Appendix 7. Systematic review of the literature identified to formulate the guidelines.

CERVICAL FACET JOINT PROCEDURES

i. Cervical facet joint intra-articular injections

Cervical facet joint intra-articular (IA) injections involve the injection of local anesthetic (LA) and/or steroid into one or more of CFJs (C2-3 to C6-7). These injections are performed for neck and occipital (back of head) pain that is suspected to arise from the CFJ. These injections can be performed for diagnostic, prognostic (to predict the response to radiofrequency ablation (RFA)) and/or therapeutic indications. Evidence from two RCTs with low and moderate risk of bias (60,61) and two comparative observational studies (62,63) was assessed to evaluate the efficacy of IA injections into CFJ. In summary, it appears that some patients may have prolonged therapeutic benefit with cervical facet IA injections with LA and/ or steroids.

Recommendation: Though IA injections into the CFJ have high technical failure rates, these procedures can be used as a diagnostic intervention for CFJ-mediated pain. Grade C recommendation, moderate level of certainty.

Good clinical practice statement: Given the limited duration of therapeutic benefit, we recommend against the routine use of IA injections as a standard treatment for facet joint-mediated neck pain.

Notes: There is limited duration of therapeutic benefit with this treatment, although IA injection can be considered as treatment in certain circumstances: in patients who may be at risk of adverse consequences from RFA (e.g., older individuals on anticoagulation therapy for whom the smaller bore needles for IA injections may pose a smaller risk of hematoma, or those with implantable cardiac devices in whom RFA may have deleterious effects on the implant); in whom

there is a strong likelihood of success (e.g., individuals who obtained prolonged relief from previous diagnostic injections with or without steroids); and/ or patients who do not have readily available access to cervical medial branch RFA; or those who have a sustained effect from the previous IA injection (≥3 months). IA CFJ injections with steroids should be performed no more than 4 times a year.

ii. Cervical facet joint medial branch blocks (MBB)/injections

CFJ MBB or injections involve the injection of LA and/or steroid to temporarily block the sensory innervation to one or more CFJs (C2-3 to C6-7). These injections are performed for neck and occipital (back of head) pain that is suspected to arise from the CFJ. These injections can be performed for diagnostic, prognostic (to predict the response to RFA) and therapeutic indications.

Diagnostic role of CFJ MBB: An RCT involving comparative diagnostic blockade for cervical MBB found two diagnostic blocks with different LA (lidocaine and bupivacaine) suggested that although comparative blocks resulted in few false-positive diagnoses, these are associated with a high proportion of false-negative diagnoses (64) while an RCT that incorporated MBB for patient selection reported 60% of the patients experienced significant pain relief at 3 to 6 months following cervical medial branch RFA in two publications (59,65). Both RCTs had a low risk of bias.

Therapeutic role of CFJ MBB: A RCT with low risk of bias that compared the therapeutic efficacy of cervical MBB with LA only against a combination of RFA and MBB found similar incidence of patients with significant reduction of pain in both groups but the combination group had a longer duration of significant pain relief versus the LA only group (42 months versus 12

months) (66). Prolonged analgesic benefit with cervical MBB with LA has been reported in other observational studies as well with the duration varying from a few days to a few months (62,64,67,68).

Recommendations

a. When selecting targets for blocks, cervical facet levels should be determined based on clinical presentation (tenderness on palpation preferably performed under fluoroscopy, pain referral patterns). Grade C recommendation, low level of certainty.
b. Cervical MBB can be used as a diagnostic intervention for CFJ-mediated pain, though healthcare providers should be aware that the nerves that innervate the facet joints innervate other potential pain-generating structures. Grade C recommendation, moderate level of certainty.
c. Cervical MBB with local anesthetics can be used as a prognostic tool for predicting response to RFA and at least 50% reduction in pain should be considered a positive prognostic block. Grade C recommendation, moderate level of certainty.

