The Use Of Pectoralis Blocks In Breast Surgery: A Practice Advisory From The Society For Ambulatory Anesthesia (SAMBA)

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INTRODUCTION

The use of pectoralis blocks (PECS) have dramatically increased since the first description of the technique by Blanco in 2011 [1][Blanco 2011]. The purpose of the original block is to anesthetize the lateral and medial pectoral nerves as they course in between the pectoralis major and minor fascia. As the popularity of the original block has grown, the original technique of placing local anesthetic between the pectoralis major and minor muscles has been reclassified as PECS-1, and another version of the block, known as the PECS-2, has also grown in popularity. This latter technique aims to also anesthetize the upper intercostal nerves by depositing local anesthetic in between the pectoralis minor and serratus anterior muscles [2][Blanco 2012]. Yet another variation, dubbed the serratus anterior plane (SAP) block, aims to anesthetize the intercostobrachial nerve, the long thoracic and thoracodorsal nerves, and cutaneous branches of the T3-T9 intercostal nerves by the deposition of local anesthetic between serratus anterior and latissimus dorsi muscles [3][Blanco 2013]. The use of these ultrasound-guided truncal blocks has been offered as an alternative to local infiltration by the surgeon and paravertebral and intercostal blocks, with potentially equal efficacy. While paravertebral blockade is an effective and well-established technique to provide excellent analgesia and anesthesia for breast surgery [4], its use may be limited because of its perceived higher degree of technical difficulty and the proximity of the paravertebral space to the spinal canal and pleura. For the anesthesiologist who desires to perform an evidence-based ultrasound-guided regional anesthetic technique for breast surgery, the pectoralis blocks certainly are an attractive option. Although pectoralis blocks may be commonly used for ambulatory breast surgery, recommendations regarding the comparative efficacy of these blocks in breast surgery have thus far not been developed by any professional anesthesia society. Furthermore, no guidelines currently exist in regard to the use of the PECS family of blocks specifically for ambulatory breast surgery. Given the potential impact of PECS blocks on analgesia after outpatient breast surgery, The Society for Ambulatory Anesthesia (SAMBA) convened a taskforce to develop a practice advisory on the use of this regional anesthetic technique.

METHODOLOGY

TASK FORCE MEMBERS

Eight members of SAMBA's regional anesthesia committee participated in this practice advisory. All task force members are practicing anesthesiologists at major university / academic

centers who are experts in regional anesthesia and provide anesthesia (including regional anesthesia) for ambulatory surgery as part of their daily practice.

PURPOSE AND APPLICATION

The purpose of this practice advisory is to provide guidance to the ambulatory anesthesiologist in regard to the current scientific evidence supporting the use of pectoralis blocks for ambulatory breast surgery.

FOCUS

Shortly after convening, the taskforce discussed and evaluated the clinical questions that would be most pertinent to the ambulatory anesthesiologist. Group consensus was achieved on three questions that were judged to be most applicable to the current use of regional anesthesia in ambulatory breast surgery:

- Does PECS-1 and/or -2 blockade provide more effective analgesia for lumpectomy than either systemic analgesics or surgeon-provided local infiltration anesthesia?
- Does PECS-1 and/or -2 blockade provide equivalent analgesia for mastectomy compared to a paravertebral block (PVB)?
- Does PECS-1 and/or -2 blockade provide equivalent analgesia for lumpectomy compared to serratus anterior plane blockade (SAP)?

These three questions were chosen because 1) lumpectomies and other tissue-conserving breast cancer surgeries are often performed on an outpatient basis, 2) the scientific literature examining the use of pectoralis blocks for these more limited breast surgeries has increased in recent years, 3) paravertebral blockade is often considered the gold standard regional anesthetic technique for major breast surgery, and 4) recently serratus anterior blockade has been presented as a possible option to PECS blocks for breast surgeries.

AVAILABILITY AND STRENGTH OF EVIDENCE

A standardized approach was utilized in the review of the scientific literature. All available English-language articles were considered for initial abstract review. Keyword literature searches were utilized using the National Library of Medicine's PubMed, Ovid, and Google Search. After initial review, only randomized controlled trials (RCTs), meta-analyses, observational studies, and retrospective analyses were considered for further assessment. The strength of the evidence was graded using a classification system similar to that found in the American Society of Anesthesiologists and American Society of Regional Anesthesia's *Practice Advisory for the Prevention, Diagnosis, and Management of Infectious Complications Associated with Neuraxial Techniques* [5][ASA Task Force].

Scientific Evidence

Category A: includes randomized controlled trials with comparison groups pertinent to the practice advisory question(s)

Level 1: The literature contains sufficient randomized controlled trials to conduct meta-analyses; meta-analyses are included in this level.

Level 2: The literature does not contain sufficient randomized controlled trials for meta-analysis formation.

Level 3: A single randomized controlled trial exists within the topic and/or parameters of interest.

Category B: includes non-randomized trials or trials in which non-pertinent comparison groups are used.

Level 1: The literature contains observational comparisons with comparative statistics between clinical interventions of interest.

Level 2: The literature contains non-comparative observational studies (e.g. uncontrolled cohort studies) with associated statistics (e.g. relative risk, correlation).

Level 3: The literature contains noncomparative observational studies with descriptive statistics.

Level 4: Case reports exist.

Opinion-Based Evidence

Expert opinion on the questions of interest was provided by the task force members when sufficient high-level evidence was not available to address a practice advisory question. Expert opinion was not classified vis a vis strength but rather considered lower overall quality of evidence compared to scientific evidence.

STRENGTH OF RECOMMENDATIONS

A modified strength of recommendation taxonomy (SORT) criteria as described by Ebell et al [Ebell] was used to categorize the practice advisory recommendations [6].

Strength of Recommendation A – recommendation based on Category A Level 1 or Category B Level 1 evidence.

