HEALTH PLANS
UNIVERSITY OF UTAH

Medical Policy

Therapeutic Nerve Blocks for Post-Operative Pain Management

Policy MP-071

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Disclaimer:

1. Policies are subject to change in accordance with State and Federal notice requirements.
2. Policies outline coverage determinations for U of U Health Plans Commercial and Healthy U (Medicaid) plans. Refer to the "Policy" section for more information.
3. Services requiring prior-authorization may not be covered, if prior-authorization is not obtained.
4. This Medical Policy does not guarantee coverage or payment of the service. The service must be a benefit in the member's plan and the member must be eligible for coverage at the time of service. Additional payment guidelines may be applied that are not included in this policy.

Description:

A nerve block is an anesthetic and/or anti-inflammatory injection targeted toward a certain nerve or group of nerves to treat pain. The purpose of the injection is to "turn off" a pain signal coming from a specific location in the body or to decrease inflammation in that area.

Imaging guidance, such as fluoroscopy, ultrasound or computed tomography (CT or "CAT" scan), may be used to help the place the needle in the most appropriate location so that the patient can receive maximum benefit from the injection.

Blocks may be a single injection or a continuous nerve block. Single-injection nerve block (sometimes called "single-shot" block) refers to a one-time injection of local anesthetic (LA) adjacent to the nerve or plexus for surgical anesthesia and/or analgesia. The duration and density of the block depends upon the dose, concentration, and pharmacology of the chosen LA; clinically effective duration may last from less than an hour to 24 hours or more.

Continuous nerve blocks involve the continuous infusion of LA through a percutaneously-placed catheter adjacent to the peripheral nerve or plexus provides prolonged anesthesia/analgesia in the distribution of the nerve or plexus and may be managed as either an inpatient or an outpatient. Continuous blocks are useful in patients who are expected to have prolonged need for analgesia. This technique may increase patient satisfaction by decreasing pain, opioid use and side effects, and sleep disturbance.

Examples of peripheral nerve blocks include, but may not be limited to, cluneal nerve block, ganglion impar block, genicular nerve block or obturator nerve block. The cluneal nerve is a sensory nerve located in the upper portion of the buttocks, consisting of a superior, medial and inferior branch. The genicular nerve is a sensory nerve that surrounds the knee and provides innervation for the joint. An obturator nerve block is an injection of a steroid, an anesthetic or a combination of both, near the obturator nerve, which is primarily a motor nerve arising from the third and fourth lumbar nerves, with distribution to the hip and thigh; this type injection is most commonly used as part of regional anesthesia for knee surgery.

Policy Statement and Criteria

1. Commercial Plans

U of U Health Plans covers a limited number of nerve blocks as the published literature has established these block have proven benefit in certain settings.

Covered Therapeutic Nerve Blocks:

A. Cervical plexus block for post-operative analgesia for neck surgery (e.g., thyroid surgery) and regional anesthesia for carotid endarterectomy

B. Fascia iliaca block for acute hip fracture, and post-operative pain control following hip and knee surgeries

C. Quadratus lumborum nerve block for post-operative pain control after abdominal and hip surgeries

D. Saphenous nerve block for post-operative pain management

E. Transversus abdominis plane (TAP) block for abdominal surgery

F. US-guided erector spinae plane (ESP) block for the management of post-operative pain.

G. US-guided supraclavicular block as regional anesthesia during surgeries and/or post-operative pain control to the distal two-thirds of the upper extremity, or from the mid-humerus to the fingertips

U of U Health Plans does NOT cover the following post-operative nerve blocks as there is insufficient evidence to support their effectiveness:

A. Femoral nerve blocks for acute post-operative pain after knee replacement surgery

B. Cervical plexus block for the management of post-operative pain following shoulder surgery

C. Combined infraclavicular-suprascapular blocks for shoulder surgery

D. IPACK (infiltration between popliteal artery and capsule of the knee) nerve block for pain management after lower extremity orthopedic procedures

E. Pericapsular nerve group (PENG) block for the management of post-operative pain

F. Pre-operative adductor canal block for post-operative pain management after anterior cruciate ligament reconstruction

G. Serratus anterior plane block for the management of post-operative pain/post-thoracotomy pain

H. Spinal accessory nerve block for post-operative pain control

I. Superior hypogastric nerve block for pain relief following abdominal hysterectomy

J. TAP block for post-operative analgesia following lumbar fusion

2. Medicaid Plans

Coverage is determined by the State of Utah Medicaid program; if Utah State Medicaid has no published coverage position and InterQual criteria are not available, the U of U Health Plans Commercial criteria will apply. For the most up-to-date Medicaid policies and coverage, please visit their website at: https://medicaid.utah.gov/utah-medicaid-official-publications/ or the Utah Medicaid code Look-Up tool

CPT/HCPCS codes covered by Utah State Medicaid may still require further evaluation to determine medical necessity for coverage.

Clinical Rationale

Cervical plexus Block for Post-operative Analgesia for Neck Surgery (e.g., thyroid surgery) and Regional Anesthesia for Carotid Endarterectomy

According to Levin (2010), nerve blocks and neurostimulation are reasonable therapeutic options in patients with head and neck neuralgias. In addition, these peripheral nerve procedures can also be effective in primary headache disorders, such as migraine and cluster headaches. Nerve blocks for headaches are generally accomplished by using small subcutaneous injections of amide-type local anesthetics (e.g., lidocaine and bupivacaine). Targets include the greater occipital nerve, lesser occipital nerve, auriculotemporal nerve, supra-trochlear and supraorbital nerves, sphenopalatine ganglion, cervical spinal roots, and facet joints of the upper cervical spine. In conclusion, the author found that although definitive studies examining the usefulness of nerve blocks are lacking, reports suggested that this area deserves further attention in the hope of acquiring evidence of effectiveness.

In a 2018 meta-analysis and systematic review, (Mayhew et al) discussed thyroid surgery as being moderately painful, but is increasingly being considered as a day-case procedure. Bilateral superficial cervical plexus nerve block (BSCPB) provides an adjuvant technique to facilitate this approach, but there is great evidential heterogeneity in RCTs regarding its use. These researchers carried out a systematic search, critical appraisal, and analysis of RCTs. Trials examining pre-operative or post-operative BSCPB compared with control in patients undergoing thyroid surgery via neck incision were included; OR and 95% CI were calculated for dichotomous data, while continuous data were analyzed using SMD. Primary outcome was rescue analgesic requirement in the first 24 post-operative hours. Secondary outcomes were VAS scores at 0, 4, and 24 hours, time until 1st analgesic request, intra-operative analgesic requirements, length of hospital stay, and incidence of post-operative nausea and vomiting (PONV). A total of 14 RCTs published between 2001 and 2016 including 1,154 patients were included. The overall effect of BSCPB compared with control showed a reduction in analgesic requirement (OR 0.30; 95% CI:

0.18 to 0.51; p < 0.00001). There was improvement in VAS scores (p < 0.002) and time to 1rst analgesic requirement in the BSCPB group (p < 0.00001). Length of hospital stay was reduced by 6 hours by use of BSCPB. There was no significant change in the incidence of PONV with its use (OR 0.82; 95% CI: 0.49 to 1.37; p = 0.44). The authors concluded that BSCPB offered analgesic efficacy in the early post-operative period for up to 24 hours following thyroid surgery, with reduced length of hospital stay, but without any beneficial effect on PONV.

A 2019 randomized control trial (Karakıs et al) indicated that BSCPB is a common method used for analgesia in thyroid surgery. These investigators examined the analgesic efficacy of BSCPB in the intra-operative and post-operative periods. Patients (n = 46) undergoing thyroidectomy were randomly separated into the following 2 groups: the general anesthesia group (GA; n = 23) and the general anesthesia plus BSCPB group (GS; n = 23). The intra-operative analgesic requirement (remifentanil) and VAS score at multiple time-points during the post-operative period (after extubation, at 15 and 30 mins and 1, 2, 6, 12, 24 and 48 hours post-operation) were evaluated. Total tramadol and paracetamol consumption as well as the amount of ondansetron used was recorded. The intra-operative remifentanil requirement was significantly lower in the GS Group than in the GA Group (p = 0.009). The post-operative pain scores were significantly lower in the GS Group than in the GA Group at 15 (p < 0.01) and 30 (p < 0.01) mins and 1 (p < 0.01), 2 (p < 0.01), 6 (p < 0.01), 12 (p < 0.01) and 24 (p = 0.03) hours. The post-operative tramadol requirement was significantly lower in the GS Group than in the GA Group (p = 0.01). The number of patients that used ondansetron was significantly lower in the GS Group than in the GA Group (p = 0.004). In conclusion, the authors determined that BSCPB with 0.25% bupivacaine reduced the post-operative pain intensity and opioid dependency in thyroid surgery patients.

