Review

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Ultrasound-guided brachial plexus block at the clavicle level: A review

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SUMMARY The supraclavicular block (SCB) and the infraclavicular block (ICB) are introduced to meet upper extremity surgery, where the transducer or the insertion point is placed superiorly and inferiorly at the approximate midpoint of the clavicle, respectively. These two approaches are highly appealing since they clearly exhibited each cord and its associated anatomy. In addition, it directed the needle accurately with real-time imaging by ultrasound guidance. Therefore, it brought higher success rates and fewer complications. Numerous trials have recently been conducted to examine the SCB and ICB regarding the new approach, injection techniques, block dynamics, and complication of hemidiaphragmatic paresis. It was found that both approaches could improve block effectiveness and postoperative analgesia for upper extremity surgery, according to recent studies at the level of the clavicular brachial plexus block. However, there is still a lack of work comparing the clinical performance and effectiveness of both approaches with ultrasonography. This review aims to outline the current available data from clinical trials along with case reports about these two approaches and to describe the findings published in the literature during the previous 5 years. Based on these findings, we attempt to determine whether there exists a one-size-fits-all approach that has the potential to meet upper extremity surgery.

Keywords Brachial plexus block, supraclavicular block, infraclavicular block, costoclavicular block, injection techniques, hemidiaphragmatic paresis, upper extremity surgery

1. Introduction

High-resolution ultrasound has been proven to identify the brachial plexus clearly, direct the needle to the target nerves precisely and visualize the pattern of local anaesthetic spread in real time (*1,2*). Various approaches to brachial plexus block with ultrasound guidance have been described elaborately, particularly recent well-recommended approaches of supraclavicular block (SCB) and infraclavicular block (ICB) at the level of the clavicle (*3,4*). Many trials have confirmed that SCB and ICB can be applied for upper extremity surgery (*5-8*). Compared with axillary block (AB) and/or interscalene block (ISB), SCB and ICB show faster onset times, higher block success rates and lower complication risks (*9,10*). However, how to flexibly choose and apply SCB and ICB in the clinical practice of upper extremity nerve block according to their respective advantages and disadvantages is still controversial (*11-15*). Recently, novel approaches have been reported around the clavicle to overcome these limitations, for example, the "corner pocket" approach in SCB and the costoclavicular approach in ICB (*1,16*). The performance of SCB and ICB may be accompanied with the risk of pneumothorax, yet it distinctly decreased when ultrasound was utilized (*3,4*).

Koscielniak-Nielsen ZJ *et al.* considered that ICB had a faster onset, better surgical effectiveness and fewer adverse events (*11*), but some recent trials indicated that similar block characteristics were both achieved in SCB and ICB, while adverse events were lower in ICB than in SCB (*12,13*). A systematic review indicated that the higher success rate of ICB may contribute to the double or triple injection technique, which accelerates anaesthetic spread (*17*). However, some trials demonstrated that there was no significant difference in the success rate by single or multiple injections, whether in SCB or ICB (*18,19*). Although multiple injections are safely and widely used to expand the block and shorten the onset time under ultrasound guidance, some confusion still exists in these techniques (*15*).

Focusing on providing equivalent analgesia and reducing complications by the SCB, many studies have been performed to compare the effect of postoperative analgesia of SCB with ISB in patients undergoing shoulder surgery. It showed that SCB might achieve comparable analgesia without increasing the risk of hemidiaphragmatic paresis (HDP), a common complication of brachial plexus block (*20,21*). It was reported that the costoclavicular block (CCB), a kind of ICB current common clinically applied, could also provide effective postoperative analgesia for shoulder surgery and prevent the occurrence of HDP (*22*). Since the shoulder area is innervated by cervical nerves, where the SCB and ICB are not able to cover, SCB and ICB may be appropriate for postoperative analgesia but not for surgical anesthesia (*3,4*).

In general, current clinical trials at the level of the clavicular brachial plexus demonstrate that both approaches of SCB and ICB can achieve better block effectiveness anesthesia and postoperative analgesia for upper extremity surgery (*3,4*). The multiple injection technique is commonly used for its advantage of shorter onset time (*18,19*). CCB can perfectly circumvent the risk of HDP (*22*). We will introduce the new approaches, injection techniques, block dynamics, and HDP complications in the SCB and ICB (as shown in Tables 1 and 2).