Strength of Recommendation B – recommendation based on Category A Level 2 or Category B Level 2 evidence

Strength of Recommendation C – recommendation based on Category A Level 3 or Category B Level 3 or 4 evidence or based on expert-opinion.

Bias Assessment

RCTs included in the formation of the practice advisory recommendations were assessed for bias using the Cochrane Collaboration's tool for assessing risk of bias [7][Higgins]. The assessments were done by all authors, and the majority assessment was utilized. Studies were assessed for random sequence generation, allocation concealment, blinding of participants, blinding of outcome assessment, incomplete data, and selective reporting. Risk of bias was categorized as low risk, high risk, or unclear risk of bias.

ADVISORIES

An initial literature review yielded 199 articles. Of these, 90 were excluded because they were not RCTs, meta-analyses, observational studies, or retrospective analyses. 63 of the remaining studies were judged by the taskforce to be relevant to this practice advisory and thus reviewed

(Table 1). Bias assessment for RCTs that satisfied analgesic intervention and surgery criteria as specified by the above three clinical questions can be found in Table 2.

QUESTION 1

Does PECS 1 / 2 blockade provide more effective analgesia for lumpectomy than either systemic analgesics or surgeon-provided local infiltration anesthesia?

Review of the literature

41 articles met initial criteria for review of this question. Of these studies, 14 fulfilled final criteria for inclusion in this practice advisory: 3 meta-analyses, 6 prospective randomized controlled trials, 1 prospective observational cohort study, and 4 retrospective cohort studies. Only two studies [8,9][Kim and Choi] restricted surgical intervention to lumpectomy or breast conserving surgery; the remaining articles included both lumpectomies and mastectomies or simply specified 'breast surgery'. For the purposes of this review, the analgesic efficacy of PECS blocks compared to systemic analgesics was examined and characterized in terms of opioid requirements, time to analgesic rescue, and postoperative pain scores.

PECS blocks versus systemic analgesics

Postoperative opioid requirements

Several publications examined postoperative opioid requirements in patient that received PECS blocks versus systemic analgesics alone. In an RCT for patients undergoing lumpectomy or mastectomy and randomized to PECS (1+2) versus sham (placebo) block, opioid use was reduced in PACU, but not at other time points [10][Versyck] (*Category A, Level 1 evidence*). In a similar RCT, opioid use was reduced at 24 hours postoperatively [8][Kim] (*Category A, Level 1 evidence*). Postoperative opioid use was also noted to be reduced in observational and retrospective cohort studies [11,12][DeCassai 2019, Abdallah]. In a meta-analysis of 16 randomized controlled trials, mean 24-hour opioid requirements were decreased in the PECS cohort [mean difference (CI) in morphine equivalents: 10.7 mg (-13.5 to -7.8)]; however, the quality of the evidence was deemed low due to significant heterogeneity (I^2 = 98%; Egger's regression P<0.001) [13][Jin]. The authors conducted several post-hoc subgroup analyses, but none reduced the heterogeneity. Notably, the authors conducted a trial sequential analysis which indicated that no more clinical trials are needed to demonstrate the opioid sparing effect of PECS block as the cumulative Z score crossed the monitoring boundaries of both moderate and strong evidence models. In two separate meta-analyses, opioid use was also reduced in the PECS group at 2, 12, and 24 hours postoperatively [14][Grape] and in the PECS group at 24 hours postoperatively [15][Versyck]. Overall, these analyses suggest that the opioid-sparing effect in the first 24 hours after surgery appears to be limited to 10-15mg of morphine equivalents. While statistically significant, the clinical significance of this opioid reduction is debatable, particularly when other important elements such as frequency of postoperative nausea/vomiting (PONV), pre-existing risk factors for PONV, and satisfaction with pain control are not specified in many studies.

Summary

PECS blocks decrease opioid use to a modest degree when examined across all types of breast surgeries when compared to systemic analgesics alone. The significant heterogeneity noted may indicate that PECs blocks have greater utility in certain types of breast surgeries, but high-quality studies are lacking to elucidate which procedures would most benefit. Additionally, the clinical significance of this modest reduction is unclear at this time.

Time to analgesic rescue

Analgesic rescue was examined in five studies. While the need for rescue analgesics did not differ in one reviewed prospective RCT [8][Kim] and one retrospective cohort study [16][Morioka], performance of a PECS block was indeed found to be associated with increased time to analgesic rescue in three meta-analyses. In a 2020 meta-analysis, data was examined from 7 studies and, as a secondary outcome, PECS blocks were found to prolong the time to analgesic rescue by a mean difference of 280 min [(CI 127 to 443), Egger's regression $p<0.001$] [13][Jin]. Similar results were noted in two separate meta-analyses, which both found time to analgesic rescue prolonged by approximately 5 hours in the PECS group [14,15][Grape, Versyck].

Summary

PECS blocks prolong the time to analgesic rescue when compared to systemic analgesics alone. The extent of this impact in regard to limited versus more extensive breast cancer surgery is unclear at this time.

Intraoperative opioids

Intraoperative opioids were evaluated in six studies. In two RCTs (Category A, Level 1 evidence) which randomized patients undergoing lumpectomy or mastectomy to PECS-1+2 versus sham or no block, a difference in intraoperative opioid use was not noted [10,17][Cros, Versyck 2017]. While one observational [11][De Cassai]and two retrospective cohort studies [12,16][Abdallah, Morioka] did indeed find decreased intraoperative opioid use when a PECS block was utilized, the study design and smaller number of patients in these studies present significant limitations. Moreover, a recent meta-analysis comparing PECS blocks to systemic analgesia in patients undergoing any breast cancer surgery showed no significant difference in intraoperative fentanyl [SMD -34.79 μg (CI -128.08 to 58.51), p=0.46] [15][Versyck 2019].

Summary

While the impact of PECS blocks on intraoperative opioid consumption is somewhat conflictive at this time, the results of higher-quality studies suggest that the use of PECS block does not result in decreased intraoperative opioid use during breast cancer surgery.