Furthermore, an UpToDate review on "Scalp block and cervical plexus block techniques" (Rosenblatt and Lai, 2020) states that "Superficial and deep cervical plexus blocks anesthetize the anterior and lateral neck and scalp. These blocks are particularly useful for awake carotid endarterectomy, in which neurologic monitoring of an awake patient may identify cerebral thromboembolic or ischemic events. They can also be used for postoperative analgesia for neck surgery".

Cervical Plexus Block for the Management of Post-operative Pain following Shoulder Surgery

Cervical plexus blocks have been proposed for the management of post-operative pain related to shoulder surgery. Search of PubMed completed on 7/24/2021 did not identify any published studies in the last 10 years published for this indication. As such use in this setting is considered unproven/investigational.

Combined Infraclavicular-suprascapular Blocks for Shoulder Surgery

Tran and colleagues (2017) noted that shoulder surgery can result in significant post-operative pain. Interscalene brachial plexus blocks (ISBs) constitute the current criterion standard for analgesia but may be contraindicated in patients with pulmonary pathology due to the inherent risk of phrenic nerve block and symptomatic hemi-diaphragmatic paralysis. Although US-guided ISB with small volumes (5 ml), dilute local anesthetic (LA) concentrations, and LA injection 4 mm lateral to the brachial plexus have been shown to reduce the risk of phrenic nerve block, no single intervention can decrease its incidence below 20%. Ultrasound-guided supraclavicular blocks with LA injection postero-lateral to the brachial plexus may anesthetize the shoulder without incidental diaphragmatic dysfunction, but further confirmatory clinical trials are needed. Ultrasound-guided C7 root blocks also appeared to offer an attractive, diaphragm-sparing alternative to ISB. However, additional large-scale studies are needed to confirm their effectiveness and to quantify the risk of periforaminal vascular breach. Combined axillary-suprascapular nerve blocks may provide adequate post-operative analgesia for minor shoulder surgery but do not compare favorably to ISB for major surgical procedures. One intriguing solution lies in the combined use of infraclavicular brachial plexus blocks and suprascapular nerve blocks. Theoretically, the

infraclavicular approach targets the posterior and lateral cords, thus anesthetizing the axillary nerve that supplies the anterior and posterior shoulder joint, as well as the subscapular and lateral pectoral nerves (both of which supply the anterior shoulder joint), whereas the suprascapular nerve block anesthetizes the posterior shoulder. The authors concluded that future randomized trials are needed to validate the effectiveness of combined infraclavicular-suprascapular blocks for shoulder surgery.

Fascia iliaca block for Acute Hip Fracture, and Post-operative Pain Control following Hip and Knee Surgeries

In a meta-analysis, Wang et al (2017) compared the safety and efficiency between femoral nerve block (FNB) and fascia iliaca block (FIB) for post-operative pain control in patients undergoing total knee and hip arthroplasties. These investigators carried out a systematic search in Medline (1966 to 2017.05), PubMed (1966 to 2017.05), Embase (1980 to 2017.05), ScienceDirect (1985 to 2017.05) and the Cochrane Library. Inclusion criteria: (i) Participants: Only published articles enrolling adult participants that with a diagnosis of end-stage of osteoarthritis (OA) and prepared for unilateral total knee arthroplasty (TKA) or THA; (ii) Interventions: The intervention group received FIB for post-operative pain management; (iii) Comparisons: The control group received FNB for post-operative pain control; (iv) Outcomes: VAS scores in different periods, opioids consumption, length of stay (LOS) and post-operative complications; (v) Study design: clinical RCTs were regarded as eligible in this study. Cochrane Hand book for Systematic Reviews of Interventions was used for assessment of the included studies and risk of bias was show. Fixed/random effect model was used according to the heterogeneity tested by I2 statistic. Sensitivity analysis was conducted and publication bias was assessed. Meta-analysis was performed using Stata 11.0 software. A total of 5 RCTs including 308 patients met the inclusion criteria. The present meta-analysis indicated that there were no significant differences between groups in terms of VAS score at 12 hours (SMD = -0.080, 95% CI: -0.306 to 0.145, p = 0.485), 24 hours (SMD = 0.098, 95% CI: -0.127 to 0.323, p = 0.393), and 48 hours (SMD = -0.001, 95% CI: -0.227 to 0.225, p = 0.993). No significant differences were found regarding opioid consumption at 12 hours (SMD = 0.026, 95% CI: -0.224 to 0.275, p = 0.840), 24 hours (SMD = 0.037, 95% CI: -0.212 to 0.286, p = 0.771), and 48 hours (SMD = -0.016, 95% CI: -0.265 to 0.233, p = 0.900). In addition, no significant increase of complications was identified between groups. The authors concluded that there was no significant differences of VAS scores at 12 to 48 hour and opioids consumption at 12 to 48 hour between 2 groups following total joint arthroplasty. No increased risk of nausea, vomiting and pruritus was observed in both groups. These investigators stated that FNB provided equal post-operative pain control compared with FIB following total joint arthroplasty. Both of them could reduce the consumption of opioids without severe adverse effects.

In a systematic review, Shin and colleagues (2018) provided a comprehensive review of the available evidence from randomized controlled trials (RCTs) and comparative studies on pain control after hip arthroscopy. Using the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines, a systematic review of the literature for post-operative pain control after hip arthroscopy was performed using electronic databases. Only comparative clinical studies with level 1 to 3 evidence comparing a method of post-operative pain control with other modalities or placebo were included in this review. Case series and studies without a comparative cohort were excluded. Several methods of pain management have been described for hip arthroscopy. A total of 14 studies met the inclusion criteria: 3 on femoral nerve block, 3 on lumbar plexus block, 3 on fascia iliaca block, 4 on intra-articular injections, 2 on soft tissue surrounding surgical site injection, and 2 on celecoxib (4 studies compared 2 or more methods of analgesia). The heterogeneity of the studies did not allow for pooling of data. Single-injection femoral nerve blocks and lumbar plexus blocks provided improved analgesia, but increased fall rates were observed. Fascia iliaca blocks do not provide adequate pain relief when compared with surgical site infiltration with local anesthetic and are associated with increased risk of

cutaneous nerve deficits. Patients receiving lumbar plexus block experienced significantly decreased pain compared with fascia iliaca block. Portal site and periacetabular injections provided superior analgesia compared with intra-articular injections alone. Pre-operative oral celecoxib, compared with placebo, resulted in earlier time to discharge and provided significant pain relief up to 24 hours. The authors concluded that perioperative nerve blocks provided effective pain management after hip arthroscopy; but must be used with caution to decrease risk of falls. Intra-articular and portal site injections with local anesthetics and pre-operative celecoxib could decrease opioid consumption. Moreover, these researchers stated that there is a lack of high-quality evidence on this topic, and further research is needed to determine the best approach to manage post-operative pain and optimize patient satisfaction.

Behrends and associates (2018) stated that ambulatory hip arthroscopy is associated with post-operative pain routinely requiring opioid analgesia. The potential role of peripheral nerve blocks for pain control after hip arthroscopy is controversial. This trial examined if a pre-operative fascia iliaca block improves post-operative analgesia. In a prospective, randomized, double-blinded trial, a total of 80 patients scheduled for hip arthroscopy were assigned to receive a pre-operative fascia iliaca block with 40 ml ropivacaine 0.2% or saline. Patients also received an intra-articular injection of 10-ml ropivacaine 0.2% at procedure end. Primary study end-point was highest pain score reported in the recovery room; other study end-points were pain scores and opioid use 24 hours after surgery. Additionally, quadriceps strength was measured to identify leg weakness. The analysis included 78 patients. Highest pain scores in the recovery room were similar in the block group (6 ± 2) versus placebo group (7 ± 2), difference: -0.2 (95% confidence interval [CI]: -1.1 to 0.7), as was opioid use (intravenous morphine equivalent dose: 15 ± 7 mg [block] versus 16 ± 9 mg [placebo]). Once discharged home, patients experienced similar pain and opioid use (13 ± 7 mg [block] versus 12 ± 8 mg [placebo]) in the 24 hours after surgery. The fascia iliaca block resulted in noticeable quadriceps weakness. There were 4 post-operative falls in the block group versus 1 fall in the placebo group. The authors concluded that pre-operative fascia iliaca blockade in addition to intra-articular local anesthetic injection did not improve pain control after hip arthroscopy but did result in quadriceps weakness, which may contribute to an increased fall risk. These researchers stated that routine use of this block cannot be recommended in this patient population.

Desmet and co-workers (2019) noted that the fascia iliaca compartment block has been promoted as a valuable regional anesthesia and analgesia technique for lower limb surgery. Numerous studies have been performed, but the evidence on the true benefits of the fascia iliaca compartment block is still limited. Recent anatomical, radiological, and clinical research has demonstrated the limitations of the landmark infra-inguinal technique. Nevertheless, this technique is still valuable in situations where ultrasound (US) cannot be used because of lack of equipment or training. With the introduction of US, a new supra-inguinal approach of the fascia iliaca has been described. Research has demonstrated that this technique led to a more reliable block of the target nerves than the infra-inguinal techniques. However, the authors concluded that more research is needed to determine the place of this technique in clinical practice.