2. Supraclavicular block

2.1. Clinical characteristics of different approaches

The SCB is a popular approach that has been approved for the brachial plexus for its greater safety due to real-time ultrasound guidance and better block dynamics known as the "spinal anesthesia of the arm" (*4,23*). Kapral *et al.* (*24*) first described the "proximal" approach with ultrasound guidance located approximately 3 cm superior at the midpoint of the clavicle, in which three trunks of the brachial plexus were clearly visualized, and complete block was achieved with a reduction in relative complications compared with axillary block (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*). Targeting the neural cluster (confluence of trunks and divisions) in a transverse sectional view with a "distal" approach, the ultrasound probe was placed in the coronal oblique plane just above the supraclavicular fossa, where the cluster lateral to the subclavian artery lies on the top of the first rib (*25*). The success rate of this approach achieved 95% without pneumothorax using 20 mL of lidocaine 2% and 20 mL of bupivacaine 0.5% (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*). For ultrasound-guided SCB in the distal approach (*1*), the needle tip advances to the corner bordered by the subclavian artery medially, the first rib inferiorly, and the divisions of the brachial plexus superior laterally, named the "corner pocket" technique, and is described as the optimal position for local anesthetic distribution, which provides a dense and complete block for the entire upper extremity within minutes. The authors found that this technique produced excellent success in achieving surgical anesthesia for the forearm and hand when administrating only as little as 15 mL of local anesthetic with ultrasound guidance (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*).

Additionally, a new technique was named the intertruncal approach and claimed that it offers an

Table 2. Evidence of the risk of HDP in SCB and CCB

Article	Approach	Method	Analgesia effect	HDP
Aliste J[20]	ISB and SCB	20 mL of 0.5% levobupivacaine	Both groups displayed equivalent postoperative pain scores at 0.5, 1, 2, 3, 6, 12, and 24 hours.	ISB:SCB = 95% *vs.* 9%, $p < 0.001$.
Karaman T[21]	ISB and SCB	20 mL of 0.25% bupivacaine	No significant differences were found between the two groups for pain scores ($p = 0.34$).	/
Tran DQ[31]	SCB	Investigation using a modified "3+3" dose escalation design for exploring the dose-response relationship, 2:1 mixture of 1.5% mepivacaine and 0.5% bupivacaine.	/	All subjects demonstrated HDP at 15-20 min, and even with the lowest dose of 5ml, one of the three subjects occurred HDP at 15 min (33% incidence),suggesting that there is no clinically relevant dose at which HDP can be avoid.
Aliste J[22]	ISB and CCB	20 mL of levobupivacaine 0.5%.	CCB could provide comparable analgesia effect and shorter onset time (14.0 (5.0) *vs.* 21.6 (6.4) minutes, $p < 0.001$).	Avoiding the risk of HDP (CCB 0%:ISB 100%).
SivashanmugamT[40]	CCB and SCB	20 mL of mixture of 0.5% bupivacaine and 2% lidocaine.	/	CCB group is 5%, while in SCB group is 45%.

Note: Table 2 shows some evidence of the occurrence of HDP regarding SCB and CCB. Abbreviations: SCB, supraclavicular block; ISB, interscalene block; CCB, costoclavicular block.