Postoperative pain scores

Postoperative numeric pain scales were evaluated in most studies. Pain scores were significantly decreased in the PECS groups in four RCTs reviewed [8-10,18][Choi, Kim, Versyck, De Cassai 2020]. The timeline of this effect, interestingly, varied among trials. Kim and colleagues found that patients who had a PECS-2 block for breast conserving surgery had consistently decreased pain scores at 3, 6, 9, and 24 hours after surgery (Category A, Level 1 evidence). However, in the studies by Versyck et al and Choi et al, the use of PECS blocks decreased pain scores in the post anesthesia care unit (PACU) but these benefits did not extend through the first 24 hours after surgery (Category A, Level 1 evidence). One RCT did not show any decrease in pain scores with or without movement, regardless of whether the patient underwent major or minor breast surgery [17][Cros] (*Category A, Level 1 evidence*). In this study, however, the authors noted that all patients received multimodal systemic analgesia, which may have influenced the results, particularly in less invasive breast surgery. In three subsequent meta-analyses, pain scores were decreased in the PECS group at numerous postoperative time points ranging from PACU to 24 hours after surgery [10,13,14][Jin, Grape, Versyck]. The mean differences in pain scores were statistically significant but small and ranged from -1.8 to -0.9 in one meta-analysis and -1.93 to -0.79 in another. Assuming a meaningful pain score difference of 2, the clinical significance of this decrease is questionable. Still, it is notable that both opioid consumption and time to analgesic rescue were often concurrently reduced in patients who received a PECS block and thus these benefits may increase the significance of these findings.

Summary

The use of PECS blocks can lower postoperative pain scores after breast surgery, but the clinical significance of this decrease may be questionable, particularly in less invasive breast surgery or in the presence of multimodal analgesia.

PECS blocks versus Local infiltration analgesia

Only one RCT has compared PECS blocks and wound infiltration by the surgical team [19][Barrington] (*Category A, Level 3 evidence*). In this study of 104 subjects undergoing a variety of breast surgeries, 0.45 ml/kg of ropivacaine 0.475% or the same volume of saline was injected as a PEC block (0.2ml/h between pectoralis major and minor muscles and 0.25 ml/kg between pectorals minor and serratus anterior muscles) or wound infiltration. No difference in outcomes were found between groups in regard to postoperative functional recovery score at 24 hours, postoperative opioid consumption (during PACU stay and at 24 hours), numeric pain scores, or chronic pain scores at 3 months after surgery. The paucity of data overall indicates a significant deficit in the literature that requires further investigation.

Unfortunately, no other studies have compared PECS blocks to local infiltration by the surgeon. In fact, two of the reviewed meta-analyses commented on either the lack of specific reporting regarding surgical infiltration [13][Jin] or the lack of any available studies examining analgesic efficacy with surgical infiltration compared to PECs blocks [14][Grape]. As previously mentioned, the double-blind RCT by Cros et al administered a multimodal analgesic regimen including surgeon-performed local anesthetic infiltration to all patients [17][Cros]. While the

study did not find any difference between the PECS or control groups in regard to PACU pain scores or opioid consumption, subgroup analysis of those having a major surgical procedure (mastectomy or lumpectomy with axillary node dissection) showed significantly lower morphine consumption in the PECS group compared with control, suggesting local infiltration may play a role in less invasive breast surgery. Nevertheless, a possible confounder in the assessment of potential benefit when comparing PECS block to local infiltration is the conflicting evidence that exists in regard to the efficacy of the latter. Both a systematic review and a meta-analysis of RCTs found that local anesthetic wound infiltration neither improved postoperative pain nor reduced postoperative opioid consumption after breast surgery [20,21][Byager, Tam].

Summary

Limited and conflicting low-quality data exists investigating the use of PECS blocks compared to local infiltration analgesia among lumpectomy patients.

ADVISORY

For patients undergoing lumpectomy or breast-conserving surgery:

- PECS blocks may reduce postoperative opioid consumption, prolong time to analgesic rescue, and decrease postoperative pain scores compared to systemic analgesics. However, the clinical impact of these effects are likely modest at best and require further investigation. **(Strength of Recommendation A)**.
- Use of PECS block will likely not result in decreased intraoperative opioids compared to systemic analgesics **(Strength of Recommendation B).**
- In regard to local infiltration analgesia, given the conflicting data, lack of high-quality evidence, and no studies comparing PECs blocks to surgical infiltration in patients undergoing only lumpectomy, we cannot recommend PECS blocks for lumpectomy over surgical infiltration or vice-versa (**Strength of Recommendation C**).

QUESTION 2

Does PECS 1 and 2 blockade provide equivalent analgesia for mastectomy compared to a paravertebral block (PVB)?

Review of Literature

Eight articles met initial criteria for review of this question and fulfilled final criteria for inclusion in this practice advisory: 3 meta-analyses and 5 prospective randomized controlled trials. All 5 RCTs examined the use of PECS-1 and -2 blocks versus thoracic paravertebral block among patients undergoing a radical or modified radical mastectomy. All studies utilized a single injection thoracic PVB performed at either T3 or T4. Significantly, all but one study [22][Tripathy] assessed sensory deficit of the blocks prior to induction of anesthesia. However, only two of these studies reported the extent of sensory blockade, and none of the studies excluded patients on the basis of limited or patchy sensory deficit. For the purposes of this review, the analgesic efficacy of PECS blocks compared to PVB was examined and characterized in terms of opioid requirements, time to analgesic rescue, and postoperative pain

scores. Only one RCT reported intraoperative opioid use, thus this variable was omitted in this discussion.