Fadhlillah et al (2019) determined the analgesic safety and efficacy profile of single injection FICB performed perioperatively for isolated hip fractures. Medline, Embase, Cochrane and CINAHL were searched from inception to February 2018. Inclusion criteria were: English language, adult patients (greater than 18 years old), isolated traumatic hip fracture treated with single injection FICB peri-operatively. Data were extracted into a pre-piloted form that utilized the PRISMA-P 2015 checklist. Two investigators conducted reviews independently; any ambiguity was resolved by discussion. The quality of studies was assessed using the GRADE checklist and Cochrane risk of bias tool. A random-effects model was applied. Outcomes reviewed were pain level at rest and movement, break-through analgesia

and complications. Out of 3,757 citations, 8 RCTs were included involving 645 participants. Pain was significantly reduced during movements (SMD = -1.82, 95% confidence interval [CI]: -2.26 to -1.38, p < 0.00001) but not at rest (SMD = -0.68, 95% CI: -1.70 to 0.35, p = 0.20); FICB allowed less (break-through) supplemental analgesic (n = 57 versus n = 73), however this did not reach statistical significance (p = 0.19). The authors concluded that FICB was effective in controlling acute perioperative pain in adult patients with traumatic hip fractures. The benefit was more evident during mobilization of the limb when compared to patients at rest.

In a meta-analysis, Cai et al (2019) examined the effect of FICB on pain control and morphine consumption in patients with THA. These investigators searched databases (PubMed, Embase, and Cochrane Library) for eligible randomized controlled trials (RCTs) published prior to September 12, 2018. They only included THA patients who received FICB versus placebo for pain control. Risk ratios (RRs), standard MD (SMD) and 95% CI were determined. Stata 12.0 was used for the meta-analysis. A total of 326 THA patients from 7 RCTs were subjected to meta-analysis. Overall, FICB was associated with lower visual analog scale (VAS) scores at 1 to 8 hours and 12 hours compared with placebo (p < 0.05). However, there was no significant difference between VAS at 24 hours (SMD = -0.56, 95% CI: -1.42 to 0.31, p = 0.206) and 48 hours after THA (SMD = -0.82, 95% CI: -2.07 to 0.44, p = 0.204). Compared with the control group, FICB significantly decreased the occurrence of nausea (RR = 0.41, 95% CI: 0.25 to 0.69, p = 0.010; I2 = 0.0%). There was no significant difference in the risk of falls between the FICB and control groups (p > 0.05). The authors concluded that FICB had a beneficial role in reducing pain intensity and morphine consumption after THA. Moreover, FICB had morphine-sparing effects when compared with a control group.

Diakomi et al (2020) stated that chronic post-surgical pain (CPSP), i.e., pain persisting greater than 3 months, may appear after any type of surgery. There is a paucity of literature addressing CPSP development after hip fracture repair and the impact of any analgesic intervention on the development of CPSP in patients after hip fracture surgery. In a prospective, randomized study, these researchers examined the impact of ultrasound-guided FICB (USG-FICB) on the development of CPSP after hip fracture repair. A total of 182 patients scheduled for hip fracture surgery were included in this trial. Patients were randomized to receive a USG-FICB (FICB group) or a sham saline injection (sham FICB group), 20 mins before positioning for spinal anesthesia. The hip-related characteristic pain intensity (CPI) at 3-months post-surgery was the primary outcome measure. Presence and severity of hip-related pain at 3- and 6-months post-surgery, NRS scores at 6, 24, 36, 48 post-operative hours, total 24-hour tramadol patient-controlled analgesia (PCA) administration and timing of the 1st tramadol dose, were documented as well. FICB group presented with lower CPI scores 3-months post-operatively (p < 0.01), as well as lower percentage of patients with high-grade CPSP, 3 and 6 months post-operatively (p < 0.001). FICB group also showed significantly lower NRS scores in all instances, lower total 24-hour tramadol consumption and higher mean time to 1st tramadol dose (p < 0.05). The overall sample of 182 patients reported a considerably high incidence of hip-related CPSP (60% at 3 months, 45% at 6 months). The authors concluded that USG-FICB in the perioperative setting may reduce the incidence, intensity and severity of CPSP at 3 and 6 months after hip fracture surgery, providing safe and effective post-operative analgesia.

Furthermore, an UpToDate review on “Lower extremity nerve blocks: Techniques” (Jeng and Rosenblatt, 2020) states that “Peripheral nerve blocks of the lower extremity are used for operative anesthesia and/or postoperative analgesia for a variety of lower extremity surgeries … Femoral nerve block is used to provide anesthesia or postoperative analgesia for surgery of the anterior thigh and knee (e.g., anterior cruciate ligament repair, patella surgery, quadriceps tendon repair) … The fascia iliaca block is an alternative to the femoral nerve block and may more reliably block the lateral femoral cutaneous

nerve than the femoral block. It blocks the sensory innervation of the lateral thigh. This block does not depend on deposition of local anesthetic (LA) near an individual nerve; instead, it works by spread of the LA in a fascial plane. Therefore, this block is not performed with nerve stimulation. It can be done using ultrasound guidance or with an anatomic approach".

IPACK (infiltration between popliteal artery and capsule of the knee) Nerve Block for Pain management after Ankle Arthroplasty

Thobhani et al (2017) stated that novel regional techniques, including the adductor canal block (ACB) and the local anesthetic infiltration between the popliteal artery and capsule of the knee (IPACK) block, provide an alternative approach for controlling pain following TKA. This study compared 3 regional techniques (femoral nerve catheter [FNC] block alone, FNC block with IPACK, and ACB with IPACK) on pain scores, opioid consumption, and performance during physical therapy and hospital length of stay (LOS) in patients undergoing TKA. All patients had a continuous perineural infusion, either FNC block or ACB. Patients in the IPACK block groups also received a single injection 30-ml IPACK block of 0.25% ropivacaine. Pain scores and opioid consumption were recorded at post-anesthesia care unit (PACU) discharge and again at 8-hour intervals for 48 hours. Physical therapy performance was measured on post-operative days (POD) 1 and 2, and hospital LOS was recorded. These researchers found no significant differences in the 3 groups with regard to baseline patient demographics. Although these investigators observed no differences in pain scores between the 3 groups, opioid consumption was significantly reduced in the FNC with IPACK group. Physical therapy performance was significantly better on POD 1 in the ACB with IPACK group compared to the other 2 groups. Hospital LOS was significantly shorter in the ACB with IPACK group. The authors concluded that the findings of this study demonstrated that an IPACK block reduced opioid consumption by providing effective supplemental analgesia following TKA compared to the FNC-only technique; ACB with IPACK provided equivalent analgesia and improved physical therapy performance, allowing earlier hospital discharge.

Sankineani et al (2018) noted that ACB is a peripheral nerve blockade technique that provides good pain control in patients undergoing TKA, which however does not relieve posterior knee pain. The recent technique of an ultrasound (US)-guided local anesthetic infiltration of the interspace between popliteal artery and the capsule of posterior knee (IPACK) has shown promising results in providing significant posterior knee analgesia without affecting the motor nerves. These researchers carried out a prospective study from September 2016 to March 2017 in 120 patients undergoing unilateral TKA. The initial 60 consecutive patients received ACB + IPACK (Group 1, n = 60), and the subsequent 60 patients received ACB alone (Group 2, n = 60). All patients were evaluated with visual analog scale (VAS) score for pain recorded at 8 hours, POD 1 and POD 2 after the surgery. The secondary outcome measures assessed were the range of movement (ROM) and ambulation distance. VAS score showed significantly ($p < 0.005$) better values in ACB + IPACK group compared to the ACB group. The mean ROM of knee and ambulation distance also showed significantly better values in ACB + IPACK group compared to the ACB group. The authors concluded that ACB + IPACK is a promising technique that offered improved pain management in the immediate post-operative period without affecting the motor function around the knee joint resulting in better ROM and ambulation compared to ACB alone. This was a relatively small study (n = 60 in the ACB + IPACK group); and its findings were confounded by the combined use of ACB and IPACK.

Kim et al (2019) stated that periarticular injections (PAIs) are becoming a staple component of multi-modal joint pathways. Motor-sparing peripheral nerve blocks, such as the infiltration between the popliteal artery and capsule of the posterior knee (IPACK) and the ACB, may augment PAI in multi-modal analgesic pathways for TKA, but supporting literature remains rare. These researchers hypothesized that the addition of ACB and IPACK to PAI would lower pain on ambulation on POD 1 compared to PAI alone.

