# Diaphragm-sparing nerve blocks for shoulder surgery, revisited

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## ABSTRACT

Although interscalene brachial plexus block (ISB) remains the gold standard for analgesia after shoulder surgery, the inherent risks of ipsilateral phrenic nerve block and hemidiaphragmatic paralysis (HDP) limit its use in patients with preexisting pulmonary compromise. In a previous Daring Discourse (2017), our research team has identified potential diaphragm-sparing alternatives to ISB for patients undergoing shoulder surgery. In recent years, the field has been fertile with research, with the publication of multiple randomized controlled trials investigating supraclavicular blocks, upper trunk blocks, anterior suprascapular nerve blocks, costoclavicular blocks, and combined infraclavicular-suprascapular blocks. To date, the cumulative evidence (pre-2017 and post-2017) suggests that costoclavicular blocks may provide similar postoperative analgesia to ISB coupled with a 0%-incidence of HDP. However, in light of the small number of patients recruited by the single study investigating costoclavicular blocks, further confirmatory trials are required. Moreover, future investigation should also be undertaken to determine if costoclavicular blocks could achieve surgical anesthesia for shoulder surgery. Anterior suprascapular nerve blocks have been demonstrated to provide surgical anesthesia and similar analgesia to ISB. However, their risk of HDP has not been formally quantified. Of the remaining diaphragm-sparing nerve blocks, supraclavicular blocks (with local anesthetic injection posterolateral to the brachial plexus), upper trunk blocks, and combined infraclavicular-anterior suprascapular blocks merit further investigation, as they have been shown to achieve similar analgesia to ISB, coupled with an HDP incidence <10%.



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Shoulder surgery ranks among the most painful surgical interventions. Its postoperative pain intensity is purported to rival that of revision hip and knee arthroplasty as well as thoracotomy.[1 2] Interscalene brachial plexus block (ISB) remains the gold standard for analgesia after shoulder surgery.[2 3] Unfortunately, the occurrences of ipsilateral phrenic nerve block and hemidiaphragmatic paralysis (HDP) limit its use in patients with preexisting pulmonary compromise who, paradoxically, would benefit most from regional anesthesia and avoidance of parenteral opioids.[4] Prior to the advent of ultrasonography (US), the risk of HDP associated with ISB reached 100% due to the need for large local anesthetic (LA) injectates (eg, 34–52 mL).[5 6] The routine use of US guidance for ISB has enabled operators to employ smaller LA volumes (eg, 5 mL),[7–9] dilute LA concentrations (eg, bupivacaine 0.125%, ropivacaine 0.1%)[10 11] and (extrafascial) targets outside the brachial plexus sheath.[12] Although these strategies have reduced the rate of HDP, none has been able to decrease its incidence <20%.[13] Thus, in January 2017, our research team authored a Daring Discourse aimed at identifying potential diaphragm-sparing alternatives to ISB for patients undergoing shoulder surgery.[13] In recent years, the field has been fertile with research, with the publication of multiple randomized controlled trials (RCTs).

In this updated Daring Discourse, we set out to analyze the evidence derived from RCTs published between January 2017 and July 2019, summarize the collective understanding regarding diaphragm-sparing nerve blocks for shoulder surgery, and identify areas requiring further investigation.

## EVIDENCE DERIVED FROM RCTS PUBLISHED BETWEEN JANUARY 2017 AND JULY 2019

The final literature search for this section was conducted on 31 July 2019. The keywords 'nerve block for shoulder surgery' were queried using PubMed. Subsequently, the results were limited to peer-reviewed reports of human studies published in the English language. Since our goal was to evaluate (diaphragm-sparing) alternatives to ISB, only RCTs comparing nerve blocks to ISB were retained. No trials were excluded based on factors such as sample size justification, statistical power, blinding, definition of intervention allocation, or primary and secondary outcomes. However, only RCTs published in PubMed-indexed journals were retained for analysis. This precautionary step was taken to minimize the impact of 'weaker' studies published in lower tiered journals. Furthermore, RCTs reported in correspondence form or investigating LA manipulation (ie, liposomal formulation or addition of dexamethasone and dexmedetomidine) were discarded.

Since January 2017, 16 RCTs have investigated diaphragm-sparing nerve blocks for shoulder surgery[14–29] (see online supplementary table 1 and figure 1). Overall, the quality of the trials was high (median Jadad score=3.5). All but one studies incorporated blinded assessment. The average sample size was 90 patients and of 50% trials included objective HDP assessment with US.