Postoperative opioid requirements

All 5 RCTs assessed analgesic medication requirements 24 hours after surgery. Three of the five studies identified less 24-hour opioid use among patients who received a PECS block compared to those who received a PVB. In the study by Kulhari et al, mean 24-hour morphine use (SD) for the PECS and PVB groups was 3.90 mg (0.79) vs 5.30 mg (0.98), $p < 0.0001$, respectively [23][Kulhari]. In another study, patients in the PECS group used a mean of 11.25 mg (SD 4.75) compared to 15 mg (SD 4.86) [p=0.018] among PVB patients [24][Siddeshwara] (Category A, Level 1 evidence). The clinical significance of these small differences in opioid use, however, can be debated. The studies by Tripathy and Martsiniv showed no significant difference in postoperative analgesic requirements between the two regional anesthetic techniques (Category A, Level 1 evidence) [22,25][Tripathy, Martsiniv]. One meta-analysis analyzed postoperative opioid use and found a standard mean difference (CI) of 1.26mg (0.91-1.62), $p<0.001$, favoring PVB over PECS [26][Singh]. However, the comparison had significantly high heterogeneity. In agreement with other meta-analyses, this study also found that PECS blocks had a morphine-sparing effect when compared to systemic analgesics. The most recent meta-analysis comparing PECS and PVB, published by Jin and colleagues in 2020, examined 10 RCTs and found no significant difference in 24-hour opioid requirements between the two techniques [27][Jin RAPM]. This equivalency persisted upon sub-analysis of only patients who underwent mastectomy (as opposed to any breast surgery).

Summary

Patients who receive PECS blocks for mastectomies have postoperative opioid requirements similar to those who receive PVBs. The clinician should note that this comparison is based mostly on the performance of a PECS-2 block and single-level paravertebral blockade.

Time to analgesic rescue

Three of the reviewed RCTs showed a longer time to analgesic rescue among patients who received PECS blockade [23,24,28][Wahba, Kulhari, Siddeshwara]. This mean prolonged duration of analgesia ranged from 37.5 to 102.5 min. The two trials that showed no difference in time to rescue analgesia also showed no or very little difference in postoperative opioid use [22,25][Tripathy, Martsiniv] (Category A, Level 2 evidence). Additionally, of the two RCTs where extent of dermatomal spread of both blocks is reported, one trial shows longer block duration with PECS [mean (SD) 294.5 (52.76) vs 197.5 (31.35), $p<0.001$] [23,25][Kulhari] while the other shows no difference [median (IQR) of 550 min (400-600) vs 510 (360-600), p=0.506] [Martsiniv] (Category A, Level 2 evidence). Only one meta-analysis investigated time to rescue analgesia [27][Jin]; these authors found a non-statistically-significant mean difference (CI) of 36.4 min (-36.9 to 109.7) between PECS and PVB, with a high level of heterogeneity.

Summary

PECS block appears to prolong time to rescue analgesia in a way comparable to PVB. Only one meta-analysis is available and contains significant heterogeneity, thus more high-quality research is required in this area.

Postoperative pain scores

The majority of RCTs examined post-procedural pain scores. Three of the trials found decreased pain scores among patients who received PECS block, while one found no difference between PECS and PVB. In the studies by Kulhari and Siddeshwara, use of PECS block was found to result in slightly decreased postoperative pain scores from the 0-2 hour and 2-6 hour mark, respectively [23,24][Kulhari, Siddeshwara] (*Category A, Level 2 evidence*). Importantly, however, differences in pain between the two groups were primarily of a magnitude of 1 on a 1 to 10 scale. Historically, a numerical pain score difference of 2 has been found to be indicative of a clinically meaningful analgesic intervention [29]. Furthermore, efficacy of analgesia may depend upon whether a patient is still or in motion. In fact, Wahba et al reported that while patients who had a PECS block reported lower pain scores at rest, pain scores with movement were equivalent to or worse than those reported by patients in the PVB group for up to 24 hours after surgery [28][Whahba]. The study by Grape et al was the only meta-analysis in our review to investigate the potential difference in pain between the two regional anesthesia techniques. The authors found a mean difference (CI) of 0.74 (-1.09 to -0.38) favoring the use of PECS blockade, but this effect was absent when analysis was conducted on patients who underwent axillary dissection [30][Grape]. Pooling of all included studies resulted in significant heterogeneity, although trial sequential analysis supported a superiority of PECS at the 2-hour mark.

Summary

PECS block decreases postoperative pain scores at rest in a manner equal to or slightly better than PVB in the first few hours after surgery. However, this effect is likely not clinically significant and may be negated if axillary dissection is performed during surgery or when the patient is not at rest.

ADVISORY

For patients undergoing mastectomy

- Consider PECS blockade to decrease postoperative opioid requirements in a manner similar to that provided by single-level PVB **(Strength of Recommendation A**)
- Consider PECS block to prolong time to rescue analgesia and decrease short-term postoperative pain at rest in a manner comparable to single-level PVB **(Strength of Recommendation B)**

QUESTION 3

Does serratus anterior plane blockade (SAP) provide equivalent analgesia for lumpectomy compared to PECS block?

Review of Literature

14 articles met initial criteria for review of this question. Of these studies, 3 fulfilled final criteria for inclusion in this practice advisory: 2 prospective randomized controlled trials and 1 retrospective cohort study.

No RCT's addressed the use of SAP exclusively among lumpectomy patients. One retrospective observational study was found that compared the efficacy of these two techniques for breast-conserving surgery. In their study, Kubodera and colleagues examined the effect of 30ml of 0.5% ropivacaine administered via a PECS-1 and -2 blockade compared to 30ml injected via SAP [31][Kubodera] in 43 women undergoing partial mastectomy or mastectomy. No differences in postoperative pain or opioid use within the first 24 hours after surgery were noted between the two groups (*Category B, Level 1 evidence*). Although the patients in the PECS group were less likely to have pain at 2 months postoperatively (OR 5.04, p=0.02), the small number of patients in this study limit the usefulness of this result.