advantage over the "intracluster" approach (*26*), as it purposefully avoids intraneural injection. It also offers advantages over the "corner pocket" approach, as it may help to avoid pneumothorax, by which local anesthetic is deposited in the two adipose tissue planes between the upper and middle trunks and the middle and lower trunks. It produced a shorter performing time within a few minutes and a rapid onset of action, similar to other injection techniques. Recently, a newest technique named "selective trunk block (SeTB)" (*27*) was performed as a "two-injection" peri-plexus technique with the first injection targeting the superior and middle trunk at the interscalene groove and the second injection targeting the inferior trunk at the corner pocket of the supraclavicular fossa. It has been demonstrated that nerve block with SeTB produces surgical anesthesia for the whole upper extremity undergoing intramedullary nailing of the humerus for a pathological fracture, except for the intercostobrachial nerve territory (the medial aspect of the upper arm) (*27*). The volume of local anesthetics (1:1 mixture of lidocaine 2% with 1:200,000 epinephrine and levobupivacaine 0.5%), targeting the superior and middle trunks, 8 mL and 7 mL, respectively, was administered at the interscalene groove, while 10 mL was injected into the inferior trunk at the corner pocket of the supraclavicular fossa (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*) (*27*). The patient remained comfortable and required no additional analgesics during the perioperative period and first requested postoperative analgesics approximately 7 h after the block. There was no residual neurological deficit on postoperative day 1. The "SeTB" technique can produce sensory-motor blockade of the whole upper extremity, including the shoulder and arm. However, this is only a case report, and further study should be performed to evaluate the safety and efficacy in cohorts of patients with well-designed clinical trials.

2.2. Clinical characteristics of different injection points

The brachial plexus could be localized accurately with ultrasound guidance, and the needle was repositioned with a focus on local anesthetic spreading around the target nerves, intentionally making a second injection, but it remained unclear whether the double injection is necessary to guarantee complete anesthesia (*25*). A trial compared the clinical outcomes of single and double injections for upper extremity surgery with ultrasound-guided SCB (*28*). In the single-injection group, 35 mL of lidocaine 1.5% with epinephrine 5 μg/mL was administered at the junction of the first rib and subclavian artery (the "corner pocket"). In the double-injection group using the same mixture of local anesthetic, 25 mL was initially injected at the "corner pocket" site, and another 15 mL was injected superolateral to the subclavian artery. The double-injection technique resulted in a shorter onset time, but this group required a higher number of needle passes, and thus the total anesthesia-related times were similar (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*). The double injection also resulted in a faster onset for sensory blockade of the musculocutaneous and radial nerves, a quicker motor block of the musculocutaneous nerve at the first 30 min and a higher rate of ulnar motor block at 10 min (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*) (*28*). However, there were no differences in the success rate, procedural pain or adverse events between the groups. Further trials have been performed regarding the comparison between single injection and double or even triple injection using the corner pocket technique for ultrasound-guided SCB, but they presented similar overall success rates and offered no benefit over a single injection, which may be attributed to the higher volume of local anesthetics administered in their studies (*6,18,29*). A trial (*29*) showed a similar rate of complete sensory block at 15 min and similar surgical block success using 30 mL of mepivacaine 1.5% (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*). Another trial (*6*) showed that the combined success of the sensory block was 20%~31% higher in the triple-injection group than in the single-injection group at 10, 15, and 20 min after injecting 30 mL of 1.5% lidocaine with epinephrine, but the overall success of surgical anesthesia did not differ significantly (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*). Nitin Choudhary *et al.* (*18*) proposed that we should take full advantage of site-specific deposition of local anesthetic solution with the use of ultrasound in SCB to reduce the overall dose of the drugs and its overall adverse effects. In their trials, they limited their drug volume to 20 mL based on some proven studies and concluded that the double-injection group achieved a higher success rate with faster sensory and motor onset and a longer duration of sensory and motor block than the single-injection group (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*) (*18*). Ten milliliters of 0.5% bupivacaine was injected into the superior cluster, and another 10 mL was injected into the corner pocket with the help of hydrodissection to ensure the correct direction in the double-injection group, while 20 mL was injected into the superior cluster in the single-injection group. Furthermore, Techasuk W *et al.* (*30*) compared the clinical outcomes of single and double injections in a novel targeted intracluster injection technique (TII), whereby 16 mL of lidocaine 1.5% was injected inside the main neural cluster and every single satellite (confluences of trunks and divisions of the brachial plexus). It demonstrated that the TII technique results in a shorter total anesthesia-related time due to quick onset (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*) (*30*), but their sample size was too small to assess the safety of needle tip placement inside the neural cluster, though no neurological deficit occurred in a month.

