ORIGINAL ARTICLE

Ultrasound Guided Combined Suprascapular/Axillary Nerve Blocks Compared to Interscalene Nerve Block and Periarticular Infiltration for Arthroscopic Shoulder Surgery Analgesia

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Abstract

Background: ***Minimally invasive arthroscopic shoulder surgery causes significant intra- and postoperative pain. Regional analgesia lowers anesthesia and surgical discomfort, speeding recovery.***

Aim and objectives: ***When it comes to arthroscopic shoulder surgeries, there are two methods that have been compared for their effectiveness: ultrasound-guided combined suprascapular/axillary nerve and interscalene block and periarticular infiltration. The comparison will focus on intraoperative hemodynamic stability, opioid requirements, and postoperative pain. Factors such as total analgesic used, pain scores, patient satisfaction, and complications were also important in the secondary aim.***

Patients and methods: ***The subjects of this prospective, randomized, double-blind trial were 105 individuals who, between 2023 and 2024, had unilateral arthroscopic shoulder surgeries performed as elective procedures at Al-Azhar University Hospitals.***

Results: ***At 15 minutes, 90 minutes, 105 minutes, and the completion of surgery, there was no significant difference in heart rate (HR) and mean arterial pressure (MAP) between the three groups. The group's interscalene brachial plexus block (ISB) and shoulder block (ShB) substantially reduced HR and MAP at 30 minutes, 45 minutes, and 60 minutes compared to the group PAB. Both groups showed considerably reduced HR and MAP at 75 minutes compared to the group that underwent periarticular block (PAB) (P-value<0.05), although there was no significant difference between the two groups.***

Conclusion: ***While both PAB and ultrasound-guided combined suprascapular/axillary nerve and ISB improve hemodynamics, the former is more effective in reducing pain scores, total opioid consumption, and cortisol levels in patients undergoing arthroscopic shoulder surgery, while the latter is preferred by the majority.***

Keywords: Ultrasound; Arthroscopic shoulder surgery

1. Introduction

Despite being a minimally invasive procedure, arthroscopic shoulder surgery still causes a lot of discomfort during and after the procedure.[1]

Reducing the need for anesthesia and postoperative discomfort with regional analgesia speeds up the healing process.[2]

When it comes to shoulder surgeries, the most dependable method of pain relief is the interscalene brachial plexus block, or ISB, Fredickson et al.,[3] However, there are a number of complications that can arise from it, such as diaphragmatic dysfunction and phrenic nerve palsy, the latter of which can cause respiratory failure.

The ultrasonic-guided (USG) method of SSN block was introduced in 2007 as a means of managing shoulder pain, Harmon and Hearty[4], and AN block, Rothe et al.,[5] being discussed as a potential alternative for the management of shoulder surgery pain. With time, the two blocks were merged to form USG ShB by Dhir et al.,[6] in the most effective manner. Since ShB is a more distal phrenic sparing block, it may become more common than ISB as a result of the high success rate provided by USG procedures.

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An analysis of studies conducted in 2020 indicated that the ISB provided superior analgesia following shoulder arthroscopy than the suprascapular nerve (SSN) block. Other options to ISB should be investigated, as the landmark-guided posterior SSN block does not offer clinically significant analgesic benefits during shoulder surgery, according to the authors.[7]

A further important factor that works in tandem with the SSN to innervate the shoulder joints is the axillary nerve (AN).[8]

Another method called shoulder block (ShB) that involves blocking both the SSN and the AN simultaneously was proposed by Ramoo et al.[9]

This study aimed to compare the intraoperative hemodynamic stability, opioid requirements, and postoperative pain that both interscalene block and periarticular infiltration and ultrasound-guided combined suprascapular/axillary nerve procedures provided in the recovery room during arthroscopic shoulder surgeries. The inclusion of the duration until the initial request for painkillers was made, the total amount of analgesics needed, pain ratings, patient satisfaction, and complications was the secondary goal.

2. Patients and methods

Between February 2023 and February 2024, 105 patients at Al-Azhar University Hospitals received elective unilateral arthroscopic shoulder surgery. These patients participated in this prospective, randomized, double-blind trial.

Inclusion criteria:

Individuals undergoing elective unilateral arthroscopic shoulder surgery who are between the ages of 18 and 60, regardless of gender, and who have received agreement from their parents (a legal person) to perform this procedure.