Good Clinical Practice Statements: At least one cervical MBB with at least 50% pain relief appropriate for the duration of local anesthetic is advised prior to proceeding with RFA. Cervical MBB injections may be more predictive than IA injections for response to medial branch RFA for CFJ-mediated pain.

Notes: The recently published multi-society guidelines recommend at least one cervical MBB with at least 50% pain relief to prognosticate pain relief with RFA. While recognizing that using two diagnostic blocks on separate occasions (one block with a shorter-acting LA such as lidocaine and the other with a longer-acting LA such as bupivacaine) may increase the RFA

success rate but result in a significant proportion of false-negative procedures and a decreased overall success rate (11). Cervical facet joint IA injections and MBB have been used to prognosticate the response to RFA. However, IA injections have high technical failure rates as the injectate may extravasate out of the joint and spread to other potential pain generators, resulting in reduced specificity.

iii. Cervical facet joint medial branch radiofrequency ablation (RFA)

RFA of the innervation to the CFJs involves creation of a thermal lesion (usually at 80-90ºC for 90-150 seconds) on the surface of the facet (or the C2-3 facet joint) at a location based on anatomical knowledge of the course of the nerves.

Evidence from two RCTs, both with low risk of bias, that compared CFJ innervation RFA against either a sham procedure (59) or cervical MBB (66) was evaluated. In the smaller RCT (24 participants) with the sham comparator, participants in the RFA group reported return of pain to 50% or greater of pre-procedure levels at a median duration of 263 days after the procedure while those in the sham procedure group reported this outcome at a median of 8 days (59). In the larger RCT (76 participants) that compared CFJ innervation RFA against cervical MBB, just over 50% of participants in both groups reported significant reduction in pain at six months after the procedures but the duration of benefit was longer in the RFA group (42 months versus 12 months) (66).

Recommendations: RFA of the innervation to the CFJs can provide pain relief for at least 4 months; Grade B recommendation, moderate level of certainty.

Good Clinical Practice Statements: Repeat CFJ RFA should be offered to patients who had at least 50% pain relief on a 0-10 pain score from their pre-RFA pain intensity for at least 6 months

along with evidence of functional improvement and then experience return of their cervical pain. There is no need to repeat diagnostic MBB if the patient presents with similar pain location, historical symptoms and no change in physical examination signs. Given the mean duration of benefit and drop-off in success rates noted in some studies with repeat RFA, no more than two CFJ RFA denervation procedures a year for each CFJ are recommended.

Notes: Pain can recur after a period of time following RFA of innervation to the CFJs. The lower end of the range for this period is around 4 months (11). *Patients should be made aware about the duration of expected relief and the potential need for repeated treatment(s). Several studies have also identified a modest reduction in the duration of meaningful pain relief with repeat RFA as compared to the original procedure* (11,20). *In general, an average of 84% of patients have a successful repeat RFA after an initial successful RFA* (11).

Role of imaging for cervical facet joint procedures

All the studies included for evaluation of procedures on cervical facet joints for these guidelines utilized fluoroscopy and or ultrasound for procedural guidance.

Good Clinical Practice Statements

a. We recommend cervical facet joint injection (medial branch or joint) should be performed under fluoroscopy for procedural guidance. Ultrasound can be used as a primary imaging modality to perform cervical medial branch blocks in situations when ultrasound can be performed safely and accurately (e.g. experienced provider, long neck, low BMI, no previous cervical spine surgery and absence of aberrant anatomy).
b. Cervical facet RFA should be performed under fluoroscopy. Ultrasound can be used as an adjunctive imaging modality to fluoroscopy but not as the sole modality.

LUMBAR SPINE PROCEDURES

i. Lumbar facet joint (LFJ) intra-articular (IA) injections

LFJ IA injections involve the injection of LA and/ or steroid into one or more of LFJs (L1-2 to L5-S1). These injections are performed for low back pain that is suspected to arise from the LFJ. These injections can be performed for diagnostic, prognostic (to predict the response to RFA of innervation to these joints) and therapeutic indications.