In the last 3 years, two RCTs have investigated the use of smaller LA volume[14] and extrafascial LA injection[15] for ISB. Albrecht *et al*[14] reported that, compared with 30 mL, a 20 mL bolus of ropivacaine 0.5% results in a lower rate of HDP (15% vs 41%) without affecting the quality of postoperative analgesia. Similarly, Ayyanagouda *et al*[15] concluded that, compared with intrafascial LA injection, LA outside the brachial plexus sheath offers an almost threefold decrease in HDP (17% vs 46%) with minimal impact on postoperative pain control and patient satisfaction.

Supraclavicular block constitutes the most investigated alternative to ISB since 2017 (seven RCTs).[16–22] The majority of trials suggest that, compared with ISB, supraclavicular blocks result in similar pain control, breakthrough analgesic consumption and patient satisfaction.[16–18 21 22] Although supraclavicular blocks are associated with better preservation of pulmonary function,[16 20] the incidence of HDP still exceeds 60% when LA is injected inside the neural cluster formed by the confluence of trunks and divisions of the brachial plexus.[17] In contrast, Aliste *et al*[22] were able to decrease the rate of HDP to 9% (while maintaining analgesic equivalence with ISB) by depositing LA posterolateral to the neural cluster.


**Figure 1** Risk of bias summary of randomized controlled trials published between January 2017 and July 2019.

Beside supraclavicular blocks, recent trials have also investigated costoclavicular blocks,[25] anterior suprascapular nerve blocks,[16 20 29] upper trunk blocks,[28] combined infraclavicular brachial plexus blocks-suprascapular nerve blocks,[23 24] and combined axillary-posterior suprascapular nerve blocks[26 27] as alternatives to ISB. While combined infraclavicular-suprascapular blocks efficiently target the cords of the brachial plexus as well as the suprascapular nerve, HDP may not be entirely circumvented with a reported incidence of 6%.[24] Moreover, analgesia may be inferior to ISB during the initial (0.5 hour) postoperative period.[23] Similarly, in a recent trial, the combination of axillary-suprascapular nerve blocks results in inferior pain control during the first 8 hours as well as a higher breakthrough analgesic requirement than ISB.[26] However, another study found no analgesic differences between ISB and axillary-suprascapular nerve blocks; in fact, the latter result in improved patient satisfaction.[27] Although upper trunk blocks may achieve similar analgesia to ISB, they are associated with a non-negligible 5%-incidence of HDP.[28] In recent years, anterior suprascapular nerve blocks have been increasingly used as alternatives to ISB for open[16] and arthroscopic[20 29] shoulder surgery. Since 2017, all published trials have consistently reported that, compared with ISB, anterior suprascapular blocks result in similar analgesia and breakthrough analgesic consumption.[16 20 29] Although diaphragmatic and pulmonary functions seem preserved with anterior suprascapular blocks,[16 20] the true incidence of HDP has not been formally quantified. To date, the only strategy proven to achieve analgesic equivalence with ISB coupled with a 0%-incidence of HDP remains the costoclavicular block. In 2019, Aliste *et al*[25] compared ISB and costoclavicular block in 44 patients undergoing arthroscopic acromioplasty, rotator cuff repair or Bankart repair. No intergroup differences were found in terms of postoperative pain scores (0.5–24 hours), consumption of intra/ postoperative opioids, and patient satisfaction at 24 hours.

In summary, the evidence derived from RCTs published between January 2017 and July 2019 suggests that, for ISB, low LA volume and extrafascial LA injection cannot decrease the rate of HDP <15%. Although conventional supraclavicular blocks are associated with better preservation of pulmonary function than ISB, the resultant incidence of HDP still exceeds 60%. Newer strategies such as supraclavicular block with LA injection posterolateral to the brachial plexus, combined infraclavicular-suprascapular blocks, and upper trunk block have been increasingly used for shoulder surgery, with reported rates of HDP varying between 5% and 9%. Anterior suprascapular blocks seem to offer clinical promise, as they have been proven noninferior to ISB for open and arthroscopic shoulder surgery. However, their attendant risk of HDP requires further investigation. To date, costoclavicular blocks constitute the only strategy documented to achieve analgesic equivalence with ISB coupled with a 0%-incidence of HDP.