Exclusion criteria:

Patients who refuse treatment, have a body mass index (BMI) of more than 30 kg/m2, are unable to comprehend the visual analogue scale (VAS), have previously experienced upper limb neurological deficits, have coagulopathy, neuropathy, severe cardiopulmonary disease, allergies to local anesthetic drugs, or have a local site infection.

Randomization and blindness:

A closed opaque envelope with their allocation code was used to randomly divide the 105 patients into three equal groups in a parallel fashion using computer-generated numbers. Patients got 10 milliliters of 0.5% bupivacaine for both the AN and SSN blocks in the group shoulder block (ShB) (N=35). Patients in the group receiving Interscalene brachial plexus block (ISB) (N=35) were given 10 milliliters of 0.5% bupivacaine. Thirty-five patients in the group periarticular block (PAB) got a 10 milliliter 0.5% bupivacaine Periarticular Infiltration block.

The trial design was concealed from both the outcome evaluator and the patients. The pharmacist who manufactured the medications under investigation did not take part in the study, and the anthropologist who performed all the blocks did not participate in the study at all.

Preoperative assessment:

All patients were subjected to the following:

Age, sex, weight, height, BMI, length of operation, and type of surgery were among the sociodemographic details and medical history that were gathered. Full clinical examination, including blood pressure measurements at the diastolic and systolic levels, temperature, and pulse. Laboratory tests include the coagulation profile test, renal function test, liver function test, and complete blood count (CBC).

All hemodynamic parameters were collected perioperatively, and standard values for heart rate (HR), peripheral oxygen saturation (SpO2), and noninvasive arterial blood pressure (MAP) were taken upon arrival in the operating room.

Intraoperative:

Suprascapular/Axillary Nerve:

The method of Harmon and Hearty, 5 Making use of two guides4 A 50-mm needle was placed into the long axis, and its whole length was visible. After observation of the infraspinatus and/or supraspinatus muscles being stimulated (current 0.6mA, pulse width 0.1 millisecond, frequency 2Hz), 10ml of 0.5% bupivacaine was injected into the supraspinatus fossa, beneath the supraspinatus muscle. For the AXNB, the in-plane caudad-to-cephalad approach was used. The neurovascular quadrangular space was identified, the axillary nerve was located, and aliquots of 0.5% bupivacaine 10mL were injected using a 100-mm needle(Pajunk) after observing the deltoid response to stimulation(current 0.6mA, pulse width 0.1millisecond, frequency 2Hz) (current 0.6mA, pulse width 0.1millisecond, frequency 2Hz).

ISB procedure:

The patient was placed in the supine posture while ISB was administered. Once the artery was located, the probe was pushed slightly laterally after being implanted transversely at the level of the cricoid cartilage. We used the "in plane" technique to advance the block needle from the lateral to the medial direction after visualizing the brachial plexus between the scalene muscles. A 5mL saline injection was then administered to confirm the block site. Thirty milliliters of 0.25% bupivacaine were given once the block's placement had been verified.

The patients were sent to the operating room after the blocks' efficacy was assessed using a cold test involving an ice pack. Because anaesthesia was present in the relevant dermatomal area (C5-T1), the suprascapular/axillary nerve block and ISB were deemed successful.

Postoperative:

VAS measured post-op pain. After surgery, meperidine 10mg was given intravenously as a rescue analgesic at 1, 2, 4, 6, 8, and 12 hours after arrival in PACU. This was repeated until VAS dropped below three or reached 100mg.

Over 12 hours post-op, the total rescue analgesic dose and the number of patients who received them were recorded.

The sedation score was tested at 2, 4, 6, 8, and 12 hours post-operatively: Grade 1: Awake and alert, Grade 2: Responding to verbal stimuli, Grade 3: Mild physical stimulus, and Grade 4: Moderate or severe physical stimulus.9 Time between local anesthetic injection and first rescue analgesic request, total meperidine use, and Nausea, vomiting, hypotension (MAP<20% of baseline, managed with ephedrine 5mg IV and/or normal saline IVI), and bradycardia (HR<60 beats/min, treated with atropine 0.6mg IV) were reported as adverse events.

Primary Outcome:

Postoperative pain is assessed by the VAS score.

Secondary Outcome:

Hemodynamic stability (MAP&HR), opioid dosage for intraoperative and postoperative use, evaluation of stress response by monitoring cortisol and glucose levels in the blood, and patient satisfaction.

Ethical considerations:

Patients' informed consent following clearance by the Al-Azhar University Faculty of Medicine's Ethical Committee. Everyone who wanted to take part in the study might opt out if they didn't want to.