2.3. Complications

Since the development of the ultrasound-guided SCB technique, various approaches (*13,26,27*), including the intertruncal approach and the selective trunk block, have been introduced. The authors made many efforts to visualize accurately and inject exactly to the individual three cords (superior, middle and inferior) that were enough to produce complete sensorimotor blockage of the entire upper extremity (shoulder, arm, elbow, forearm and hand), except for the medial aspect of the upper arm (*27*). Further research is needed to confirm the application of these approaches for shoulder surgery. A trial (*20*) administered 20 mL of levobupivacaine 0.5% mixed with epinephrine and primarily examined the effect of analgesia and the incidence of HDP after arthroscopic shoulder surgery under ultrasound-guided ISB and SCB. Although the ISB resulted in a shorter onset time and a higher minimal composite score of 6 points at 30 min, it was definitely accompanied by a higher incidence of HDP than SCB (Table 2) (*20*). However, there are no intergroup differences in terms of performance time or intraoperative/postoperative opioid consumption, showing that small-volume SCB might achieve comparable anesthesia/analgesia without increasing the risk of HDP (*20*). Another trial (*21*) presented similar results that pain scores and analgesia requirements were not significantly different between SCB and ISB with 20 mL of 0.25% bupivacaine, concluding that SCB can be an alternative approach to ISB for postoperative pain management in shoulder surgery. Despite the lower incidence of HDP with the supraclavicular approach, the risk of this common adverse event should not be underestimated. The volume of local administration during SCB was determined to be essential for the occurrence of HDP following upper extremity surgery. The authors (*31*) conducted an investigation using a modified "3+3" dose escalation design for exploring the dose-response relationship and ipsilateral HDP in subjects undergoing ultrasound-guided SCB for surgeries on the right upper extremity. Dosing levels of 5, 10, 15, 20, 25, 30, 35 and 40 mL of the local anesthetic mixture (2:1 mixture of mepivacaine 1.5% and bupivacaine 0.5%) were administered in cohorts of three subjects per dose. Due to the 100% incidence of HDP at the starting dose of 35 mL, the dose of 40 mL was excluded. All subjects demonstrated HDP at 15-20 min, and even with the lowest dose of 5 mL, one of the three subjects experienced HDP at 15 min (33% incidence). It concluded that HDP occurred to some extent at all dose levels administered, suggesting that there is no clinically relevant dose at which HDP can be avoided, most likely due to the investment of the phrenic nerve and brachial plexus within the same prevertebral fascial sheath. It must be remembered that the optimal volume of local anesthetics has not yet been determined to decrease the complications without compromising the success rate of the brachial plexus block by various approaches.

3. Infraclavicular block

3.1. Clinical characteristics of different approach

Various ultrasound-guided ICB approaches have been reported. A trial (*32*) reported an approach as the lateral infraclavicular with the ultrasound transducer in the sagittal plane adducting the arm 90° inferiorly to the coracoid process. It showed excellent success without any supplemental anesthetics in 90.4% of the patients. However, all three cords are not always identifiable and close together lying deep to the pectoralis minor muscle. Another trial (*33*) compared the quality of surgical anesthesia in the lateral infraclavicular approach with the medial infraclavicular approach, which was performed at the apex of the delto-pectoral groove in the sagittal plane with the arm abducted 110°, where the cords are grouped close together, superior to the axillary artery. It demonstrated that the medial infraclavicular approach had better outcomes of onset time, ready imaging, closer to the surface and tolerance of tourniquet when compared with the lateral infraclavicular approach (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*) (*33*). A novel approach, described by Karmakar (*16*), was named the costoclavicular approach and has been introduced. It was demonstrated that the costoclavicular space lying deep and posterior to the midpoint of the clavicle was bounded anteriorly by the subclavius and clavicular head of the pectoralis major muscle and posteriorly by the anterior chest wall, where the cords are relatively superficial, clustered together and share a consistent triangular relationship with one another laterally to the axillary artery. Their primary trial demonstrated that ultrasound-guided CCB using 20 mL local anesthetic produced a very rapid onset but decreased the risk of inadvertent vascular or pleural puncture, thereby concluding that CCB is a beneficial approach to ICB (*16*). There are significant variations in the position of the individual cords between the lateral approach and the costoclavicular approach (*34*). The former lying deep to the pectoral muscles (3-6 cm) around the second part of the axillary artery are rarely visualized in a single ultrasound window, while the latter lying between the posterior surface of the clavicle and the second rib around the first part of the axillary artery are clearly imaged laterally to the artery in a dense and consistent triangular arrangement. A study performed by Songthamwat *et al.* (*35*) demonstrated that ultrasound-guided CCB with 25 mL ropivacaine 0.5% could produce a faster overall sensory onset time, lower overall sensory score at 5 and 20 min, lower overall motor score at 10 min, complete sensory-motor blockade at 20 min, and faster ready time for surgery than the lateral approach

(Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*) (*35*). They concluded that the CCB had a promising future for upper extremity surgery with ultrasound guidance. Further research should be performed to ensure its safety, efficacy and reliability.

3.2. Clinical characteristics of different injection points

A trial (*36*) compared a single local anesthetic injection placed at the very posterior aspect of the axillary artery using 30 mL of mepivacaine 1.5% to triple injections placed at the posterior, lateral and medial sides of the artery during ultrasound-guided ICB. The rate of complete sensory block was comparable at 15 min and at each time interval up to 30 min, concluding that the success rate and the onset of complete sensory block are not enhanced by a triple injection (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*) (*36*). Another similar trial (*19*) confirmed the effectiveness of a single injection at the optimal site posterior to the axillary versus triple injection ultrasound-guided ICB by the medial approach. Lidocaine 2% 30 mL was injected posteriorly to the artery in the single-injection group and in each brachial plexus spinal cord in the three-injection group. The single group produced a reduction in procedural time, a superior blockade at 20 min, and a higher success rate at 20 min for each individual nerve, especially for the ulna and radial nerves (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*) (*19*). They concluded that the single injection technique demonstrated superiority and provided brachial plexus block as well as a triple injection. Tran *et al.* (*37*) also demonstrated a similar outcome: double injection provided no significant advantage compared with single injection, in which 35 mL of lidocaine 1.5% was injected at the 6-o'clock position of the axillary artery in the single group, while 15 mL and 20 mL were deposited at the 9-o'clock and 6-o'clock positions of the artery, respectively. There were no differences in imaging, needling, performance, onset and total anesthesia-related times or the rate of surgical anesthesia between the two groups (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*) (*37*). Although the number of needle passes was also similar, the double-injection technique resulted in slightly less procedural discomfort (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*) (*37*). However, there was a similarity among the above three trials (*19,36,37*) in that efforts were not made to identify the 3 cords of the brachial plexus around the artery. Since the costoclavicular space was discovered (*16*), CCB is thought to be a beneficial approach for ultrasound-guided ICB because all three cords of the brachial plexus are clustered together lateral to the axillary artery and are visualized clearly. A study (*38*) compared ultrasound-guided costoclavicular with lateral sagittal infraclavicular brachial plexus blocks and showed that sensorimotor onset was faster in the CC group, but there was no difference in the block performance times (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*). Another trial (*39*) compared single and double injections using 35 mL of lidocaine 1%-bupivacaine 0.25% with epinephrine 5 μg/mL for ultrasound-guided CCB, by which the total volume of local anesthetic was injected between three cords of the brachial plexus in the single-injection group, while the first half of the volume was injected in this location, and the second half was deposited at the medial cord and the axillary artery in the double-injection group. It was proven that double injection provided a faster onset time and total anesthesia-related time but a similar success rate compared with single injection (Table 1, online data, *https://www.ddtjournal.com/supplementaldata/150*) (*39*). Luo *et al*. (*15*) confirmed that CCB and SCB resulted in similar block dynamics when the procedures were guided by ultrasound and verified by a nerve stimulator with 23 mL of local anesthetic. They proposed that the single-injection technique used commonly for the costoclavicular approach, with or without a peripheral nerve stimulator, has a high success rate (97%), which might be partially explained by the large LA volume used for the procedure (up to 35 mL). Studies on ultrasound guidance, whether in SCB or CCB, suggest that a single local anesthetic injection at the "corner pocket" or at the costoclavicular space as described above can provide sufficient and effective brachial plexus blockade and can become an alternative option.