## CURRENT UNDERSTANDING OF DIAPHRAGM-SPARING NERVE BLOCKS

The avoidance of HDP for shoulder surgery rests on two fundamental principles. First, in patients with pre-existing pulmonary compromise, any risk of HDP, no matter how small, becomes prohibitive. Therefore, like contraception, the circumvention of HDP should be viewed as a binary phenomenon with the clinical target being 0%.[13] Second, the glenohumeral joint and its adjacent ligaments, tendons and bursae receive sensory innervation from the axillary, lateral pectoral, subscapular, and suprascapular nerves. While the first three nerves originate from the lateral and posterior cords of the brachial plexus, the suprascapular nerve branches out from the upper trunk.[13] Thus, alternatives to ISB should endeavor to anesthetize as many of these neural structures as possible. Such alternatives may take the form of single-location strategies (eg, supraclavicular brachial plexus block, C7 root block, upper trunk block, costoclavicular brachial plexus block). Alternatively, they can partition shoulder blockade into separate components (eg, combined axillary-suprascapular nerve blocks, or combined infraclavicular brachial plexus block-suprascapular nerve block).

### Interscalene brachial plexus block

In our 2017 Daring Discourse,[13] we reported that multiple strategies (ie, digital compression to prevent rostral LA spread, decreased LA volume, dilute LA concentration, LA injection outside of the brachial plexus sheath) had been previously attempted to circumvent the inherent risk of HDP associated with ISB. Although some of these methods did curtail the incidence of HDP, none successfully sidestepped it altogether, and the lowest reported risk still hovered uncomfortably around 20%.[10 12]

Since 2017, new trials by Albrecht *et al*[14] and Ayyanagouda *et al*[15] have confirmed the existing body of literature. Although smaller injectates[14] and extrafascial LA injections[15] did decrease the incidence of HDP to new documented lows of 15%–17%, they were unable to completely avoid it. Thus, the cumulative evidence (before and after 2017) suggests that a 0%-incidence of HDP may be difficult to achieve with current permutations of ISB. To date, no RCT has investigated the impact of a multimodal intervention (eg, US-guided ISB with small LA volume *and* dilute LA concentation *and* extrafascial LA injection) on the incidence of HDP after ISB (table 1). Although such a combined strategy may avoid HDP, it should be tempered against the very real risk of decreased block duration and analgesic failure. More importantly, low volume and dilute ISB may be unable to provide surgical anesthesia for shoulder surgery (table 1).

### C7 nerve root block

In our 2017 Daring Discourse,[13] we reported that C7 nerve root block performed with volumes lower than 6 mL could potentially circumvent HDP.[30] However, we also advised caution as well as additional studies to quantify the risk of vascular breach due to the high prevalence of blood vessels surrounding the C7 foramen.[31] Since 2017, no trial has further investigated C7 nerve root block for shoulder surgery.

### Supraclavicular brachial plexus block

In our 2017 Daring Discourse,[13] we concluded that supraclavicular blocks provide a reliable analgesic alternative to ISB for shoulder surgery. However, their incidence of HDP can still reach 34% even with US guidance.[32] Thus, we advised the investigation of a novel method for supraclavicular block, pioneered by Renes *et al*, whereby LA is injected posterolateral to the neural cluster (ie, confluence of trunks