This triple-blinded, randomized-controlled trial included 86 patients undergoing unilateral TKA. Patients either received a PAI (control group, n = 43) or an IPACK with an ACB and modified PAI (intervention group, n = 43). The primary outcome was pain on ambulation on POD 1; secondary outcomes included numeric rating scale (NRS) pain scores, patient satisfaction, and opioid consumption. The intervention group reported significantly lower NRS pain scores on ambulation than the control group on POD 1 (difference in means [95% confidence interval (CI)]: -3.3 [-4.0 to -2.7]; $p < 0.001$). In addition, NRS pain scores on ambulation on POD 0 (-3.5 [-4.3 to -2.7]; $p < 0.001$) and POD 2 (-1.0 [-1.9 to -0.1]; $p = 0.033$) were significantly lower. Patients in the intervention group were more satisfied, had less opioid consumption ($p = 0.005$, post-anesthesia care unit, $p = 0.028$, POD 0), less intravenous opioids ($p < 0.001$), and reduced need for intravenous patient-controlled analgesia ($p = 0.037$). The authors concluded that the addition of IPACK and ACB to PAI significantly improved analgesia and reduced opioid consumption after TKA compared to PAI alone. They stated that this study strongly supported IPACK and ACB use within a multi-modal analgesic pathway. This was a relatively small study (n = 43 in the ACB + IPACK + PAI group); and its findings were confounded by the combined use of ACB, IPACK and PAT.

Currently, there is a lack of evidence regarding the use of IPACK block following ACL repair.

Pericapsular nerve group (PENG) block for the management of post-operative pain

Giron-Arango et al (2018) stated that fascia iliaca block or femoral nerve block is used frequently in hip fracture patients because of their opioid-sparing effects and reduction in opioid-related adverse effects. A recent anatomical study on hip innervation led to the identification of relevant landmarks to target the hip articular branches of femoral nerve and accessory obturator nerve. Using this information, these researchers developed a novel ultrasound (US)-guided approach for blockade of these articular branches to the hip, the PENG (PEricapsular Nerve Group) block. The authors described the technique and its application in 5 consecutive patients.

Sandri et al (2020) examined the efficacy of the PENG block and local infiltration analgesia (LIA) combination as the only anesthesia technique for the total hip arthroplasty (THA). These researchers considered the anesthetic plan, post-operative analgesia, hospital length of stay (LOS), functional recovery, bleeding, complications and the adverse events (AEs). They reported 10 American Society of Anesthesiologists (ASA) I-II patients admitted for elective primary THA, receiving LIA during (n = 5) and at the end of surgery (n = 5). For the PENG block, these investigators used a single injection of 40-ml levobupivacaine 0.25% and 4-mg dexamethasone. For LIA, a mixture of 0.25% levobupivacaine, ketorolac, epinephrine, and morphine was injected into periarticular tissues. The pain intensity was evaluated with a numeric rating scale (NRS). All patients were fully satisfied and improvement in pain relief, symptoms, and functional activity was remarkable. Intra-operative blood losses ranged 100 to 600 ml. No intra-operative complications or signs of toxicity occurred. The median duration of surgery was 59.5 ± 4.5 mins and the hospital LOS ranged between 2 and 3 days. The authors concluded that the PENG block and LIA could be hypothesized as a safe and effective anesthesia technique for the THA surgery, facilitating hip functional recovery and limit intra-operative blood losses and AEs. The main drawbacks of this study were its small (n = 5 for PENG block and LIA administered at the end of surgery) sample size; and the findings were confounded by the combined use of the PENG block and LIA.

Pre-operative Adductor Canal Block for Post-operative Pain Management after Anterior Cruciate Ligament Reconstruction

Runner et al (2018) stated that peripheral nerve blocks, particularly femoral nerve blocks (FNBs), are commonly performed for anterior cruciate ligament reconstruction (ACLR). However, associated quadriceps muscle weakness after FNBs is well described and may occur for up to 6 months post-operatively. The adductor canal block (ACB) has emerged as a viable alternative to the FNB, theoretically

causing less quadriceps weakness during the immediate post-operative period, as it bypasses the majority of the motor fibers of the femoral nerve that branch off proximal to the adductor canal. In a prospective, single-blinded, randomized controlled trial (RCT), these researchers examined if a difference in quadriceps strength exists after an ACB or FNB for ACLR beyond the immediate post-operative period. Beyond the immediate post-operative period, these investigators anticipated no difference in quadriceps strength between patients who received ACBs or FNBs for ACR. A total of 102 patients undergoing primary ACLR using a variety of graft types were enrolled between November 2015 and April 2016. All patients were randomized to receive an ACB or FNB before surgery, and the surgeon was blinded to the block type. All patients underwent aggressive rehabilitation without functional bracing post-operatively. The time to the first straight-leg raise was reported by the patient. Isokinetic strength testing was performed at 3 and 6 months post-operatively. Data for 73 patients were analyzed. There was no significant difference in patient demographics of age, body mass index (BMI), sex, or tourniquet time between the FNB (n = 35) and ACB (n = 38) groups. The mean time to the first straight-leg raise was similar, at 13.1 ± 1.0 hours for the FNB group and 15.5 ± 1.2 hours for the ACB group (p = 0.134). The mean extension torque at 60 deg/s increased significantly for both the ACB (53.7% ± 3.4% to 68.3% ± 2.9%; p = 0.008) and the FNB (53.3% ± 3.3% to 68.5% ± 4.1%; p = 0.006) groups from 3 to 6 months post-operatively. There was also no significant difference in mean extension torque at 60 deg/s or 180 deg/s between the FNB and ACB groups at 3 and 6 months. There were no significant differences in post-operative complications (infection, arthrofibrosis, re-tear) between groups. The authors concluded that although prior studies have shown immediate post-operative benefits of ACBs compared with FNBs, with a faster return of quadriceps strength, in the current study there was no statistically or clinically significant difference in quadriceps strength at 3 and 6 months post-operatively in patients who received ACBs or FNBs for ACLR.

Bailey et al (2019) compared FNB versus ACB for post-operative pain control and quadriceps muscle function in patients undergoing ACLR with patellar tendon autograft. These researchers performed a randomized therapeutic trial of 90 patients undergoing ACLR with patellar tendon autograft comparing ACB versus FNB at 24 hours, 2 and 4 weeks, and 6 months post-surgery. Early outcome measures included average pain score and morphine equivalent units (milligrams) consumed, quadriceps surface electromyography (EMG), straight leg raise, and ability to ambulate without assistive devices. The 6-month outcome measures included knee range of motion (ROM), isokinetic knee extension peak torque, single-leg squat, and single-leg hop performance. Complications were recorded throughout the study for the development of anterior knee pain, knee extension ROM loss, deep vein thrombosis (DVT), and graft failure. Mixed-model analysis of variance and Mann-Whitney U tests were performed using an alpha of 0.05. Quadriceps surface EMG deficits were higher for FNB at 24 hours ($p < 0.001$) and 2 weeks ($p < 0.001$) when compared with the ACB group. There were no between-groups difference for subjective pain ($p = 0.793$) or morphine consumption ($p = 0.358$) within the first 24 hours of surgery. A higher percentage of patients in the ACB group met the full ambulation criteria at 4 weeks compared with the FNB group (100% versus 84.2%, $p < 0.001$). No between-group differences were observed at 6 months; however, the rate of knee extension ROM loss was higher for the FNB group versus the ACB group (21.1% versus 5.0%, $p = 0.026$), respectively. The authors concluded that ACB was as effective as FNB in providing pain control while eliciting fewer quadriceps muscle activation deficits and fewer post-operative complications. Based on previous evidence and the results of this study, these investigators recommended the use of ACB over FNB for the analgesic management of patients undergoing ACLR with patellar tendon autograft. Level of Evidence = I.

Lynch et al (2019) stated that FNB is a commonly performed technique that has been proven to provide effective regional analgesia after ACLR. The ACB uses a similar sensory block around the knee while avoiding motor blockade of the quadriceps muscles. In a prospective, double-blinded RCT, these

researchers compared the efficacy of FNB versus ACB for pain control after ACLR. It was hypothesized that there would be no difference in pain levels or opioid requirements between the 2 groups. A total of 60 patients undergoing primary ACLR with bone-patellar tendon-bone autograft were randomized to receive either an ACB or an FNB pre-operatively. The primary outcomes assessed were pain levels (VAS) and narcotic requirements for 4 days after surgery. Secondary outcomes included ability to perform a straight leg raise in the recovery room and difference in thigh circumference between the operative and non-operative leg measured at 7 days post-operatively. Morphine requirements were less in the ACB group in the first 4 hours post-operatively ($p = 0.02$). Aside from this time interval, no differences were found between the 2 groups with regard to opioid requirements and pain scores at any other time. Similarly, no differences were noted in patients' ability to perform a straight leg raise in the recovery room ($p = 0.13$) or in thigh circumference at the first post-operative visit ($p = 0.09$). The authors concluded that the findings of this study suggested similar efficacy in peri-operative pain control with the use of an ACB for ACLR when compared with FNB. These researchers stated that the potential long-term benefit of quadriceps preservation with the ACB is worthy of future study. Level of Evidence = I.