Evidence from 10 RCTs that examined the efficacy of IA injections into LFJ was evaluated. Five of these RCTs did not report a benefit with IA injections of LA and steroids when compared against a variety of inactive injections (saline or LA) in the facet joints or at their innervation (14, 74,75,78,79) [three with a low risk of bias (14, 74, 75) and two with a high risk of bias (78, 79)] while the other five RCTs [two with a low risk of bias (77, 81), two with a moderate risk of bias (80, 82), and one with a high risk of bias (76)] did report analgesic benefit with IA steroid injections at three to six months after the intervention (76,77, 80, 81, 82).

Recommendations

a. Diagnostic role: Lumbar facet IA injections with LA and steroids are a diagnostic intervention for LFJ-mediated pain. Grade C recommendation, moderate level of certainty.
b. Prognostic role: Lumbar facet IA injections with LA and steroids are less predictive than MBB for response to medial branch RFA for LFJ mediated pain. Grade C recommendation, moderate level of certainty.

Good Clinical Practice Statements

Given the limited duration of therapeutic benefit, we recommend against the routine use of lumbar facet IA injections with LA and steroids as a standard treatment for FJ-mediated low back pain.

Notes: Lumbar facet IA injections with LA and steroids can be considered as treatment in certain circumstances: in patients who may be at risk of adverse consequences from RFA (e.g., older individuals on anticoagulation therapy for whom the smaller bore needles for IA injections may pose a smaller risk of hematoma, or those with implantable cardiac devices in whom RFA may have deleterious effects on the implant); in whom there is a strong likelihood of success (e.g., individuals who obtained prolonged relief from previous diagnostic injections with or without steroids); and/ or patients who do not have readily available access medial branch RFA; or those who have a sustained effect from the previous IA injection (≥3 months). IA LFJ injections with steroids should be performed no more than 4 times a year.

ii. Lumbar facet joint medial branch blocks (MBB) /injections

LFJ MBB or injections involve the injection of LA and/ or steroid to temporarily block the sensory innervation to one or more of LFJs (L1-2 to L5-S1 in patients with five lumbar vertebrae). These injections are performed for lower back pain that is suspected to arise from the LFJs. These injections can be performed for diagnostic, prognostic (to predict the response to RFA) and/ or therapeutic indications.

When selecting targets for diagnostic or prognostic innervation blocks of the lumbar facet joints, levels should be determined based on clinical presentation (radiological findings when available, tenderness on palpation performed under fluoroscopy, and pain referral patterns) (48). One RCT

with a low risk of bias examined the value of LFJ MBB in predicting the outcome of future RFA and found that two sequential blocks have similar predictive value but higher costs for two blocks (83). Two RCTs evaluated the therapeutic role of lumbar MBB versus IA LA and steroid injections in the LFJ with one RCT with a moderate risk of bias finding IA injections more efficacious at 3 months after the intervention (80) while the other RCT with a low risk of bias found similar efficacy at 1 month after the interventions (14).

Recommendations

a. When selecting targets for blocks, lumbar facet levels should be determined based on clinical presentation (tenderness on palpation over the facet joints with no or minimal pain over the midline, preferably performed under fluoroscopy). Grade C recommendation, low level of certainty.

b. Lumbar MBB can be used as a diagnostic intervention for LFJ-mediated pain, though healthcare providers should be aware that MBBs suffer from limitations related to aberrant LFJ innervation. Compared with saline controls, medial branch injections with LA provide better predictive information for medial branch RFA with increasing specificity and costs and decreasing sensitivity as the MBBs are repeated. Grade B recommendation, moderate level of certainty.

Good Clinical Practice Statements

a. At least one lumbar MBB with at least 50% pain relief appropriate for the duration of local anesthetic is advised prior to proceeding with RFA.

b. Lumbar MBB injections may be more predictive than IA injections for response to medial branch RFA for LFJ-mediated pain.