**Table 1** Current state of knowledge and areas requiring future investigation

| Diaphragm-sparing block | Current state of knowledge | Future investigation regarding postoperative analgesia for shoulder surgery | Future investigation regarding surgical anesthesia for shoulder surgery |
|---|---|---|---|
| ISB | No current permutation of ISB can achieve a 0%-rate of HDP | Can a multimodal intervention (eg, US-guided ISB with small LA volume *and* dilute LA concentration *and* extrafascial LA injection) provide postoperative analgesia and a 0%-incidence of HDP? | Can a multimodal intervention (eg, US-guided ISB with small LA volume *and* dilute LA concentration *and* extrafascial LA injection) provide surgical anesthesia and a 0%-incidence of HDP? |
| SCB | SCB with LA injection inside the neural cluster cannot achieve a 0%-rate of HDP<br>SCB with LA injection (20 mL levobupivacaine 0.5%-epinephrine 5 µg/mL) posterolateral to the brachial plexus provides similar analgesia to ISB with a 9%-rate of HDP | Can LA injection posterolateral to the brachial plexus with a volume <20 mL provide similar analgesia to ISB and a 0%-incidence of HDP? | Can LA injection posterolateral to the brachial plexus with a volume <20 mL provide surgical anesthesia and a 0%-incidence of HDP? |
| UTB | UTB (15 mL bupivacaine 0.5%) achieves surgical anesthesia and provides similar postoperative analgesia to ISB with a 5%-rate of HDP | Can a volume <15 mL provide similar analgesia to ISB and a 0%-incidence of HDP? | Can a volume <15 mL provide surgical anesthesia and a 0%-incidence of HDP? |
| Anterior SSNB | Anterior SSNB (10–15 mL LA) provides similar analgesia to ISB (rate of HDP not assessed)<br>In cadavers: 5–10 mL injectate spreads to the phrenic nerve in 20% of cases | Will anterior SSNB (10–15 mL LA) result in HDP?<br>Can anterior SSNB (with a volume <5 mL) provide similar analgesia to ISB and a 0%-incidence of HDP? | Can anterior SSNB (with a volume <5 mL) provide surgical anesthesia and a 0%-incidence of HDP? |
| CCB | CCB (20 mL levobupivacaine 0.5%- epinephrine 5 µg/mL) provides similar analgesia to ISB with a 0%-rate of HDP | Can the 0%-rate of HDP be reproduced in future confirmatory trials? | Can CCB provide surgical anesthesia? |
| Combined ICB and SSNB | ICB (20 mL levobupivacaine 0.25%- epinephrine 5 µg/mL) and posterior SSNB (10 mL levobupivacaine 0.25%-epinephrine 5 µg/mL) achieves a 0%-rate of HDP but analgesia is inferior to ISB during the first 30 min<br>ICB (20 mL ropivacaine 0.5%) and anterior SSNB (5 mL ropivacaine 0.5%) provides similar analgesia to ISB with a 6%-rate of HDP | Can ICB (with a volume <20 mL) and anterior SSNB (with a volume <5 mL) provide similar analgesia to ISB and a 0%-incidence of HDP? | Can ICB (with a volume <20 mL) and anterior SSNB (with a volume <5 mL) provide surgical anesthesia and a 0%-incidence of HDP? |

CCB, costoclavicular brachial plexus block; HDP, hemidiaphragmatic paralysis; ICB, infraclavicular brachial plexus block; ISB, interscalene brachial plexus block; LA, local anesthetic; SCB, supraclavicular brachial plexus block; SSNB, suprascapular nerve block; US, ultrasonography; UTB, upper trunk block.

and divisions of the brachial plexus) and not inside the latter per se.[33] We speculated that such a technique could prove equianalgesic to ISB while avoiding HDP.

Since 2017, the multiple trials comparing supraclavicular blocks and ISB for shoulder surgery have consistently confirmed analgesic parity between the two approaches as well as a prohibitive incidence of HDP (up to 60%) associated with supraclavicular blocks.[16–21] In 2018, Aliste *et al*[22] compared ISB and SCB using Renes *et al*'s technique. Although the latter did provide similar pain control to ISB, its rate of HDP was 9% (and not 0% as expected). Thus, the cumulative evidence (before and after 2017) suggests that a 0%-incidence of HDP may be difficult to achieve with current permutations of the supraclavicular block. Further investigation should be undertaken to determine if lower LA volumes (<20 mL) could be used for Renes *et al*'s technique in order to completely circumvent HDP while providing analgesia (and surgical anesthesia) for shoulder surgery (table 1).

### Upper trunk block

Upper trunk block, first described by Burckett-St Laurent *et al*[34] in 2014, aims to deposit LA next to the upper trunk of the brachial plexus, prior to the takeoff of the suprascapular nerve. Its rationale lies in the fact that, as the phrenic nerve and brachial plexus move caudally, they diverge from each other at a rate of 3 mm for every centimeter below the cricoid cartilage.[35] Thus, the more distal injection site provided by upper trunk block could theoretically result in a lower incidence of HDP than ISB. In fact, in a recent anatomical study, Cros Compoy *et al*[36] reported that 5 mL of dye injected at the level of the upper trunk results in staining of the suprascapular nerve, lateral pectoral nerve as well as C5 and C6 roots but not of the phrenic nerve. To date, only one RCT has compared upper trunk blocks and ISBs for shoulder surgery. In 2019, Kim *et al*[28] reported non-inferior pain scores in the post anesthesia care unit as well as similar opioid consumption between the two groups. Interestingly, these authors were also able to achieve surgical anesthesia with upper trunk blocks (combined with intravenous propofol sedation). Although the rate of HDP was lower than that of ISB (5% vs 71%), it was not 0%. However, Kim *et al*[28] used a 15 mL LA injectate instead of the 5 mL volume employed by Cros Campoy *et al*[36] in their cadaveric study. Thus, future investigation should be undertaken to determine if lower LA volumes (<15 mL) could be used for upper trunk blocks in order to circumvent HDP while providing postoperative analgesia (and surgical anesthesia) for shoulder surgery (table 1).