Statistical analysis:

Analysis was done with SPSS v27 (IBM©, Chicago, IL, USA). Histograms and the Shapiro-Wilk test examined data normality. Mean and SD parametric quantitative data were examined using ANOVA(F) with Tukey post hoc test. Comparing Kruskal-Wallis and Mann tests on median and IQR quantitative non-parametric data for each group. The Chi-square test examined frequency and percentage qualitative data. A two-tailed P-value <0.05 represented significance.

3. Results

Table 1. Demographic data and duration of surgery of the studied groups.

		GROUP SHB (N=35)	GROUP ISB (N=35)	GROUP PAB (N=35)	P-VALUE
AGE(YEARS)	Mean±SD	38.2±10.23	40.1±11.81	41.3±9.9	0.476
	Range	19-54	21-60	24-57	
SEX	Male	22(62.86%)	24(68.57%)	19(54.29%)	0.464
	Female	13(37.14%)	11(31.43%)	16(45.71%)	
WEIGHT(KG)	Mean±SD	66.5±8.66	67.4±13.54	64.3±8.15	0.436
	Range	52-83	51-89	54-83	
HEIGHT(M)	Mean±SD	1.65±0.05	1.68±0.08	1.66±0.07	0.143
	Range	1.57-1.72	1.55-1.8	1.54-1.75	
BMI(KG/M²)	Mean±SD	24.2±2.8	23.5±3.86	23.9±3.14	0.643
	Range	18.2-29.2	16.5-29.7	18.8-29.3	
ASA PHYSICAL STATUS	I	20(57.14%)	23(65.71%)	22(62.86%)	0.754
	II	15(42.86%)	12(34.29%)	13(37.14%)	
DURATION OF SURGERY(MIN)	Mean±SD	87.7±19.03	89.4±14.03	85.1±18.25	0.580
	Range	60-115	65-110	60-110	

Body mass index (BMI) and the American society of anesthesiologists (ASA) are acronyms.

There was no statistically significant difference between the three groups with respect to age, sex, height, weight, body mass index, ASA physical status, or length of operation.

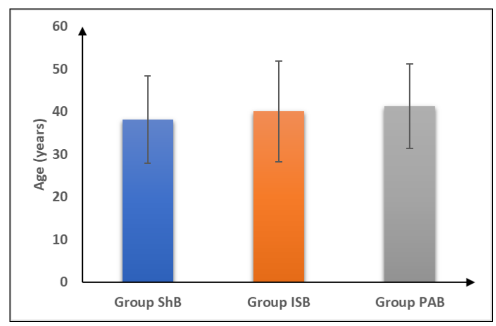

Figure 1. Age of the studied groups.

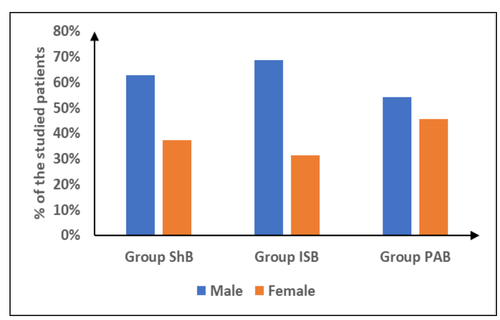

Figure 2. Genre of the research subjects.

Table 2. HR of the studied groups.

	GROUP SHB (N=35)	GROUP ISB (N=35)	GROUP PAB (N=35)	P-VALUE	POST-HOC
BASELINE	79.2±9.5	79.97±9.01	83.97±9.56	0.078	
15MIN	77.71±9.5	77.4±9.32	82.14±9.45	0.067	
30MIN	74.17±9.16	68.74±7.96	80.77±10	<0.001*	P1=0.037* P2=0.008* P3<0.001*
45MIN	73.63±9.16	68.31±7.25	80.54±10.09	<0.001*	P1=0.037* P2=0.004* P3<0.001*
60MIN	71.94±9.16	66.94±6.28	79.39±9.33	<0.001*	P1=0.042* P2=0.002* P3<0.001*
75MIN	70.74±8	67.26±5.84	77.36±10.47	<0.001*	P1=0.296 P2=0.022* P3<0.001*
90MIN	73.53±8.58	70.53±7.62	77.88±9.89	0.147	
105MIN	70.29±7.95	69.5±6.35	70.67±4.93	0.974	
END OF SURGERY	75.74±9.5	74.71±9.06	76.49±9.65	0.732	

Data displayed as mean±SD, *:significant as P-value≤0.05. Comparison of the P1:P value between the ISB and ShB groups. P2:P value comparing groups PAB and ShB. Comparing Groups ISB and PAB, with a P3 value.