Notes: The recently published multi-society guidelines recommend at least one lumbar MBB with at least 50% pain relief to prognosticate pain relief with RFA. While recognizing that using two diagnostic blocks on separate occasions (one block with a shorter-acting LA such as lidocaine and the other with a longer-acting LA such as bupivacaine) may increase the RFA success rate but result in a significant proportion of false-negative procedures and a decreased overall success rate (11). Lumbar facet joint IA injections and MBB have been used to prognosticate the response to RFA. However, IA injections have high technical failure rates as the injectate may extravasate out of the joint and spread to other potential pain generators, resulting in reduced specificity.

iii. Lumbar facet joint medial branch radiofrequency ablation

RFA of the innervation to the LFJs involves creation of a thermal lesion (usually at 80-90°C or higher temperature for 90-150 seconds) along the course of the nerves at the junction of the superior articular and transverse process of the lumbar vertebra.

We found nine RCTs that compared LFJ innervation RFA against either a sham or no procedure (15,84–89) or IA LFJ injection (81,82). Five RCTs with a low-to-moderate risk of bias reported analgesic and functional benefits of RFA of LFJ innervation in comparison to sham procedures at 3 to12 months after the intervention (84,86-89) while two RCTs, both with a low risk of bias, did not find any benefit of the RFA compared to sham intervention (15,85). The two RCTs that compared LFJ innervation RFA against IA injection of LA and steroids reported more (82)

(moderate risk of bias) or similar (81) (low risk of bias) analgesic benefit with RFA at 6 months after the intervention.

Recommendations

RFA of the innervation to the LFJs can provide pain relief for at least 4 months. Grade B recommendation, moderate level of certainty.

Good Clinical Practice Statements

It is recommended that repeat RFA of innervation to the LFJ should be offered to patients who had at least 50% pain relief in a 0-10 pain score from their pre-RFA pain intensity for at least 6 months along with evidence of functional improvement, who experience return of their lumbar pain after a successful RFA. Given the mean duration of benefit and drop-off in success rates noted in some studies with repeat RFA, we recommend no more than two LFJ RFA procedures in a year.

Notes: Pain can recur after a period of time following RFA of innervation to the LFJs. The lower end of the range for this period is around 3 months (12)*. An average of 80% of patients who reported at least 50% pain relief for at least three months have a successful repeat lumbar RFA after an initial successful RFA* (12)*.*

Role of imaging for lumbar facet joint procedures

All the studies included for evaluation of procedures on lumbar facet joints for these guidelines utilized fluoroscopy and or ultrasound for procedural guidance. Though ultrasound has been

validated for guidance for these procedures, accuracy with ultrasound is variable (93), declines with higher body mass index (94), and targets partially obscured by other bones (90).

Good Clinical Practice Statements

Lumbar facet joint injection (medial branch or joint) and RFA should be performed under fluoroscopy as an imaging guidance modality. USG can be used as a primary imaging modality for medial branch and facet blocks in selected patients in whom the required sonographic landmarks can be visualized (e.g. low BMI, absence of post-surgical changes, transitional anatomy or significant degenerative changes). The use of ultrasound for RFA has not been validated in the lumbar spine.

SACROILIAC JOINT PROCEDURES

i. Sacroiliac joint (SIJ) intra-articular and peri-articular (IA/PA) injections

An intra- or peri-articular (IA or PA) injection to the SIJ can be done with the dual purpose of both confirming the diagnosis of SIJ as the pain generator and therapeutic relief. Therapeutic SIJ injections should be considered in patients having moderate to severe chronic pain due to suspected SIJ pathology, despite conservative management. The injectate usually consists of a LA solution and/ or steroid. Confirmation of IA injection needs verification of needle placement and spread of contrast medium using fluoroscopic image guidance. For PA injection, it is important to cover ligaments and soft tissue structures overlying SIJ (26). In a controlled study comparing fluoroscopically-guided IA injections compared to landmark-based injections, significant reductions in pain scores were observed in the fluoroscopy group at 3 months after

the injections compared to the landmark group (20). Use of both fluoroscopy and ultrasound for IA and PA injections is described in literature (27-30).

