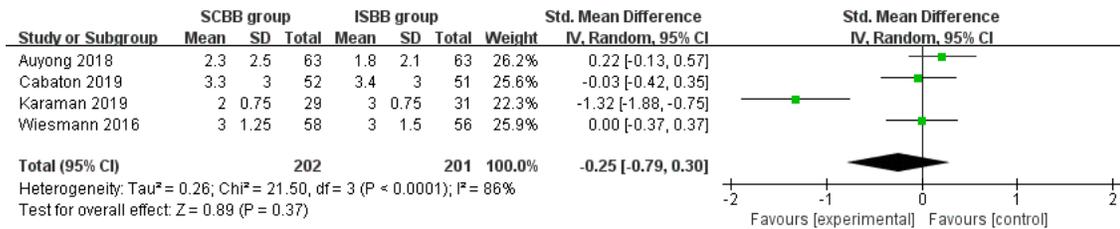


Figure 2

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

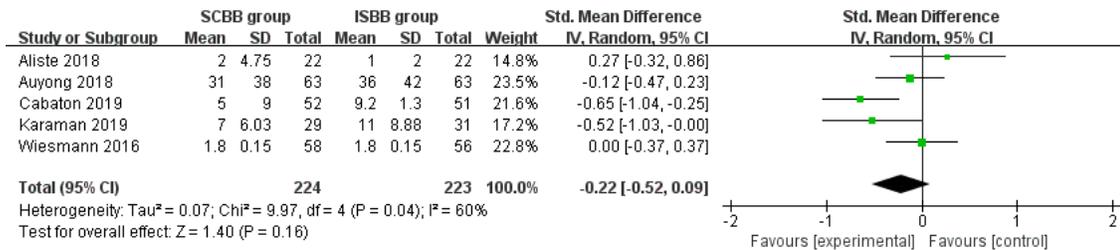


Figure 3

Forest plot for the meta-analysis of additional analgesic requirement.

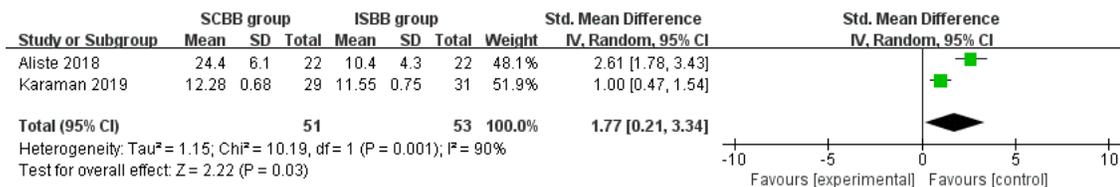


Figure 4

Forest plot for the meta-analysis of onset time of block.

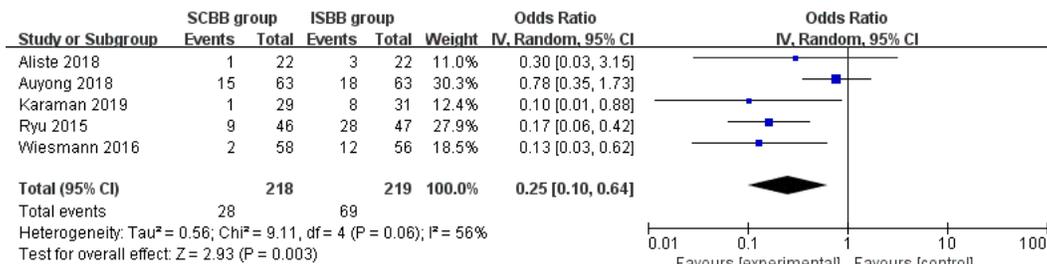


Figure 5

Forest plot for the meta-analysis of horner's syndrome.

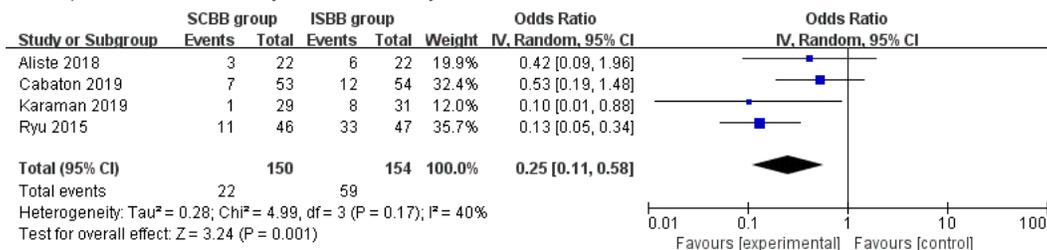


Figure 6

Forest plot for the meta-analysis of adverse events.