At 15 minutes, 90 minutes, 105 minutes, and the completion of surgery, there was no significant difference in HR between the three groups. Groups ISB and ShB had significantly lower HR than group PAB at 30 minutes, 45 minutes, and 60 minutes (P<0.05). Group ISB also had significantly lower HR than group ShB. At 75 minutes, there was no significant difference in heart rate between group ShB and group ISB, however it was significantly lower in groups ShB and ISB compared to group PAB (P-value<0.05).

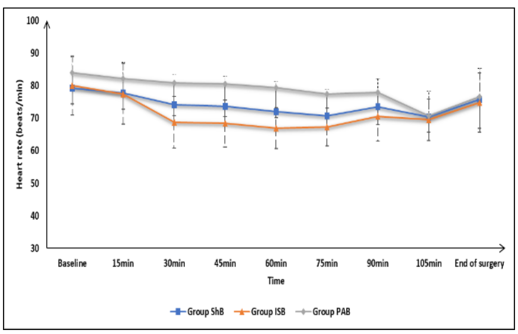

Figure 3. Heart rate of the studied groups.

Table 3. Mean arterial pressure of the studied groups.

	GROUP SHB (N=35)	GROUP ISB (N=35)	GROUP PAB (N=35)	P-VALUE	POST-HOC
BASELINE	93.97±13.76	91.46±10.06	97.17±11.1	0.130	
15MIN	91.37±14.14	88.63±10.26	95.6±11.08	0.053	
30MIN	87.86±14.97	80.51±10.07	94.97±11.1	<0.001*	P1=0.036* P2=0.044* P3<0.001*
45MIN	86.97±13.55	79.63±11.18	94.57±12.11	<0.001*	P1=0.038* P2=0.03* P3<0.001*
60MIN	84.1±14.16	76.71±10.93	92.32±11.96	<0.001*	P1=0.046* P2=0.033* P3<0.001*
75MIN	82.13±13.38	77.96±11.37	91.23±11.44	0.001*	P1=0.447 P2=0.036* P3<0.001*
90MIN	85.4±13.42	79.47±10.08	88.29±12.06	0.119	
105MIN	81.86±14.58	76.5±6.66	94.33±18.45	0.269	
END OF SURGERY	90.43±13.57	87.8±10.1	93.6±11.13	0.121	

Data presented as mean±SD, *:significant as P-value≤0.05. P1:P value between group ShB and group ISB. P2:P value between group ShB and group PAB. P3:P value between group ISB and group PAB.

At 15 minutes, 90 minutes, 105 minutes, and the completion of operation, there was no significant difference in mean arterial pressure among the three groups. Groups ISB and ShB had significantly lower mean arterial pressures than group PAB at 30 minutes, 45 minutes, and 60 minutes (P<0.05). Groups ShB and ISB had considerably lower mean arterial pressure compared to group PAB (P-value<0.05), whereas there was no significant difference between the two groups at 75 minutes.

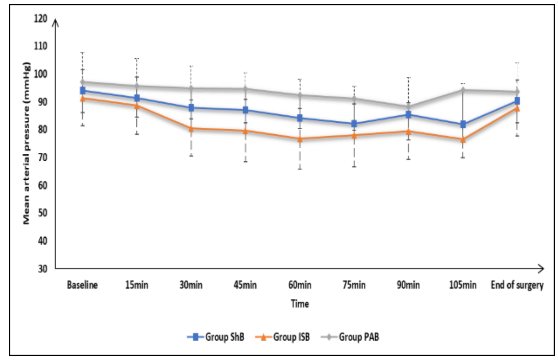

Figure 4. Mean arterial pressure of the studied groups.

Table 4. Anaalgesia duration, first rescue analgesia time, and total morphine consumption among the groups that were studied.