Also in 2019, 2 studies (Ramlogan et al and Sehmbi et al) noted effective pain control after anterior cruciate ligament repair (ACLR) is vital for recovery and rehabilitation. More recently, local instillation analgesia (LIA) during ACL surgery has been used in addition to, or as a replacement for, peripheral nerve blocks. Recent studies and subsequent systematic reviews have shown that FNB (femoral nerve block) or ACB (adductor canal block) may not produce additional analgesic advantage when compared with multi-modal analgesia alone, whereas LIA can provide effective analgesia compared with placebo for ACLR. Contemporary evidence suggests that the benefits of adding nerve block to multimodal analgesia for ACLR are modest and conflicting. The analgesic benefits of ACB are not different from placebo or FNB after ambulatory ACLR, suggesting a limited role of the block in this procedure. In conclusion, adductor canal block for ACL surgery should be experimental until further studies are published.

<u>Quadratus lumborum Nerve Block for Post-operative Pain Control after Abdominal and Hip surgeries</u>

Stuart Green (2018) noted that THA is a common procedure being performed at an increasing rate in the United States. Recovering from this surgery to the extent that one can participate in criteria for discharge relies heavily on effective post-operative analgesia. Many regional anesthetic techniques are deployed in this realm. The recent utilization of QL blocks with success in other procedures warrants investigation in the THA population. A total of 20 patients received general anesthesia for elective THA; 10 cases included a pre-operative US-guided trans-muscular QLB with 30 cc 0.5% ropivacaine; 10 cases that lacked this regional procedure. The primary outcome was length of hospital stay (LOS); secondary outcomes include total procedure time, intra-operative and post-operative fentanyl administration, and mean post-operative VAS (1 - 10); LOS was shorter in patients receiving QLB (2.9 days) versus patients not receiving QLB (5.1 days) (p value 0.0146). Intra-operative use of fentanyl was lower in patients receiving QLB (183.5 mcg) versus patients not receiving QLB (240 mcg) (p value 0.0376); PACU narcotic utilization, 24-hour VAS score, and length of operative procedure lacked statistical significance, though the study was not powered for these outcomes. The authors concluded that QL block employment in hip surgery produced significant reduction in LOS and intra-operative fentanyl use. These researchers stated that while QLB are rapidly becoming a popular option due to its quality and spread of analgesia, more adequately powered prospective research must be performed to appropriately elucidate significant trends

Bak et al (2020) noted that QLB, which is based on an easy fascial plane technique that has been reported to be effective in pain control after abdominal surgery. These investigators reported on a case involving an 83-year-old man (weight: 64 kg) who received continuous trans-muscular QLB as part of a

multi-modal analgesia after hardware removal and THA. The patient received continuous infusion of 0.2% ropivacaine at 8 ml/h through an indwelling catheter in addition to patient-controlled analgesia (PCA) with intravenous fentanyl and oral celecoxib. The area of sensory blockade ranged from T8 to L3, and he received the 1st demand dose of fentanyl via the PCA pump at 17 hours after surgery. The patient's pain scores did not exceed 4, and no additional analgesics were required until post-operative day 5. The authors concluded that these findings suggested that trans-muscular QLB may be a suitable option for multi-modal analgesia after THA.

Kukreja et al (2019) compared analgesia and opioid consumption for patients undergoing primary THA with pre-operative posterior QLB with patients who did not receive QLB. The medical records of patients undergoing unilateral THA between January 1st, 2017 and March 31, 2018 were reviewed, and 238 patients were included in the study. The primary outcome was post-operative opioid consumption in the first 24 post-operative hours. Secondary outcomes were intraoperative, PACU, and 48-hour opioid consumption, post-operative VAS pain scores, and PACU-LOS. Primary and secondary end-point data were compared between patients undergoing primary THA with pre-operative posterior QLB with patients who did not receive QLB. For the patients who received QLB, the 24-hour total oral morphine equivalent (milligram) requirements were lower (53.82 mg ± 37.41), compared to the patients who did not receive QLB (77.59 mg ± 58.42), with $p = 0.0011$. Opioid requirements were consistently lower for the patients who received QLB at each additional assessment time-point up to 48 hours; VAS pain scores were lower up to 12 hours after surgery for the patients who received a posterior QLB, and the PACU-LOS was shorter for the patients who received QLB. The authors concluded that pre-operative posterior QLB for primary THA was associated with decreased opioid requirements up to 48 hours, decreased VAS pain scores up to 12 hours, and shorter PACU-LOS.

Saphenous Nerve Block for Post-operative Pain Management

Jarrell et al (2018) noted that the increasing scope and complexity of foot and ankle procedures performed in an out-patient setting require more intensive perioperative analgesia. Regional anesthesia (popliteal and saphenous nerve blocks) has been proven to provide satisfactory pain management, decreased post-operative opioid use, and earlier patient discharge. This can be further augmented with the placement of a continuous-flow catheter, typically inserted into the popliteal nerve region. These investigators examined the use of a combined popliteal and saphenous continuous-flow catheter nerve block compared to a single popliteal catheter and single-injection saphenous nerve block in post-operative pain management after ambulatory foot and ankle surgery. A prospective study was conducted using 60 patients who underwent foot and ankle surgery performed in an out-patient setting. Demographic data, degree of medial operative involvement, American Society of Anesthesiologists physical classification system, anesthesia time, and post-anesthesia care unit time were recorded. Outcome measures included pain satisfaction, numeric pain scores (NPS) at rest and with activity, and opioid intake. Patients were also classified by degree of saphenous nerve involvement in the operative procedure, by the surgeon who was blinded to the anesthesia randomization. Patients in the dual-catheter group took significantly less opioid medication on the day of surgery and post-operative day 1 (POD 1) compared to the single-catheter group ($p = 0.02$). The dual-catheter group reported significantly greater satisfaction with pain at POD 1 and POD 3 and a significantly lower NPS at POD 1, 2, and 3. This trend was observed in all 3 subgroups of medial operative involvement. The authors concluded that patients in the single-catheter group reported more pain, less satisfaction with pain control, and increased opioid use on POD 1, suggesting dual-catheter use was superior to single-injection nerve blocks with regard to managing early post-operative pain in out-patient foot and ankle surgery. Level of Evidence = II.

Bjorn et al (2018) stated that major ankle surgery causes intense post-operative pain, and whereas the importance of a sciatic nerve block is well established, the clinical significance of a supplemental saphenous nerve block has never been determined in a prospective, randomized, double-blind, placebo-controlled trial. These researchers hypothesized that a saphenous nerve block reduces the proportion of patients experiencing significant clinical pain after major ankle surgery. A total of 18 patients were enrolled and received a popliteal sciatic nerve block. Patients were randomized to single-injection saphenous nerve block with 10 ml 0.5% bupivacaine with 1:200,000 epinephrine or 10 ml saline. Primary outcome was the proportion of patients reporting significant clinical pain, defined as a score greater than 3 on the numerical rating scale (NRS); secondary outcomes were maximal pain and analgesia of the cutaneous territory of the infra-patellar branch of the saphenous nerve; 8 of 9 patients in the placebo group reported significant clinical pain versus 1 of 9 patients in the bupivacaine-epinephrine group ($p = 0.003$). Maximal pain was significantly lower in the active compared with the placebo group (median, 0 [0 to 0] versus 5 [4 to 6]; $p = 0.001$). Break-through pain from the saphenous territory began within 30 mins after surgery in all cases. Sensory testing of the cutaneous territory of the infra-patellar branch of the saphenous nerve showed correlation between pain reported in the anteromedial ankle region and the intensity of cutaneous sensory block in the anteromedial knee region. The authors concluded that the saphenous nerve is an important contributor to post-operative pain after major ankle surgery, with significant clinical pain appearing within 30 mins after surgery.

Furthermore, an UpToDate review on "Lower extremity nerve blocks: Techniques" (Jeng and Rosenblatt, 2020) states that "Saphenous nerve block -- The saphenous nerve can be blocked below the knee for surgery of the lower leg and ankle using an anatomic approach. Perineural catheters are not used for saphenous nerve block below the knee … Side effects and complications -- The degree to which adductor canal blocks preserve the function of the quadriceps muscle, and therefore the ability to safely ambulate postoperatively, is controversial. A number of studies have reported that these blocks result in little or no quadriceps weakness, in particular compared with femoral nerve block. However, quadriceps paralysis has been reported after adductor canal block. Therefore, patients should be monitored for motor strength to reduce the risk of fall … The saphenous nerve block is useful for surgeries of the superficial, medial lower leg and provides analgesia of the medial ankle and foot".