### Suprascapular nerve block

Suprascapular nerve blocks constitute arguably the most controversial diaphragm-sparing option for shoulder surgery. The suprascapular nerve can be anesthetized using an anterior[37] or posterior[38] approach. Randomized trials conducted prior to 2017 have consistently found that, compared with ISB, suprascapular blocks result in higher pain scores in the immediate postoperative period (0–4 hours).[39–41] In contrast, all trials published since 2017 have concluded that suprascapular nerve blocks and ISBs provide similar analgesia and breakthrough analgesic consumption for arthroscopic[16 29] as well as open[20] shoulder surgery.

The contradictory findings stemming from the two sets of RCTs could be attributed (in part) to the approach used. While studies performed prior to 2017 anesthetized the suprascapular nerve in the suprascapular fossa (or notch), recent trials have targeted the suprascapular nerve in the anterior neck, immediately after its take off from the upper trunk of the brachial plexus. From an anatomical standpoint, the anterior approach may provide a more complete block of the suprascapular nerve. Indeed, cadaveric studies have revealed that, in 50% of cases, sensory and articular branches of the suprascapular nerve split off from the parent trunk proximal to the transverse scapular ligament,[42 43] thereby eluding blockade with the posterior approach. Unfortunately, this explanation does not fully elucidate the analgesic similarity between anterior suprascapular blocks and ISBs.[16 20 29] In other words, no matter how complete, a targeted suprascapular nerve block still ignores the important roles played by the axillary, lateral pectoral and subscapular nerves in the innervation of the shoulder. A more plausible explanation could be inferred from recent cadaveric studies conducted by Laumonerie *et al*[44] and Sehmbi *et al*.[45] These authors observed that an anterior suprascapular block with 5–10 mL of a mixture containing methylene blue results in retrograde staining of the upper and middle trunks.[44 45] Therefore, the term 'anterior suprascapular nerve block' may be somewhat of a misnomer, as LA spread is not solely confined to the suprascapular nerve. In addition to the brachial plexus, the phrenic nerve was also stained with dye in 20% of cases in both cadaveric reports.[45 46] Thus, future investigation should be undertaken to formally quantify the risk of HDP in live patients and to determine if anterior suprascapular nerve blocks could provide surgical anesthesia for shoulder surgery (table 1).

### Costoclavicular brachial plexus block

First described in 2015,[47] the costoclavicular approach to the brachial plexus targets the latter in the costoclavicular space (proximal infraclavicular fossa), where its three cords are tightly clustered together, thereby efficiently anesthetizing the axillary, subscapular, and lateral pectoral nerves. Furthermore, the costoclavicular space can also serve as a retrograde channel to the supraclavicular brachial plexus and suprascapular nerve.[48] In a recent RCT, Aliste *et al*[25] found no intergroup differences between ISBs and costoclavicular blocks in terms of postoperative pain scores (0.5–24 hours), consumption of intra/ postoperative opioids, and patient satisfaction. Thus, to date, costoclavicular block remains the only strategy proven to achieve analgesic equivalence with ISB coupled with a 0%-incidence of HDP. However, in light of the small number of patients (n=44) recruited by Aliste *et al*,[25] further confirmatory trials are required to validate this 0%-rate of HDP. Moreover, future investigation should also be undertaken to determine if costoclavicular blocks could provide surgical anesthesia for shoulder surgery (table 1).

### Combined axillary and suprascapular nerve block

The idea to partition shoulder block into separate components can be credited to Dr Darcy Price.[49] Unfortunately, the combination of axillary and suprascapular nerve blocks proposed by Price in 2007 omits the contributions of the lateral pectoral and subscapular nerves. Thus, in our 2017 Daring Discourse,[13] we concluded that combined suprascapular-axillary nerve blocks may provide adequate analgesia for minor shoulder surgery but do not compare favorably with ISB for major surgical procedures, as they result in higher intraoperative opioid requirement, increased pain/opioid consumption in the immediate postoperative period, and decreased patient satisfaction.

Since 2017, two RCTs have compared ISB and combined axillary-suprascapular nerve blocks[26 27] with mixed results. While

one trial found no analgesic differences between the two groups,[27] the other one echoed previous findings (ie, decreased pain and piritramide consumption in the first eight postoperative hours with ISB).[26] Thus, the cumulative evidence (before and after 2017) does not support the use of combined axillary-suprascapular nerve blocks for major shoulder surgery.