SIJ injections have a diagnostic role in revealing the joint to be the cause of low back pain. Pain relief with SIJ injections can be predicted with 94% sensitivity and 78% specificity in the presence of three of six provocation physical examination tests for SIJ pain (102).SIJ injections also have a therapeutic role with multiple observational studies (28,98,104) and RCTs comparing a combination of LA and steroids against sham or LA injection (99,100) have reported analgesic benefit from IA or PA SIJ injections of LA and steroids of one to six months after the injections in patients with low back pain suspected to be originating in the SIJ complex. However, the incidence of recurrence of SIJ pain increases as time elapses after a SIJ injection with LA and steroids, from 13% at one month to 42% at six months after the injections (98).

There are no RCTs to evaluate or assess the optimal frequency of these injections for pain relief because existing studies have short duration of follow-up. Frequency and dose of steroid injections are interrelated because the important limiting factors are the efficacy and adverse effects of steroid. There does not seem to be a dose-dependent improvement in using corticosteroid doses beyond 40 mg methylprednisolone equivalents (105). Repeated steroid injections can have cumulative systemic adverse effects by causing osteoporosis, skin and connective tissue changes, and impairing the immune system. Osteoporosis has been associated with a cumulative methylprednisolone dose of 200 mg over a one-year period and 400 mg over three years in post-menopausal women (106,107). Additionally, there can also be adverse effects

due to glucocorticoids after each injection and these include hyperglycemia, hypertension, weight gain, mood changes and reduced immunity (108).

Recommendations

a. For patients with suspected SIJ pain based on appropriate history and at least three provocation tests, IA injections may not have additional diagnostic value. However, IA injections may have diagnostic value in selected patients with less than three positive provocation tests. Grade C recommendation, moderate level of certainty.
b. Both IA and PA injections have similar efficacy in patients with SIJ pain. Based on existing evidence the use of PA or IA injections can be recommended for short-term relief (up to 2 months) from SIJ pain. Grade C recommendation, moderate level of certainty.

Good Clinical Practice Statements

Number of IA or PA injections should be limited to 4 in one year. Any repeat injection should only be offered if IA or PA injection provides significant improvement in pain (≥50% pain relief) and function for at least 3 months and the patient presents with similar pain location, historical symptoms and no change in physical examination.

Notes: Frequency of injections should be based on safety considerations that include the dose of steroid administered in the SIJ and any other steroid injections received by the patient around the same time interval. History of exposure to corticosteroids, including at other injection sites or surgical, should be obtained from any patient prior to a steroid injection.

ii. Sacroiliac joint lateral branch blocks/injections

The innervation to the SIJ is predominantly from the lateral branches of the first three sacral nerve roots (S1, S2, and S3), along with some contribution from the lumbar (L5) dorsal ramus (8%) and the sacral (S4) nerve root (4%) (32). In an RCT on 20 volunteers with a low risk of bias, it was demonstrated that multi-site lateral branch blocks (LBB) can block pain from ligamentous probing in 70% of cases (33). It is likely that lateral branches provide innervation to extracapsular nociceptors.

Based on the paradigm for diagnostic innervation blocks for cervical and lumbar facets, SIJ LBB are considered as a pre-requisite to confirm the diagnosis of SIJ pain with the potential to predict pain relief from RFA of these nerves. Single or dual diagnostic blocks with a positive response being 50% or greater reduction in the intensity of pain are recommended before a therapeutic RFA procedure. A single block can result in a false positive rate of approximately 20% (110). However, no studies comparing outcomes of RFA with or without preceding diagnostic block of SIJ LBB with LA have been published. Though some patients can demonstrate prolonged relief with diagnostic LBB (111), LBB are not intended to provide therapeutic benefit in practice. There is no basis for adding steroid to LA for the conduct of LBB with an expectation of therapeutic benefit.