Serratus Anterior Plane Block for the Management of Post-operative Pain/Post-thoracotomy Pain

Wang et al (2019) stated that reports of post-operative pain treatment after uniportal video-assisted thoracoscopic surgery (VATS) are limited. Thoracic para-vertebral block and SAPB have been described recently in pain management after thoracic surgery. A comparison between these 2 blocks for post-operative analgesia after uniportal VATS has not been previously reported. In a retrospective, propensity-matched study, these researchers compared the analgesic benefits of SAPB and thoracic para-vertebral block after uniportal VATS and examined the 2 block types for non-inferiority. From December 2015 to May 2018, a total of 636 relevant records of patients who underwent uniportal VATS under general anesthesia alone or with the addition of SAPB or thoracic para-vertebral block performed pre-operatively were identified. A propensity-matched analysis incorporating pre-operative variables was used to compare the efficacy of post-operative analgesia in 3 groups. A total of 123 patients were identified for analysis. Propensity score matching resulted in 41 patients in each group. The VAS scores were significantly lower in the SAPB group and the thoracic para-vertebral block group than in the control group at the 1st, 2nd, 4th, and 6th post-operative hours. Cumulative opioid consumption was significantly lower in the SAPB and thoracic para-vertebral block groups than in the control group at 6 hours (18.3 ± 3.1 mg, 18.7 ± 3.9 mg versus 21.5 ± 4.4 mg; $p = 0.001$) and 24 hours (43.4 ± 7.3 mg, 42.5 ± 7.7 mg versus 49.3 ± 8.8 mg; $p < 0.001$) post-operatively. The SAPB group was non-inferior to the thoracic para-vertebral block group on pain score and opioid consumption. The authors concluded that the findings of this study suggested that in patients undergoing unipolar VATS, the addition of single-

injection SAPB or thoracic para-vertebral block was associated with early analgesic benefits, including a reduction in post-operative opioid consumption and VAS score. These researchers stated that SAPB was as effective as thoracic para-vertebral block in reducing post-operative pain. Compared to thoracic para-vertebral block, SAPB is advantageous due to its relative ease of application. Moreover, they stated that although SAP block could be an effective therapeutic option for post-operative unipolar VATS analgesia, further prospective, large-scale, randomized controlled trials are needed to examine the efficacy of and indications for SAPB.

In a randomized controlled trial, Reyad et al (2020) examined US-guided SAPB versus patient-controlled analgesia (PCA) on the emergence of post-thoracotomy pain syndrome (PTPS) after thoracotomies for thoracic tumors. This trial included 89 patients with chest malignancies, scheduled for thoracotomy were randomly allocated into 2 groups: Group A "PCA-group; n = 44" receiving patient-controlled analgesia; and group B "SAPB group; n = 45" where analgesia was provided by SAPB. The primary outcome measure was the assessment for the possible emergence of PTPS at 12 weeks. The secondary outcome measures were pain relief measured using VAS score. Quality of life (QOL) was assessed using Flanagan QOL Scale (QOLS) and activity level was assessed using Barthel Activity of daily living (ADL) score. At week 8, PTPS incidence was significantly ($p = 0.037$) higher in the PCA group (45%) than in the SAPB group (24%) with a relative risk (RR) of 1.38 and 95% confidence interval (CI): 1.01 to 1.9; while the incidence of PTPS at week 12 was significantly ($p = 0.035$) higher in the PCA group (43%) than in the SAPB group (22%) with a RR of 2.38 and 95% CI: 1.23 to 4.57. The need for pain therapy in PTPS patients was significantly lower in the SAPB group (17.7%) than the PCA group (38.6%) ($p = 0.028$) at week 12. Pain intensity: VAS-R and VAS-D (pain scores at rest and with activity, respectively) was comparable ($p > 0.05$) between both groups at 6, 12, 18 and 24 hours, however VAS was significantly higher in the PCA group at week 8 ($p = 0.046$) and week 12 ($p = 0.032$). Both groups were comparable regarding ADL and QOL scores ($p > 0.05$). The authors concluded that SAPB is assumed to be a good alternative for post-thoracotomy analgesia following thoracotomies. The current work hypothesized that SAPB for a week post-operatively, may reduce the emergence of PTPS and may reduce the demand for pain therapy in those patients.

Furthermore, an UpToDate review on “Thoracic nerve block techniques” (Rosenblatt and Lai, 2020) states that “Thoracic interfascial plane blocks include the Pecs I, Pecs II, serratus plane (SP), transversus thoracic muscle plane (TTMP), and erector spinae (ESP) blocks. These blocks can be utilized for superficial and deep surgery in the chest wall and axillary regions (e.g., mastectomy, cosmetic breast surgery, chest tube placement, multiple rib fractures). We suggest the use of ultrasound guidance for TPVB and the interfascial plane blocks of the chest (Grade 2C), to increase the success rate and reduce complications”.

<u>Spinal Accessory Nerve Block for the Treatment of Neck Pain and Upper Back Pain or Post-operative pain</u>

Taguchi et al (2000) described the radiologic anatomy for selective medial branch block for low back pain (LBP) resulting from facet joints. A groove between the mammillary process and the accessory process (M-A groove) was chosen as the target point for this nerve block. The position of M-A groove was constant on X-rays at each level of the lumbar spine. Confirming this position under the fluoroscope, the medial branch nerves can be blocked selectively. The authors concluded that this method clarified the features of LBP related to the medial branch.

Townsley et al (2011) reported the 1st description of ultrasound (US)-guided spinal accessory nerve blockade using single-shot and subsequently continuous infusion (via a perineural catheter) local anesthetic techniques, for the diagnosis and treatment of myofascial pain affecting the trapezius muscle. A 38-year old man presented with a 2-year history of incapacitating left suprascapular pain after a fall onto his out-stretched hand. The history and clinical examination was suggestive of myofascial pain

affecting the trapezius muscle. This had been unresponsive to pharmacological therapy, physiotherapy or suprascapular nerve blockade. Following identification of the spinal accessory nerve in the posterior triangle of the neck, these investigators performed US-guided nerve blocks, first using a single injection of local anesthetic and subsequently using a continuous infusion via a perineural catheter, to block the nerve and temporarily relieve the patient's pain. The authors demonstrated that the spinal accessory nerve is identifiable in the posterior triangle of the neck and can be blocked successfully using US guidance. They stated that this technique can aid the diagnosis and treatment of myofascial pain originating from the trapezius muscle.

There is currently insufficient evidence to support the use of spinal accessory neve block for treatment of neck pain and upper back pain.

Superior Hypogastric Nerve Block for Pain Relief following Abdominal Hysterectomy

In a randomized, double-blind, placebo-controlled, clinical trial, Rapp and colleagues (2017) examined if superior hypogastric plexus block performed during abdominal hysterectomy decreases post-operative opioid consumption and pain. A total of 68 women scheduled for total abdominal hysterectomy for a benign indication were included in this study; 20 ml of ropivacaine 7.5 mg/ml or saline was injected retro-peritoneally in the area of the superior hypogastric plexus during the hysterectomy. Subjects were individually randomized to either intervention; subjects, caregivers, and those assessing the outcomes were blinded to group assignment. The primary outcomes were post-operative opiate consumption and patients' self-assessment of pain (VAS scores); secondary outcomes were mobilization and side effects related to opiate consumption. The trial was completed with 38 women randomized to ropivacaine and 37 women randomized to saline. Analysis was performed on 35 women in the ropivacaine group and 33 women in the saline group. The post-operative opioid consumption was significantly lower in the ropivacaine group than in the placebo group (median of 55.8 and 72.4 mg, respectively, $p = 0.032$). The proportion of women scoring VAS less than 4 at 2 hours after block was significantly higher in the ropivacaine group (63%) than in the placebo group (25%) ($p = 0.015$). No side effects or important AEs occurred during the trial. The authors concluded that superior hypogastric plexus block is a new method in this context and a promising contribution to post-operative pain treatment following abdominal hysterectomy.

Transversus Adominis Plane (TAP) block for Abdominal Surgery and Post-Operative Analgesia Following Lumbar Fusion

Transversus abdominis plane (TAP) block is a peripheral block that entails nerves of the anterior abdominal wall. The block has been developed for post-operative pain control after gynecologic and abdominal surgery. The initial technique described the lumbar triangle of Petit as the landmark used to access the TAP in order to facilitate the deposition of local anesthetic solution in the neurovascular plane. Other techniques include US-guided access to the neurovascular plane via the mid-axillary line between the iliac crest and the costal margin, and a subcostal access termed the “oblique subcostal” access.