### Combined infraclavicular brachial plexus block and suprascapular nerve block

An interesting method to achieve partitioned shoulder block consists in combining infraclavicular brachial plexus block with suprascapular nerve block.[13] The infraclavicular approach targets the brachial plexus at the cord level thus anesthetizing the lateral pectoral nerve (lateral cord), subscapular nerve (posterior cord), and axillary nerve (posterior cord) while the selective suprascapular nerve block anesthetizes the remaining nerve supplying the shoulder joint. The infraclavicular approach also offers operators considerable practical flexibility, as it can be performed using paracoracoid[23] or retroclavicular[24 50] techniques. Moreover, the infraclavicular approach can target the three cords en bloc[23] or select out the lateral and posterior cords.[51] In turn, the suprascapular nerve block can performed using either with an anterior[24] or posterior[23] approach.

To date, two RCTs have compared ISB with combined infraclavicular-suprascapular block.[23 24] In the first trial, Aliste *et al*[23] found that, despite a 0%-incidence of HDP, combined infraclavicular-posterior suprascapular blocks result in higher pain scores than ISB during the initial (0.5 hour) postoperative period.[23] Aliste *et al*[23] attributed this analgesic difference to an incomplete block of the lateral pectoral and subscapular nerves. However, since the authors carried out suprascapular blockade with a posterior approach, partial block of the suprascapular nerve constitutes another plausible explanation.[42 43] In fact, in the second trial, Taha *et al*[24] concluded that combined infraclavicular and anterior suprascapular blocks provide similar analgesia to ISB. Furthermore, the combination of anterior suprascapular blocks and paracoracoid infraclavicular brachial plexus block has even been purported to achieve surgical anesthesia for arthroscopic shoulder surgery.[52] However, Taha *et al*[24] also observed a 6%-rate of HDP in their infraclavicular-anterior suprascapular group. Since phrenic blockade could occur both with infraclavicular[32] and suprascapular nerve block,[44 45] it may be difficult, in hindsight, to elucidate its etiology. Thus, future investigation should be undertaken to determine if infraclavicular blocks with a LA injectate <20 mL *and* low-volume (<5 mL) anterior suprascapular blocks could achieve postoperative analgesia and surgical anesthesia without HDP (table 1).

### Summary of the current understanding

In summary, only costoclavicular blocks have been shown to provide similar postoperative analgesia to ISB coupled with a 0%-incidence of HDP. However, further confirmatory trials are required to validate this 0%-rate of HDP. Moreover, future investigation should also be undertaken to determine if costoclavicular blocks could result in surgical anesthesia. Anterior suprascapular nerve blocks have been demonstrated to provide surgical anesthesia and similar analgesia to ISB. However, their risk of HDP has not been formally quantified. Of the remaining diaphragm-sparing nerve blocks, supraclavicular blocks (with LA injection posterolateral to the brachial plexus), upper trunk blocks, and combined infraclavicular-anterior suprascapular blocks merit further investigation, as they have been shown to achieve similar analgesia to ISB, coupled with an HDP incidence <10%. Perhaps a simple decrease in LA injectate could sidestep HDP altogether. If this were the case, these options should also be investigated for the provision of surgical anesthesia.

## FUTURE RESEARCH

In the last 3 years, the combined efforts of multiple research teams around the world have enabled diaphragm-sparing nerve blocks to stand shoulder to shoulder with their quadriceps-sparing counterparts.[53] A plethora of alternatives to ISB now exists. Although only costoclavicular blocks have (so far) achieved analgesic equivalence with ISB as well as HDP circumvention, further investigation should be able to refine alternate strategies such as supraclavicular blocks with LA injection outside the neural cluster, upper trunk blocks, anterior suprascapular nerve blocks, and combined infraclavicular-suprascapular blocks. Going forward, RCTs should focus on the provision of surgical anesthesia in addition to postoperative analgesia. Furthermore, future studies should also elucidate the rate of HDP for continuous diaphragm-sparing nerve blocks. While a single-injection technique could initially spare the phrenic nerve, over time, HDP may occur with continuous blockade due to LA accumulation.[13]

If present trend persists, it is our prediction (and conviction) that, in 3 years' time, the next update to the topic of diaphragm-sparing nerve blocks need no longer adopt a Daring Discourse format. Instead, it will simply be a review article.

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