While research among lumpectomy patients is lacking, several RCTs have compared the efficacy of SAP and PECS in more invasive breast surgery. In one RCT, Bakeer and colleagues compared SAP, PECS-2, and no blockade among 180 patients undergoing modified radical mastectomy. They highlighted significantly decreased morphine requirements in first 24 hours, lower intraoperative fentanyl consumption, longer time to first rescue analgesic and lower VAS scores in the PECS-2 and SAP groups compared to the control group [32](*Category A, Level 2 evidence*) [Bakeer]. The PECS-2 and SAP groups were comparable in terms of intraoperative fentanyl consumption, time to first rescue analgesia and VAS pain scores. Likewise, in another RCT among modified radical mastectomy patients, Kaur and colleagues demonstrated a statistically significant and comparable decrease in static and dynamic postoperative pain scores among patients who received SAP or PECS-2 compared to no block [33](*Category A Level 2 evidence)* [Kaur]. However, the mean difference in pain scores was less than 2 on the numeric rating scale and thus not likely to be clinically relevant. In contrast, another RCT that compared SAP to PECS in patients undergoing mastectomy [34][Fujii] found no difference in acute postoperative pain scores between the two groups and higher morphine consumption in the first 24 hours after surgery among SAP patients. Interestingly, patients who received PECS block but not SAP were less likely to have moderate/severe pain 6 months after mastectomy (*Category A, Level 2 evidence*).

Some randomized controlled trials have shown limited analgesic benefit to SAP compared to no block [35-37][Yao, Mazzinari, Ahiskalioglu] (*Category A, Level 2 evidence*). Yao et al highlighted significantly lower 24 hour sufentanil consumption (50 μg vs 70μg, p<0.001) and pain scores, a better Quality of Recovery-40 score (158 vs 141, p<0.001), and decreased postoperative nausea / vomiting (6% vs 26%, p=0.02) among patients who received a SAP block. Mazzinari and colleagues showed a median difference of 9 mg (95% CI: 4-14.5 mg, p<0.001) in morphine consumption over 24 hours when patients received SAP for mastectomy (compared to no block), along with significantly lower pain scores (p<0.001) and longer time to rescue analgesia (p=0.002). While these results are encouraging, these studies have been small and include a variety of types of breast surgery and surgical settings. Thus, their applicability to breast-conserving surgery in an ambulatory setting remains to be elucidated.

Summary

High quality evidence comparing SAP to PECS block among lumpectomy patients is lacking. However, it is likely that SAP can provide some analgesic benefit in breast surgery when compared to no block.

ADVISORY

- We cannot recommend SAP instead of PECS block among lumpectomy patients given the current lack of evidence (**Strength of Recommendation B**).

LIMITATIONS

A fundamental limitation of this practice advisory is the overall low number of high-quality RCTs and meta-analyses available that address the specified clinical questions. For example, while a large number of studies were found that investigate the use of PECS blocks for breast surgery, investigations that assessed the impact of PECS blocks for breast conserving surgery were much more limited. While some of the conclusions investigating the analgesic effect of PECS among mastectomy patients may be applicable to patients undergoing less invasive surgery, any extrapolation should be made with caution given the differences in expected postoperative pain between the two surgical approaches, particularly if the relative site of tumor location is not described in the study. Nevertheless, the taskforce members have assessed the available data and used a systematic, evidence-grading approach to reach the recommendations. Second, as evidenced by the high level of heterogeneity present in many of the meta-analyses, the included studies involved varying nerve block techniques, local anesthetic volumes, comparison groups, and outcome measures. This heterogeneity may inherently bias the conclusions of meta-analyses. For example, previous investigations have shown that multilevel PVBs (T1-T6) can provide deep anesthesia for breast surgery [38] and better postoperative pain control compared to a single-level PVB [39-41]. Since only one PVB article included in this review utilized the multilevel method, a direct comparison between the use of PECS and multilevel PVBs cannot be assumed and requires further investigation. Third, of the 63 studies reviewed for this advisory, only 3 limited the study population to patients undergoing ambulatory breast surgery. Although this may not directly influence any of the outcome metrics, the task force members realize the paucity of studies involving only ambulatory surgery patients may inherently affect the applicability of the results. The deficiency of ambulatory surgery data also presents a challenge when outcome metrics of interest to the ambulatory anesthesiologist, such as length of stay in recovery and incidence of nausea/vomiting after PACU discharge, are lacking. Lastly, the topic of block efficacy deserves mention. While many of the included studies confirmed post-block sensory deficit in some way, very few described the extent of the deficit. Although some literature suggests that sensory blockade after a fascial plane block can have a variable correlation with block efficacy [42], the presence of appropriate sensory deficit in the expected distribution would certainly be reassuring in interpreting study results, particularly when evidence exists that spread of local anesthetic after a fascial plane block can be unpredictable [43]. Likewise, reporting of extent of sensory deficit after a high-volume single-level PVB would be beneficial, as high-volume injections may result in intercostal or bilateral spread [44].

CONCLUSION

Among patients undergoing lumpectomy or breast-conserving surgery, PECS blocks appear to modestly reduce postoperative opioid use, prolong time to analgesic rescue, and decrease postoperative pain scores when compared to systemic analgesics. However, no evidence currently exists that strongly favors the use of PECS blocks over surgeon-performed local infiltration anesthesia or vice-versa. Likewise, compelling evidence supporting the use of SAP instead of PECS within this surgical population is lacking. For patients undergoing a mastectomy, a PECS block may provide an opioid-sparing effect similar to that achieved with a single-level paravertebral blockade. There is some limited evidence to indicate that a PECS block may, like a single-level PVB, also prolong the time to first analgesic request. The authors of this paper recognize that PVB (particularly when performed in a multi-level fashion) is a very effective technique that provides excellent analgesia for breast surgery. However, the authors also recognize that some anesthesiologists may prefer to perform a PECS block either because of its lower technical demands or of the physician's comfort level with either block. Certainly, anesthesiologists should only perform blocks in which they are skilled, and efficacious performance of any evidence-based regional anesthetic technique is preferable to no block at all. Regardless, the current evidence reviewed in this practice advisory suggests that PECS blockade can provide significant analgesic benefits for patients undergoing breast surgery and can be a very useful tool for the anesthesiologist working in a busy ambulatory breast surgery setting.