Law et al (2015) compared paravertebral block (PVB) with general anesthesia/systemic analgesia, neuraxial blocks, and other PNBs. These investigators analyzed 14 RCTs from PubMed, MEDLINE, CENTRAL, EMBASE, and CINAHL up to February 2015, without language restriction, comparing PVB under sedation with general anesthesia/systematic analgesia (135 versus 133 patients), neuraxial blocks (191 versus 186 patients), and other PNBs (119 versus 117 patients). These researchers investigated pain scores, consumption of post-operative analgesia, incidence of post-operative nausea and vomiting (PONV), length of hospital stay, post-anesthesia care unit bypassing rate, time to perform blocks, intra-operative hemodynamics, and incidence of urinary retention. Joint hypothesis testing was adopted for pain and analgesics, PONV, and hemodynamic variables. All analyses were performed with RevMan

5.2.11 (Cochrane Collaboration, Copenhagen). Hartung-Knapp-Sidik-Jonkman method was used for post-hoc testing. Paravertebral block reduced PONV (nausea: RR = 0.22; 95% CI: 0.05 to 0.93; numbers needed to treat [NNT] = 4.5; I = 15% and vomiting: RR = 0.15; 95% CI: 0.03 to 0.76; NNT = 8.3; I = 0%) compared with general anesthesia/systematic analgesia (quality of evidence [QoE]: high). Compared with neuraxial blocks, PVB resulted in less post-operative nausea (RR = 0.34 [95% CI: 0.13 to 0.91], NNT = 8.3, I = 0%) and urinary retention (RR = 0.14 [95% CI: 0.05 to 0.42], NNT = 7.4, I = 0%) than neuraxial blocks (QoE: high). More time was needed to perform PVB than neuraxial blocks (standardized mean difference = 1.90 [95% CI: 0.02 to 3.77], I = 92%; mean difference = 5.33 minutes; QoE: moderate). However, the available data could not reject the null hypothesis of non-inferiority on all pain scores and analgesic requirements for both PVB versus general anesthesia/systematic analgesia and PVB versus neuraxial blocks (QoE: low), as well as on hemodynamic outcomes for PVB versus neuraxial blocks (QoE: moderate). This systematic review showed that PVB decreased post-operative pain scores and analgesic requirement as compared with ilio-inguinal block and transversus abdominis plane block. The authors concluded that this meta-analysis showed that PVB provides an anesthesia with fewer undesirable effects for inguinal herniorrhaphy. The choice between general anesthesia/systematic analgesia, neuraxial blocks, PVB, and other PNBs should be based on time available to perform the block and a complete coverage over the relevant structures by the blocks.

In a Cochrane review, Hamilton and colleagues (2016) evaluated the analgesic effectiveness and adverse effects of liposomal bupivacaine infiltration PNB for the management of patients with post-operative pain. These researchers identified randomized trials of liposomal bupivacaine PNB for the management of post-operative pain. They searched the Cochrane Central Register of Controlled Trials (CENTRAL) (2016, Issue 1), Ovid Medline (1946 to week 1 of January 2016), Ovid Medline In-Process (January 14, 2016), Embase (1974 to January 13, 2016), ISI Web of Science (1945 to January 14, 2016), and reference lists of retrieved articles. These investigators sought unpublished studies from Internet sources, and searched clinical trials databases for ongoing trials. The date of the most recent search was January 15, 2016. Randomized, double-blind, placebo- or active-controlled clinical trials of a single-dose of liposomal bupivacaine administered as a PNB in adults aged 18 years or over undergoing elective surgery at any surgical site were selected for analysis. The authors included trials if they had at least 2 comparison groups for liposomal bupivacaine PNB compared with placebo or other types of analgesia. Two review authors independently considered trials for inclusion in the review, assessed risk of bias, and extracted data. They performed analyses using standard statistical techniques as described in the Cochrane Handbook for Systematic Reviews of Interventions, using Review Manager 5. They planned to perform a meta-analysis, however there were insufficient data to ensure a clinically meaningful answer; as such they have produced a “Summary of findings” table in a narrative format, and where possible they assessed the evidence using GRADE. These researchers identified 7 studies that met inclusion criteria for this review; 3 were recorded as completed (or terminated) but no results were published. Of the remaining 4 studies (299 participants): 2 investigated liposomal bupivacaine transversus abdominis plane (TAP) block, 1 liposomal bupivacaine dorsal penile nerve block, and 1 ankle block. The study investigating liposomal bupivacaine ankle block was a phase II dose-escalating/de-escalating trial presenting pooled data that these investigators could not use in their analysis. The studies did not report primary outcome, cumulative pain score between 0 and 72 hours, and secondary outcomes, mean pain score at 12, 24, 48, 72, or 96 hours. One study reported no difference in mean pain score during the 1st, 2nd, and 3rd post-operative 24-hour periods in participants receiving liposomal bupivacaine TAP block compared to no TAP block. Two studies, both in people undergoing laparoscopic surgery under TAP block, investigated cumulative post-operative opioid dose, reported opposing findings. One found a lower cumulative opioid consumption between 0 and 72 hours compared to bupivacaine hydrochloride TAP block and 1 found no difference during the 1st, 2nd, and 3rd post-

operative 24-hour periods compared to no TAP block. No studies reported time to 1st post-operative opioid or percentage not requiring opioids over the initial 72 hours. No studies reported a health economic analysis or patient-reported outcome measures (outside of pain). The review authors sought data regarding AEs but none was available, however there were no withdrawals reported to be due to AEs. Using GRADE, these researchers considered the quality of evidence to be very low with any estimate of effect very uncertain and further research very likely to have an important impact on the confidence in the estimate of effect. All studies were at high risk of bias due to their small sample size (fewer than 50 participants per arm) leading to uncertainty around effect estimates. Additionally, inconsistency of results and sparseness of data resulted in further down-grading of the quality of the data. The authors concluded that a lack of evidence has prevented an assessment of the effectiveness of liposomal bupivacaine administered as a PNB. At present there is a lack of data to support or refute the use of liposomal bupivacaine administered as a PNB for the management of post-operative pain. They stated that further research is very likely to have an important impact on the confidence in the estimate of effect and is likely to change the estimate.

Tsai and colleagues (2017) stated that transversus abdominis plane (TAP) block is a regional technique for analgesia of the antero-lateral abdominal wall. These investigators highlighted the nomenclature system and recent advances in TAP block techniques and proposed directions for future research. Ultrasound guidance is now considered the gold standard in TAP blocks. It is easy to acquire US images; it can be used in many surgeries involving the anterolateral abdominal wall. However, the efficacy of US-guided TAP blocks is not consistent, which might be due to the use of different approaches. The choice of technique influenced the involved area and block duration. To investigate the actual analgesic effects of TAP blocks, these researchers unified the nomenclature system and clarified the definition of each technique. Although a single-shot TAP block is limited in duration, it is still the candidate of the analgesic standard for abdominal wall surgery because the use of the catheter technique and liposomal bupivacaine may overcome this limitation.

Petersen and colleagues (2010) performed a systematic search of the literature and identified a total of 7 RCTs examining the effect of TAP block on post-operative pain, including a total of 364 patients, of whom 180 received TAP blockade. The surgical procedures included large bowel resection with a mid-line abdominal incision, caesarean delivery via the Pfannenstiel incision, abdominal hysterectomy via a transverse lower abdominal wall incision, open appendectomy and laparoscopic cholecystectomy. Overall, the results were encouraging and most studies have demonstrated clinically significant reductions of post-operative opioid requirements and pain, as well as some effects on opioid-related side effects (sedation and post-operative nausea and vomiting). Moreover, the authors concluded that further studies are needed to support the findings of the primary published trials and to establish general recommendations for the use of a TAP block.

A 2012 systematic review (Abdallah et. al.,) stated that US guidance has led a surge of interest in TAP block for post-operative analgesia following abdominal surgery. Despite or because of the numerous descriptive applications and techniques that have recently populated the literature, results of comparative studies for TAP block have been inconsistent. In a systematic review, these investigators addressed many unanswered questions, specifically the following: what are the effects of surgical procedure, block dose, block technique, and block timing on TAP block analgesia? A total of 18 intermediate-quality to good-quality randomized trials that included diverse surgical procedures were identified. Improved analgesia was noted in patients undergoing laparotomy for colorectal surgery, laparoscopic cholecystectomy, and open and laparoscopic appendectomy. There was a trend toward superior analgesic outcomes when 15-ml of local anesthetic or more was used per side compared with lesser volumes. All 5 trials investigating TAP block performed in the triangle of Petit and 7 of 12 trials

performed along the mid-axillary line demonstrated some analgesic advantages; 8 of 9 trials using pre-incisional TAP block and 4 of 9 with post-incisional block revealed better analgesic outcomes. The authors concluded that although the majority of trials reviewed suggested superior early pain control, these researchers were unable to definitively identify the surgical procedures, dosing, techniques, and timing that provide optimal analgesia following TAP block. The authors concluded that the understanding of the TAP block and its role in contemporary practice remains limited.

Currently, there is a lack of evidence regarding the use of TAP block for post-operative analgesia following lumbar fusion.

US-guided Erector Spinae Plane (ESP) Block for the Management of chronic Myofascial Pain Syndrome, and Post-operative Pain.