Recommendations

Repeat LBB (with or without steroid) cannot be recommended as a therapeutic procedure for SIJ pain. Grade D recommendation, moderate level of certainty.

Good Clinical Practice Statements

At least one LBB targeting lateral branches of the S1, S2, and S3 nerves associated with at least 50% reduction in the intensity of pain can be considered to prognosticate the outcome of RFA of innervation to the SIJ. If there is incomplete relief in a patient in whom SIJ is deemed likely to be the source of low back pain, a repeat block involving L5, in addition to S1, S2, and S3 can be considered.

iii. Sacroiliac joint lateral branch radiofrequency ablation (RFA)

Multiple techniques for RFA of the posterior innervation to the SIJ have been described with a variety of cannula types, ablation parameters and cannula placement. Ablation can be achieved with conventional (80-90°C) or cooled (60°C) RFA techniques. Cannulas for RFA can be placed at multiple levels. Although recent cadaveric studies identify lateral branches of S1, S2, and S3 as the main targets, all reported RCTs have targeted L5 medial branches as well, with one RCT targeting S1 to S4 lateral branches (15), and another targeting L4 medial branch as well (34). Both RCTs had a low risk of bias. These nerves can be targeted with multiple monopolar lesioning, cooled RF technology, or a palisade technique with multiple bipolar RF lesions performed to denervate the SIJ (35).

In a case series, cooled RFA was associated with 86% and 48% of subjects experiencing 50% or greater reduction in pain intensity at 6 and over 12 months, respectively (112). Two controlled studies compared cooled RFA with sham treatment in patients with SIJ pain and significant improvement in pain was observed in the treatment group at 1 and 3 months in both studies (34,113). The mean duration of improvement was 5.8 months in one of the studies (34). Another RCT with a moderate risk of bias comparing RFA with IA injection showed better pain

outcomes lasting 3 to 12 months following RFA with bipolar RF technique using a palisade technique (117).

Recommendations

In appropriately selected patients, RFA of S1, S2, S3 lateral branches (using cooled RF, bipolar palisade technique or multiple electrode probe) along with L5 dorsal ramus is recommended for intermediate to long-term pain relief of SIJ pain. Grade B recommendation, moderate level of certainty.

Good Clinical Practice Statement

RFA of innervation to the SIJ should be conducted following a diagnostic block associated with at least 50% reduction in the intensity of pain on a 0-10 pain score.

It is recommended that repeat RFA of innervation to the SIJ should be offered to patients who had at least 50% pain relief in a 0-10 pain scale from their pre-RFA pain intensity for at least 4 months along with evidence of functional improvement and then experience return of their SIJ pain. There is no need to repeat diagnostic block if the patient present with similar pain location, historical symptoms and no change in physical examination signs. Given the mean duration of benefit and drop-off in success rates noted in some studies with repeat RFA, we recommend no more than two SIJ lateral branch RFA procedures a year (i.e., RFA can be performed up to two times a year for pain arising from the same SIJ).

Role of imaging for sacroiliac joint procedures

There is a significant body of literature that demonstrates imaging techniques for SIJ injection are superior to non-imaging techniques in terms of both accuracy and efficacy of SIJ injections (**Error! Reference source not found.**) (20,36,37) Ultrasound may confer equivalent advantages to fluoroscopy for this procedure (30).

Good Clinical Practice Statements

Procedures on the SIJ should be performed under fluoroscopy and/or ultrasound or a combination of both image-guidance modalities to enhance accuracy and safety of these procedures.