Table 1: 63 studies reviewed for practice advisory development.

Table 1: 63 studies reviewed for practice advisory development.								
Author; Journal, Year	**Type of Study**	**Blinded?**	**Number of patients**	**Surgery**	**Intervention**	**Control**	**Primary Outcome**	**Secondary Outcome**
PECS vs LIA or systemic analgesia								
Morioka; JA Clin Rep 2015	Retrospective	no	71	Breast surgery	PECS	No block	Intraoperative remifentanil use	Pain scores, intraoperative fentanyl, % of patients needing supplemental analgesics, PONV
Bashandy; RAPM 2015	RCT	no	120	MRM	PECS	No block	Pain scores	Need for PCA, morphine requirements, PONV, sedation, hospital LOS
Ueshima; J Clin Anesth 2017	Retrospective	no	498	Breast surgery	PECS	No block	Any complications	N/A
Adbdallah; Anesth Analg 2017	Retrospective	no	225	Partial mastectomy or mastectomy +/- SLNB or ALND	PECS-1 or SAP	No block	Total OME use in 24hrs and PONV	Intraoperative fentanyl requirement, time to 1st analgesic, pain scores, and PACU duration
Versyck; J Clin Anesth 2017	RCT	yes	140	Mastectomy or lumpectomy +/- SLNB or ALND	PECS-2	Sham	NRS pain scores and perioperative opioid use	Pain management satisfaction
Cros; RAPM 2018	RCT	yes	128	Lumpectomy or mastectomy +/- SLNB or ALND	PECS-1	Sham	Pain score at varying time points	Postop opioid use
Thomas; J Anaesthesiol Clin Pharmacol 2018	RCT	yes	60	MRM	PECS	Sham	Time to 1st request and total doses of analgesics	Pain scores over 24hrs
Kumar; Indian J Anaesth 2018	RCT	no	50	MRM	PECS	No block	VAS score at rest	Pain on abduction, analgesic requirement in 24-hours, intraoperative/postoperative hemodynamic changes; and adverse effects
Matsumoto; Sci Rep 2018	RCT	no	50	Radical mastectomy with ALND and reconstruction	PECS1, SAP	GA	VAS scores	24-hour opioids
Kim; Pain Res Manag 2018	RCT	no	80	Breast conserving + SLNB	PECS-1,2	GA	24-hr fentanyl equivalents	Pain score breast and axilla
Chiu; BMC Anesthesiol 2018	Retrospective	no	372	Total mastectomy with immediate reconstruction	PECS-1,2 or PVB	GA	Total opioid use	Highest VAS score
Lanier; Plast Reconstr Surg 2018	RCT	yes	47	Mastectomy with reconstruction	Intercostals/PEC1 by surgeon	Sham blocks by surgeon	Global 40 item quality recovery score	VAS score

Kamiya; Eur J Anaesthesiol 2018	RCT	yes	60	Simple-total mastectomy with axillary dissection	PECS-1,2	PECS-1,2 sham	NRS score at rest	Quality-of-Recovery-40 (functional recovery score)
Wang; Clin J Pain 2018	RCT	no	64	MRM with reconstruction	PECS-1,2	GA alone	24-hour morphine use	VAS, shoulder movement
Ortiz de la Tabla Gonzalez; Rev Esp Anestesiol Reanim 2018	RCT	no	137	MRM with ALND	PECS 1 catheter	GA	VAS resting and dynamic scores	Analgesia required
Bell; Ann Med Surg (Lond) 2019	Prospective cohort	no	52	Mastectomy	PECS-2	No block	VAS scores at 4 and 8 h	PONV; opioid; ability to discharge home
De Cassai; Korean J Pain 2019	Prospective observational	no	140	Breast surgery	PECS-2	No block	Incidence of chronic pain at 3, 6, 9, and 12 months	Intraoperative opioid; postoperative pain during first 24 hours; need for additional analgesic administration
Najeeb; J Coll Physicians Surg Pak 2019	RCT	yes	120	MRM	PECS-1,2, SAP	No block	Pain score in first 24 hours in 2 groups	Opioid and anti-emetic use
Lovett-Carter; RAPM 2019	MA	yes	458	Mastectomy	PECS-1,2	No block	Total opioid use within 24 hours of surgery	Pain scores and side effects
Choi; J Clin Med 2019	RCT	yes	39	Breast conserving surgery	PECS-2	No block	Intraoperative remifentanil administration	Postoperative pain score and rescue analgesic requirement.
Al Ja'bari; Anaesthesia 2019	RCT	yes	50	Unilateral radical mastectomy	PECS	Sham	Cumulative morphine use POD1	Cumulative morphine use POD2; pain scores POD1-2; nausea/vomiting
Wang; Pain Physician 2019	RCT	Partially	61	MRM	PECS-1, SAP	No block	Time to first analgesic request; Time to PACU discharge; Postoperative pain severity at 1,3,6,12,24, 48 hours; Patient satisfaction with pain relief; Sleep quality within 48 hours of surgery; Incidence of adverse events	No secondary outcomes specified.
Zhao; Medicine (Baltimore) 2019	MA	N/A	993	MRM	"PECS block." Combined PECS1 and PECS2 into single group for some results	No block.	Intraoperative opioid use	Incidence of PONV; Pain scores at 0,6,12,24 hours postoperatively; Number of patients requiring analgesic treatment with opioids