Forero et al (2017) stated that post thoracotomy pain syndrome (PTPS) remains a common complication of thoracic surgery with significant impact on patients' quality of life (QOL). Management usually involves a multi-disciplinary approach that includes oral and topical analgesics, performing appropriate interventional techniques, and coordinating additional care such as physiotherapy, psychotherapy and rehabilitation. A variety of interventional procedures have been described to treat PTPS that is inadequately managed with systemic or topical analgesics. Most of these procedures are technically complex and are associated with risks and complications due to the proximity of the targets to neuraxial structures and pleura. The ultrasound (US)-guided ESP block is a novel technique for thoracic analgesia that promises to be a relatively simple and safe alternative to more complex and invasive techniques of neural blockade. These researchers examined the application of the ESP block in the management of PTPS and reported their preliminary experience to illustrate its therapeutic potential. The ESP block was performed in a pain clinic setting in a cohort of 7 patients with PTPS following thoracic surgery with lobectomy or pneumonectomy for lung cancer. The blocks were performed with US guidance by injecting 20 to 30 ml of ropivacaine, with or without steroid, into a fascial plane between the deep surface of erector spinae muscle and the transverse processes of the thoracic vertebrae. This para-spinal tissue plane is distant from the pleura and the neuraxis, thus minimizing the risk of complications associated with injury to these structures. The patients were followed-up by telephone 1 week after each block and reviewed in the clinic 4 to 6 weeks later to evaluate the analgesic response as well as the need for further injections and modification to the overall analgesic plan. All the patients had excellent immediate pain relief following each ESP block, and 4 out of the 7 patients experienced prolonged analgesic benefit lasting 2 weeks or more. The ESP blocks were combined with optimization of multi-modal analgesia, resulting in significant improvement in the pain experience in all patients. No complications related to the blocks were seen. The authors concluded that these findings observed in this case series indicated that the ESP block may be a valuable therapeutic option in the management of PTPS. Its immediate analgesic efficacy provided patients with temporary symptomatic relief while other aspects of chronic pain management were optimized, and it may also often confer prolonged analgesia. Moreover, these researchers stated that further studies are needed to validate these findings. This was a small (n = 7) study; and its findings were confounded by the use of multi-modal analgesia.

In a prospective, single-blinded, randomized, controlled clinical trial, Tulgar et al (2018) evaluated the effectiveness of ESP block (ESPB) for post-operative analgesia management in laparoscopic cholecystectomy (LC). A total of 36 patients (ASA I-II) were recruited in 2 equal groups (block and control group). Following exclusion, 30 patients were included in final analysis. Standard multi-modal analgesia was performed in Group C (control) while ESPB block was also performed in Group B (block). Pain intensity between groups were compared using Numeric Rating Scores (NRS). Also, tramadol consumption and additional rescue analgesic requirement were measured. NRS was lower in Group B during the first 3 hours. There was no difference in NRS scores at other hours. Tramadol consumption

was lower in Group B during the first 12 hours. Less rescue analgesia was required in Group. The authors concluded that bilateral US-guided ESPB led to effective analgesia and a decrease in analgesia requirement in first 12 hours in patients undergoing LC. This was a small study (total of 30 subjects) and its findings were confounded by the use of multi-modal analgesia.

In a single-blinded, randomized controlled study, Gurkan et al (2018) evaluated the analgesic effect of US-guided ESP block in breast cancer surgery. A total of 50 ASA I-II patients aged 25 to 65 years and scheduled for elective breast cancer surgery were included in the study. Patients were randomized into 2 groups, ESP and control. Single-shot US-guided ESP block with 20 ml 0.25% bupivacaine at the T4 vertebral level was performed pre-operatively to all patients in the ESP group. The control group received no intervention. Patients in both groups were provided with intravenous patient-controlled analgesia device containing morphine for post-operative analgesia. Morphine consumption and NRS pain scores were recorded at 1, 6, 12 and 24 hours post-operatively. Morphine consumption at post-operative hours 1, 6, 12 and 24 decreased significantly in the ESP group ($p < 0.05$ for each time interval). Total morphine consumption decreased by 65% at 24 hours compared to the control group (5.76 ± 3.8 mg versus 16.6 ± 6.92 mg). There was no statistically significant difference between the groups in terms of NRS scores. The authors concluded that these findings showed that US-guided ESP block exhibited a significant analgesic effect in patients undergoing breast cancer surgery. Moreover, they stated that further studies comparing different regional anesthesia techniques are needed to identify the optimal analgesia technique for this group of patients. The findings of this study were also confounded by the use of patient-controlled analgesia devices.

Hannig et al (2018) noted that post-operative pain after laparoscopic cholecystectomy can be severe. Despite multi-modal analgesia regimes, administration of high doses of opioids is often necessary. This can further lead to several adverse effects such as drowsiness and respiratory impairment as well as post-operative nausea and vomiting (PONV). This will hinder early mobilization and discharge of the patient from the day surgery setting and is sub-optimal in an early recovery after surgery setting. The ultrasound-guided Erector Spinae Plane (ESP) block is a novel truncal inter-fascial block technique providing analgesia of the thoracic or abdominal segmental innervation depending on the level of administration. Local anesthetic penetrates anteriorly presumably through the costotransverse foramina to the paravertebral space. These researchers demonstrated the analgesic efficacy of the ESP block in a case series of 3 patients scheduled for ambulatory laparoscopic cholecystectomy. They stated that these findings must be validated in future randomized controlled trials (RCTs).

In a prospective, single-center, single-blinded, randomized controlled trial (RCT), Krishna et al (2019) examined the analgesic efficacy of bilateral ESP block compared with conventional treatment for pain after cardiac surgery in adult patients. A total of 106 patients undergoing elective cardiac surgery with cardiopulmonary bypass were included in this study. Patients were randomized into 2 groups. Patients in group 1 (ESP block group, n = 53) received US-guided bilateral ESP block with 3 mg/kg of 0.375% ropivacaine before anesthesia induction at the T6 transverse process level. Patients in group 2 (paracetamol and tramadol group, n = 53) received paracetamol (1 gm every 6 hours) and tramadol (50 mg every 8 hours) intravenously in the post-operative period. The primary study outcome was to evaluate pain at rest using an 11-point NRS. Mann-Whitney U test was used for comparing NRS scores. The post-operative pain level after extubation and duration of analgesia during which NRS was less than 4 of 10 was compared between the groups. The median pain score at rest after extubation in group 1 was 0 of 10 until hour 6, 3 of 10 at hour 8, and 4 of 10 at hours 10 and 12 post-extubation. These were significantly less in comparison with group 2 ($p = 0.0001$). Patients in group 1 had a significantly higher mean duration of analgesia (8.98 ± 0.14 hours), during which NRS was less than 4 of 10, compared with group 2 (4.60 ± 0.12 hours) ($p = 0.0001$). The authors concluded that ESP block safely provided

significantly better pain relief at rest for longer duration as compared to intravenous paracetamol and tramadol.

Applicable Coding

CPT Codes

Possibly covered

64415	Injection(s), anesthetic agent(s) and/or steroid; brachial plexus
64416	Injection(s), anesthetic agent(s) and/or steroid; brachial plexus, continuous infusion by catheter (including catheter placement)
64447	Injection(s), anesthetic agent(s); femoral nerve
64450	Injection(s), anesthetic agent(s) and/or steroid; other peripheral nerve or branch
64486	Transversus abdominis plane (TAP) block (abdominal plane block, rectus sheath block) unilateral; by injection(s) (includes imaging guidance, when performed)
64487	Transversus abdominis plane (TAP) block (abdominal plane block, rectus sheath block) unilateral; by continuous infusion(s) (includes imaging guidance, when performed)
64488	Transversus abdominis plane (TAP) block (abdominal plane block, rectus sheath block) bilateral; by injections (includes imaging guidance, when performed)
64489	Transversus abdominis plane (TAP) block (abdominal plane block, rectus sheath block) bilateral; by continuous infusions (includes imaging guidance, when performed)
64999	Unlisted procedure, nervous system

Not covered

64493	Injection(s), diagnostic or therapeutic agent, paravertebral facet (zygapophyseal) joint (or nerves innervating that joint) with image guidance (fluoroscopy or CT), lumbar or sacral; single level
64494	Injection(s), diagnostic or therapeutic agent, paravertebral facet (zygapophyseal) joint (or nerves innervating that joint) with image guidance (fluoroscopy or CT), lumbar or sacral; second level (List separately in addition to code for primary procedure)
64495	Injection(s), diagnostic or therapeutic agent, paravertebral facet (zygapophyseal) joint (or nerves innervating that joint) with image guidance (fluoroscopy or CT), lumbar or sacral; third and any additional level(s) (List separately in addition to code for primary procedure)
64418	Injection(s), anesthetic agent(s) and/or steroid; suprascapular nerve
64517	Injection, anesthetic agent; superior hypogastric plexus

HCPCS Codes

No applicable codes

ICD-10 Codes

Too numerous to mention

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