LUMBAR EPIDURAL STEROID INJECTIONS

Lumbar epidural steroid injections (L-ESI) involve the injection of steroids, often with LA, into the lumbar epidural space. These injections are performed for lumbar radicular pain (sciatica) and low back pain due to a variety of causes - disc herniation, neurogenic claudication due to spinal stenosis, and scarring following lumbar spine surgery. The rationale for epidural steroid administration is the anti-inflammatory effect of the corticosteroids because the medication is injected close to the nerve roots inflamed due to compression from a herniated disc or stenosis or scarring. Both particulate (methylprednisolone and triamcinolone) and non-particulate steroids (dexamethasone) are used for L-ESI (118).

There are three approaches to inject steroids in the epidural space: interlaminar (between the lumbar vertebra in the midline, transforaminal (in the foramen around the exiting nerve root) and

caudal (through the sacral hiatus). The reported benefits of L-ESI include relief of back and radicular lower limb pain, improvement in physical activity, reduction of analgesic consumption, and improvement of quality of life (119). Although epidural steroids are commonly used for conservative management of radicular lower limb pain, controversies exists about the optimal approach, type and dose of steroid, injectate volume and frequency of administration.

i. Interlaminar epidural injections

The interlaminar approach with a relatively larger volume of injection (5 to 10 cc) allows medication to spread over multiple segments in the epidural space which can be advantageous in case of multi-level spinal pathology. However, the ventral epidural spread of the injectate is limited with L-ILESI compared to the transforaminal approach and this can curtail the therapeutic effect in case of ventral pathology causing nerve irritation (38).

We found eight RCTs (120–127) on the use of L-ILESI for low back pain or radicular limb pain due to herniated disc or spinal stenosis. Five of these RCTs compared I-LESI against LA or saline or a sham injection with all five RCTs reporting analgesic benefit and or functional improvement from ILESI for one to three months after the injection (120,121,123, 124,126). Two of these RCTs had a low risk of bias (120, 123), one RCT had a moderate risk of bias (121), and the other two RCTs had a high risk of bias (124, 126). Only one RCT with a high risk of bias investigated the effect of L-ILESI with LA versus LA only for predominantly LBP with significantly lower pain intensity scores and better physical function in the steroid group at all study follow-ups up to 12 months after the procedures (125).

Two RCTs evaluated the effect of lumbar epidural steroid injections for low back and radicular pain secondary to lumbar spinal stenosis. In the first RCT with a low risk of bias, epidural (interlaminar or transforaminal) steroid injections with LA were compared against epidural LA injections only in 400 patients. Both groups showed an improvement in function and a reduction in leg pain but ESI with LA group was superior to the LA group only at 3 weeks. However, more patients in the ESI with LA group reported being somewhat or very satisfied with the treatment as compared to the LA only group (122). The second RCT with a high risk of bias assessed the benefits of adding LA to ESI as compared to ESI combined with saline in 29 patients with intermittent claudication and radicular pain due to spinal stenosis who received fluoroscopy-guided epidural injections. Pain intensity scores reduced and physical function improved in both groups but there was no difference between the two groups at 1 and 3 months after the procedures, suggesting a lack of benefit of adding LA to ESI (127).

We also found two systematic reviews that evaluated the evidence for effectiveness of L-ILESI for low back pain and/or radicular pain that concluded that there was no evidence for effectiveness for L-ILESI in treating primarily axial pain regardless of etiology. However, most studies on radicular pain due to lumbar disc herniation or stenosis showed significant short-term (one to three months) reduction in pain (38,119).