Versyck; Anaesthesia 2019	MA	N/A	815	Breast cancer surgery	PECS-2	No block for one group. Thoracic paravertebral block for other control.	Postoperative opioid use in first 24 hours after surgery	Pain scores at 0,3,6,9, and 24 hours after surgery; intraoperative opioid administration; Time to 1st analgesic request; PONV
Senapathi; J Pain Res 2019	Rct	Yes	50	MRM	PECS-2	Sham block	Intraoperative fentanyl administration	Postoperative VAS; Postoperative opioid use
Schuitemaker; Rev Esp Anestesiol Reanim 2019	RCT	yes	30	Retro-pectoral augmentation mammoplasty	Modified PECS-2 and serratus plane block	Sham	Analgesic efficacy of block	Patient and Surgeon satisfaction with technique
Karaca; Anaesth Crit Care Pain Med 2019	RCT	yes	54	Sub-pectoral breast augmentation	PECS-1 and PECS-2	No block	Intraoperative fentanyl administration	VAS score; LOS; PACU times and PONV
Kaur; Korean J Anesthesiol 2020	RCT	yes	60	MRM	PECS-2 or Serratus-Intercostal Fascial Plane Block (SIFP)	Sham	Postoperative static and dynamic pain scores	Shoulder pain; range of shoulder joint motion; hemodynamics
Abu Elyazed; Pain Physician 2020	RCT	yes	60	MRM	PECS-2 vs PECS-2and pecto-intercostal fascial block (PIFB)	Sham	Analgesic efficacy of combo blocks vs single block	Dermatomal spread
Bakeer; J Pain Res 2020	RCT	yes	180	MRM	Group 1: PECS 2 Group 2: (SAP)	GA	24 morphine use	Intraoperative fentanyl, time to first analgesic, VAS scores rest and movement
Deng; Clin Interv Aging	RCT	yes	120	MRM	PECS at different concentrations	No block	Pain scores	Time when pain felt; number pain complaints; analgesic requirement
Fancellu; Breast J 2020	Case matched analysis	no	207	BCS, mastectomy, mastectomy with immediate reconstruction	PECS-1, 2, combined with parasternal or PVB	No block	Intraoperative analgesics	PONV, postoperative analgesics, LOS
De Cassai; J Clin Anesth 2020	RCT	no	88	Mastectomy or quadrantectomy	PECS-2	No block	Chronic pain	Opioid use; postoperative pain
Kim; Pain Manag 2020	Retrospective	no	152	Mastectomy	PECS	No block	Opioid use	PACU LOS
Sun; Medicine (Baltimore) 2020	MA		940	Mastectomy	PECS	No block	Pain scores	Opioid use in PACU; intraoperative opioid use; time to first analgesic request; PONV; block-related complications
Grasso; Anticancer Res 2020	RCT	no	255	MRM with or without reconstruction/nodal assessment	PECS 1, 2, SAP	GA	NRS pain score on first POD	Perioperative opioid use; rescue analgesics; PONV; readiness for ambulatory discharge; described effectiveness of multimodal analgesia
Cui; Am J Surg 2020	RCT	Yes	196	Mastectomy or breast conserving surgery	PECS-2	GA	NK cell proliferation or function in peripheral	Natural killer T (NKT) cells, helper T cells, cytoxic T cells, cytokines; remifentanil

							blood mononuclear cell (PBMC)	administration; Intraoperative hemodynamics
Grape; J Clin Anesth 2020	MA	n/a	1026	Any breast surgical procedure	PECS-1, 2, or SAP	GA	Rest pain scores	Rest pain at 12h & 24h. Dynamic pain scores 2, 12, 24h. Time to first analgesic request. PONV rates at 24h. Hospital LOS. Persistent postop pain at 6 months. Block related infections.
Jin; Int J Physiol Pathophysiol 2020	MA	n/a	1116	Any breast surgery	PECS-1 or PECS-2	GA	Opioid requirement at 24hrs	NRS Pain scores (PACU or within 1h, 4-6h, 9-12h, 24h postop). Intraoperative opioids. Time to first rescue analgesia, PONV incidence, block complications
Barrington; Anesth Analg 2020	RCT	Yes	108	Mastectomy or wide local excision +/- SLNB or AND	PECS-2	LIA	Quality of Recovery score	Postoperative pain scores, postoperative opioid use, chronic pain at 3 months
PECS vs PVB								
Wahba; Egyptian J Anaesthesia 2014	RCT	no	60	MRM	PVB	PECS	Morphine use in 1st 24h	Pain scores, intraoperative fentanyl, PONV
Kulhari; Br J Anaesth 2016	RCT	no	40	MRM	PVB	PECS 2	Time to first rescue analgesic; total analgesic use in 24 hours	Pain; adverse events
Singh; Saudi J Anaesth 2018	MA	variable	297	All breast surgeries	PECS-2	PVB or IV analgesia	24 hour morphine use	Intraoperative fentanyl
Tripathy; J Anaesthesiol Clin Pharmacol 2019	RCT	yes	58	MRM with ALND	Ultrasound-guided PECS	PVB	Analgesic (paracetamol) use in the first 24 hours	Postoperative Visual analogue scale pain scores; Duration of analgesia and PONV postoperatively
Siddeshwara; Saudi J Anaesth 2019	RCT	yes	40	MRM	PECS-2	PVB	Duration of analgesia (time to request first analgesic dose)	Total rescue analgesic use and numeric rating score (NRS) in first 24 hours; complications;
Martsiniv; Kin Onkol 2020	RCT		60	Radical mastectomy or quadrantectomy with AND	PECS-2	PVB	Pain scores	Postop analgesics; time to first analgesic request
Grape; J Clin Anesth 2020	MA	n/a	388	Radical mastectomy	PECS (PECS-1, PECS-2, Serratus, or combination)	PVB (single and multiple injections)	Rest pain scores 2h postoperatively	Rest pain 12 & 24h. Dynamic pain 2, 12, 24h. IV morphine administration, intraoperative and 24h postoperatively. Time to first analgesia request. PONV