		GROUP SHB (N=35)	GROUP ISB (N=35)	GROUP PAB (N=35)	P-VALUE	POST-HOC
DURATION OF ANALGESIA(H)	Mean±SD	19.9±1.45	23.4±2.04	12.6±1.07	<0.001*	P1<0.001* P2<0.001* P3<0.001*
	Range	17-22	19-26	11-14		
TIME OF FIRST RESCUE ANALGESIA(H)	Mean±SD	18.4±1.38	21.9±1.94	11.1±0.87	<0.001*	P1<0.001* P2<0.001* P3<0.001*
	Range	16-20	18-24	10-12		
TOTAL MORPHINE CONSUMPTION(MG)	Mean±SD	13.1±4.71	10.6 ±2.36	16.3±4.9	<0.001*	P1=0.029* P2=0.006* P3<0.001*
	Range	10-20	10-20	10-20		

*Significant if the p-value is less than or equal to 0.05. Comparison of the P1:P value between the ISB and ShB groups. group ShB and group PAB in terms of P2:p-value. Comparing Groups ISB and PAB, with a P3 value.

Both the duration of analgesia and the time it took for the first rescue medication were shown to be significantly delayed in groups ISB and ShB compared to group PAB, with a p-value of less than 0.001. Compared to group PAB, total morphine intake was significantly reduced in both group ISB and group ShB (P<0.05).

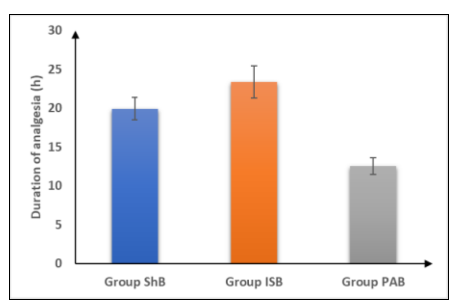

Figure 5. Duration of analgesia of the studied groups.

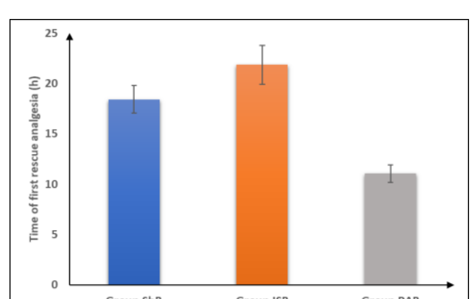

Figure 6. Starting times of rescue analgesics for the groups under study.

Table 5. assessments of the groups that were examined

	GROUP SHB (N=35)	GROUP ISB (N=35)	GROUP PAB (N=35)	P-VALUE	POST-HOC
AT PACU	1(0-1)	1(0-1)	1(0-1)	0.477	
2H	2(1-2)	1(1-2)	2(1-2)	0.174	
4H	2(1-3)	2(1-2.5)	2(1.5-3)	0.618	
8H	2(1.5-3)	2(1-3)	3(1.5-3)	0.571	
12H	2(2-3)	2(2-3)	3(2-4)	0.031*	P1=0.728 P2=0.037* P3=0.015*
24H	3(2-4)	2(1-4)	4(3.5-5)	<0.001*	P1=0.044* P2=0.013* P3<0.001*

Visual analysis scale (VAS), median (IQR):If the p-value is less than or equal to 0.05, the visual analoge scale is considered significant. Comparison of the P1:P value between the ISB and ShB groups. group ShB and group PAB in terms of P2:p-value. Comparing Groups ISB and PAB, with a P3 value.

At2,4, and 8 hours in the PACU, there was no statistically significant variance in VAS scores between the groups. Groups ShB and ISB did not differ significantly in VAS at 12 hours, although both groups had significantly lower VAS values than group PAB (P-value<0.05). At 24 hours, the VAS was discovered to be considerably lower in both the ISB and ShB groups compared to the PAB group, and in the ISB group compared to the ShB group (P<0.05).

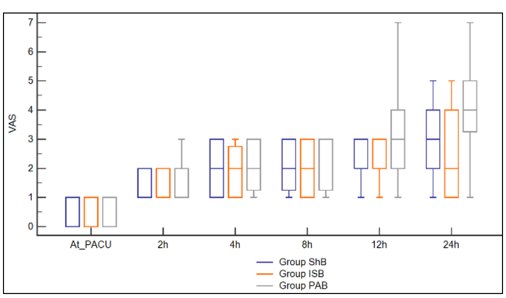

Figure 7. VAS of the studied groups.

Table 6. Cortisol level and glucose level of the studied groups.

		GROUP SHB (N=35)	GROUP ISB (N=35)	GROUP PAB (N=35)	P-VALUE	POST-HOC
CORTISOL LEVEL (MCG/DL)	Mean±SD	27.2± 2	26.9±2.03	28.1±2.43	<0.001*	P1=0.873 P2<0.001* P3<0.001*
	Range	24-31	23-30	25-32		
GLUCOSE LEVEL (MG/DL)	Mean±SD	119±9.57	117.7±8.53	121.9±8.69	0.137	
	Range	105-133	103-132	107-136		

*Significant if the p-value is less than or equal to 0.05. Comparison of the P1:P value between the ISB and ShB groups. P2:P value comparing groups PAB and ShB. Comparing Groups ISB and PAB, with a P3 value.