3.3. Complications

A trial (*40*) aimed to compare the incidence of HDP between CCB and SCB using 20 mL of an equal mixture of bupivacaine 0.5% and lidocaine 2% with 5 μg/mL epinephrine. The authors found that the rate of HDP was 5% in the CCB group and 45% in the SCB group. When CCB is applied postoperatively for shoulder surgery compared with ISB with 20 mL of levobupivacaine 0.5% and epinephrine 5 μg/mL, it demonstrated that CCB could provide comparable analgesia effects at 0.5, 1, 2, 3, 6, 12, and 24 h, as well as avoiding the risk of HDP and a shorter onset time (Table 2) (*22*). There were no intergroup differences in the minimal composite scores of 6 points at 30 min, intraoperative/postoperative opioid consumption, side effects, or patient satisfaction at 24 h. The above trials seem to prove that CCB is a better choice for surgical anesthesia and analgesia with a reduction in the occurrence of HDP.

4. Cadaver evidence

Although the intracluster injection technique with ultrasound-guided SCB has been introduced for the advantage of faster onset time, one patient experienced numbness during the procedure and after surgery. It spontaneously resolved in the follow-up 1 month; thus, the significance and safety of needle tip placement inside the neural clusters deserves special mention (*30*). One study performed by Susanne Retter (*41*) assessed the rate of subperineural needle placement with a single intracluster on ultrasound-guided SCB among 21 human cadavers using 0.2 mL black India ink. It demonstrated that Ink was extra-epineural in 13/41 (32%), sub-epineural but outside perineurium in 18/41 (44%), and sub-perineural in 10/41 sections (24%), which presented a high rate of sub-perineural injection with a single intracluster injection. Although an injection deep to the epineurium generally leads to reversible anesthesia, subperineural injections are associated with long-term nerve injury. An editorial (*42*) concerning the targeted intracluster for ultrasound guided SCB, which is too close for comfort. It mentioned that it is prudent to place the needle in the same interfascial plane toward the nerves, although it seems not to actually touch nerves with the widespread use of ultrasound guidance. Meanwhile, the occurrence of paraesthesias due to needle-nerve contact is accompanied by an increased risk for neurologic complications. The imaging of the compact region with the individual nerves under ultrasound revealed no advantages under this condition because there were no differences in the nerve elements, and it was difficult to identify separation among the epineurium when local anesthetic was injected into the intra- or intercluster. They concluded that it may not prevent injury even if each nerve fascicle is reliably identified. It aroused an awareness that is it worthy to achieve latency advantage but bring axonal disruption. Therefore, great efforts should be made to avoid subperineural placement of the needle and injection of local anesthetic.

5. Conclusion

During ultrasound-guided SCB, multiple injection techniques can achieve a faster onset time than single injection, but not the success rate. We might attribute this improvement to the discovery of the optimal injection site "corner pocket" with the large volume of local anesthetic. Compared with ISB, SCB could achieve equivalent surgical anesthesia and postoperative analgesia for shoulder surgery, but the rate of HDP should not be ignored or overestimated. Further study should focus on the optimal selection between various techniques with decreasing the volume of solution and the relative complication. Since the costoclavicular space has been discovered, in which the 3 cords tightly bundle together in a superficial location around the axillary artery and can be seen clearly, ultrasound-guided CCB would provide a better success rate even in a single injection. Compared with SCB and ISB, CCB seems to have great potential advantages in proving a better dynamic block effect, reducing relative complications, and performing more flexibility. However, there is no exact trial to prove that CCB alone is appropriate for shoulder surgery, despite better postoperative analgesia. Ultrasound-guided brachial plexus block at the level of the clavicle has recently been advocated for proximal extremity surgery, and SCB and CCB definitely demonstrate greater beneficial effects than ISB and axillary block. Although the incidence of postoperative nerve deficit is very low and major neurological complications are rare, continual caution should be made regarding the issue of intra-epineurial injection. Since the novel technique, selective trunk block, was introduced, many researchers have highly praised that this hybrid approach has great potential to meet upper extremity surgery. Numerous trials are needed to identify the safety and efficacy. Hence, all the approaches mentioned above could be an alternative for the clinical setting, but recent evidence did not determine which was the best or one-size-fits-all approach, and further research is required.

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