								rates at 24h. Complications. Chronic pain at 3 & 6 months postop.
Jin; RAPM 2020	MA	n/a	502	Mastectomy	PECS	PVB	24h opioid use	Time to rescue analgesia; PONV
PECS versus SAP								
Hards; J Clin Anesth 2016	Retrospective	no	27	Mastectomy +- SLNB +- axillary clearance +- reconstruction	SAP by surgeon	Local infiltration	Pain scores	Nausea
Hetta; J Clin Anesth 2015	RCT	no	64	MRM	SAP	PVB	Morphine in 1st 24h	Time to first analgesic request
Kunigo; RAPM 2017	RCT	yes	42	Total mastectomy or partial mastectomy (unilateral only)	SAP with 20ml	SAP with 40ml	Number of affected dermatomes	Time to first analgesic request, adverse events, complications
Abdallah; RAPM 2018	Prospective cohort	no	166	Partial or simple mastectomy +/- SLNB or ALND	Superficial or deep serratus	None	Total morphine use; rest pain VAS scores predischarge	Intraoperative fentanyl requirement; time to 1st analgesic; PONV rate; PACU duration
Fujii; Anaesthesia 2019	RCT	yes	80	Mastectomy	PECS-2 block	SAP	Rate of pain worse than mild (moderate or severe pain) at six postoperative months	Morphine use and pain scores within 24 postoperative hours; rate of participants without pain and the health-related quality of life at 6 months
Wang; Pain Physician 2019	RCT	Partially	61	MRM	PECS-1 + Serratus Intercostal plane block	No block. No sham.	Primary outcome not stated. Outcomes were 1) time to first analgesic request 2) time to PACU discharge 3) Postoperative pain severity at 1,3,6,12,24, 48 hours 4) Patient satisfaction with pain relief 5) Sleep quality within 48 hours of surgery and 6) Incidence of adverse events-nausea, vomiting, pruritis.	No secondary outcomes specified.
Yao; Eur J Anaesthesiol 2019	RCT	yes	72	"Elective unilateral breast cancer surgery" = partial mastectomy with sentinal/axillary LN, mastectomy with sentinal/axillary LN	SAP	Sham	40 item Quality of Recovery questionnaire score 24 hours after surgery	Postoperative pain score, cumulative opioid use, Postoperative nausea and vomiting, dizziness, PACU time, patient satisfaction

Mazzinari; RAPM 2019	RCT	Yes	60	"Oncologic breast surgery" with or without reconstruction = mastectomy, partial mastectomy, lumpectomy +/- lymph node with at least 24 hour hospital stay	SAP	Conventional analgesia. No sham.	First 24-hour total morphine use	Pain scores at 1,3,6,12,24 hours; time to first opioid rescue analgesia; adverse effects
Schuitemaker; Rev Esp Anestesiol Reanim 2019	RCT	yes	30	Retro-pectoral augmentation mammoplasty	Modified PECS-2 and serratus plane block	Sham	Analgesic efficacy of block	Patient and Surgeon satisfaction with technique
Kaur; Korean J Anesthesiol 2020	RCT	yes	60	MRM	PECS-2 or Serratus-Intercostal Fascial Plane Block (SIFP)	Sham	Postoperative static and dynamic pain scores	Shoulder pain range of shoulder joint motion and hemodynamics
Bakeer; J Pain Res 2020	RCT	yes	180	MRM	Group 1: PECS-2, group 2: SAP	Group 3: GA with no block	24h morphine use	Intraoperative fentanyl, time to first analgesic, VAS scores at rest and with movement
Kubodera; Nagoya J Med Sci 2020	Retrospective	no	43	Breast cancer surgery	PECS-2 (Pec 1+2)	SAP	Proportion of patients without Pain (NRS=0) at 2 months postoperatively	Pain at 24h and at 2 months. 24h morphine use.
Huang; J Pain Res 2020	RCT	yes	60	Breast surgery (fibroadenoma or intraductal papilloma)	SAP ropi 20ml 0.375%, 0.5%, or 0.75%	SAP ropi 20ml 0.375%, 0.5%, or 0.75%	Area under the curve of NRS scores at rest over time	AUC of NRS pain scores on movement over time, sensory block duration, tramadol use, time to rescue analgesia
Ahiskalioglu; Aesthetic Plast Surg 2020	RCT	yes	40	Breast reduction surgery	SAP	Saline block	Opioid use at 24h postoperatively	VAS at rest and with movement. Need for rescue analgesia. Time to first analgesic rescue. Side effects.

ALND: axillary lymph node dissection; AUC: area under the curve; LOS: length of stay; MA: meta-analysis, MME: morphine mg equivalents; MRM: modified radical mastectomy; NRS: numeric rating scale; NSAID: non-steroidal anti-inflammatory drugs; OME: oral morphine equivalents; PACU: post anesthesia care unit; PECS: pectoralis block; POD: postoperative day; PONV: postoperative nausea/vomiting; PVB: paravertebral block; RCT: randomized controlled trial, SAP: serratus anterior plane; SLNB: sentinel node biopsy; VAS: visual analog scale.

Table 2: Risk of bias in reviewed randomized controlled trials

	Random sequence generation	Allocation concealment	Blinding of participants	Blinding of outcome assessment	Incomplete data	Selective reporting
Bakeer 2020	Low	Low	Low	Low	Low	Low
Barrington 2020	Low	Low	Low	Low	Low	Low
Choi 2019	Unclear	High	Low	Low	Low	Unclear
Cros 2018	Low	Low	Low	Low	Low	Low
De Cassai 2020	Unclear	High	Low	Unclear	Low	Unclear
Fujii 2019	Low	Unclear	Low	Unclear	Low	Unclear
Kim 2018	Low	Low	Low	Low	Low	Unclear
Kulhari 2016	Low	Low	Unclear	Low	Low	Low
Martsiniv 2020	Unclear	Low	Unclear	Unclear	Low	Low
Siddeshwara 2019	Low	Low	Unclear	Low	High	Low
Tripathy 2019	Low	Low	High	Low	Unclear	Low
Versyck 2017	Low	Low	Low	Low	Low	Low
Wahba 2014	Low	Low	Unclear	Low	Low	Low

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