Groups ShB and ISB had insignificantly different cortisol levels, however both groups' levels were significantly lower than group PAB's (P-value<0.001). The three groups' glucose levels were not significantly different from one another.

4. Discussion

Heart rate (HR) and mean arterial pressure (MAP) were not significantly different among the three groups after 15, 90, and 105 minutes after surgery ended. Groups ISB and ShB had much lower HR and MAP than group PAB at30,45, and 60 minutes, but at 75 minutes, there was no significant difference between the two groups.

Nerve blocks can modulate the autonomic nervous system(ANS) by blocking sympathetic nerve fibers responsible for cardiovascular responses. Suprascapular/axillary and interscalene blocks, targeting nerves in the brachial plexus, can lead to vasodilation and reduced sympathetic tone in the upper extremity, resulting in lower HR and MAP. In contrast, periarticular infiltration may not provide as targeted an effect on the ANS, leading to a different hemodynamic response. Effective pain control achieved through nerve blocks can contribute to reduced pain perception and the associated stress response. Lower pain levels can lead to decreased sympathetic activation and subsequent reductions in HR and MAP. The localized analgesic effects of nerve blocks may result in better pain relief compared to periarticular infiltration, influencing hemodynamic parameters.[10]

Groups ISB and ShB had much longer delays in analgesia duration and time to first rescue analgesia compared to groups PAB and ShB, respectively, in our results. Groups ISB and ShB had much reduced total morphine intake compared to groups PAB and ISB, respectively.

In disagreement with our result, Şahin et al.,[11] conducted a randomized interventional trial at a single facility on 60 patients who were over the age of 18, had ASA grades of I to II, and were elective candidates for shoulder arthroscopy. Each group of patients received 20 milliliters of 0.5% bupivacaine; the SSNB+ANB group and the PAI group were randomly assigned. Compared to the SSNB+ANB group, the PAI group had substantially reduced total opioid use and fewer analgesia rescues. The variations in bupivacaine volume accounted for this discrepancy.

Among the three groups, we found no statistically significant difference in VAS at PACU, 2 hours, 4 hours, and 8 hours. There was no statistically significant difference in VAS between the ShB and ISB groups. Both groups (ISB and ShB) had substantially lower VAS than group PAB, and ISB was even lower than group ShB.

In line with our result, Dhir et al.,[6] enrolled 60 adults with ASA I-III levels who were going to undergo elective general anesthesia for arthroscopic shoulder surgery. Each patient was randomly assigned to one of two groups: one that had an interscalene block and another that received a suprascapular and axillary nerve block

(SSAX). The results demonstrated that the ISB group had much reduced pain scores compared to the SSAX group.

Cortisol levels were significantly lower in both groups compared to group PAB, and there was no statistically significant difference between groups ShB and ISB in this investigation.

Suprascapular/axillary nerve blocks and ISB primarily target local nerves and tissues, delivering the local anesthetic directly to the site of surgery or pain. In contrast, PAB involves a more systemic distribution of the anesthetic, affecting a larger area, including soft tissues, joints, and potentially systemic circulation. Localized nerve blocks may result in a reduced stress response compared to periarticular infiltration. The direct blockade of sensory nerves and pain pathways can lead to decreased nociceptive input and subsequent attenuation of the stress response, which includes cortisol release from the adrenal glands. Blocking these nerves can lead to effective analgesia with minimal systemic impact on stress hormones like cortisol.

In contrast, PAB may affect a broader range of nerves and tissues, potentially triggering a more significant stress response.[12]

demonstrated that VAS was markedly reduced in the PAI group compared to the SSNB+ANB group.

Cortisol levels were significantly lower in both groups compared to group PAB, and there was no statistically significant difference between groups ShB and ISB in this investigation. Şahin et al.,[11] found no statistically significant difference in patient satisfaction between the PAI and SSNB+ANB groups.

4. Conclusion

While both PAB and ultrasound-guided combined suprascapular/axillary nerve and ISB improve hemodynamics, the former is more effective in reducing pain scores, total opioid consumption, and cortisol levels in patients undergoing arthroscopic shoulder surgery, while the latter is preferred by the majority.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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