Recommendations

a. For the treatment of discogenic low back pain, the evidence for L-ILESI is weak. Healthcare providers and patients should discuss the balance of benefits and harms of this intervention before making a decision. Grade C recommendation, low level of certainty.

b. For the treatment of sciatica (radicular pain) secondary to herniated disc or from spinal stenosis, the evidence for ESI suggests that L-ILESI can offer a mild-to-moderate, short-term reduction in pain and improvement in function from one to three months. Grade C recommendation, moderate level of certainty.

ii. Transforaminal epidural injections and selected nerve root blocks

Lumbar transforaminal epidural steroid injections (L-TFESI) involve the injection of LA and steroid in the anterior ventral lumbar epidural space through the foramens for exiting nerve roots between the vertebrae. This technique targets specific nerve roots under fluoroscopy-guidance and delivers the steroids directly at the presumed site of pain generation, specifically the inflamed nerve root (39). The indication for L-TFESI is radicular pain due to an inflamed nerve root caused by mechanical compression of the nerve roots by herniated disc (disco-radicular conflict) or foraminal stenosis (due to facet hypertrophy or disc disease).

We found five RCTs that compared that evaluated the effects of L-TFESI for radicular pain due to disc herniation or foraminal stenosis against a variety of comparators (medical management (131), transforaminal LA injection only (132,133,135), and I-LESI (134). L-TFESI were associated with lower pain intensity and improved physical function at one to six months after

the intervention (131,133,134,135) and a lower incidence of discectomy operation up to 28 months (132). Two of these RCTs had a low risk of bias (132,133) and the other RCTs had a high risk of bias (131,134,135).

Recommendations

a. For the treatment of sciatica due to herniation of an intervertebral disc compressing the nerve root, L-TFESI can provide pain relief for up to six months and reduce the need for surgical procedures. Evidence indicates that L-TFESI are more effective than L-ILESI. Grade B recommendation, moderate level of certainty.
b. For the treatment of sciatica due to spinal foraminal stenosis, the evidence is insufficient to make a recommendation. Grade I recommendation, low level of certainty.
c. For the treatment of sciatica due to spinal canal stenosis, L-TFESI can provide pain relief from one to three months. Grade C recommendation, moderate level of certainty

iii. Caudal epidural steroid injections

Caudal epidural steroid injections (C-ESI) involve the injection of steroids, usually with LA, into the caudal epidural space through the sacral hiatus. These injections are performed for low back pain and/ or sciatica that is suspected to arise from a lumbar disc prolapse, especially in the setting of previous lumbar spine surgery. These injections are performed only for therapeutic indications. Anatomic landmarks, fluoroscopy, ultrasound or a combination of these modalities have been used to guide these procedures. These injections can be offered to patients with severe radicular pain and technical difficulties in performing interlaminar or transforaminal approach (e.g., previous lumbar spine surgery or severe degenerative lumbar spine disease) (40).

Three RCTs investigated the effect of C-ESI against sham interventions or LA only in patients with radicular pain in the lower limb secondary to a herniated disc pressing on the nerve roots. Two of the three RCTs, one with a high risk of bias (136) and the other with a low risk of bias (137) did not report analgesic benefit with C-ESI beyond four weeks (136, 137) while the third RCT with a low risk of bias reported pain relief and better physical function with C-ESI at three months after the intervention (138).

Recommendation

There are no recommendations for this procedure.

Good Clinical Practice Statements

C-ESI can be used as a therapeutic intervention for disc-related radicular pain in the lower leg, but the evidence is weak and only indicates short-term improvement. The caudal route can be used in case of technical difficulties accessing the epidural space by interlaminar or transforaminal approaches.

Notes: The caudal approach to epidural space should only be offered to patients with severe radicular pain when there are technical difficulties in performing interlaminar or transforaminal approach (e.g., previous lumbar spine surgery or severe degenerative lumbar spine disease).

Role of Imaging for lumbar epidural steroid injections

Studies that evaluated use of anatomic landmarks to determine the intervertebral level of spinal epidural injections found 35% probability of anatomic landmarks being incorrect (141,143). Studies that examined the accuracy of anatomic landmark-guided epidural injections found almost 50% incidence of the needle not being in the epidural space when caudal epidural space was accessed using anatomic landmarks (144-151) and 7-30% incidence of the needle not being in the epidural space when lumbar epidural space was accessed using anatomic landmarks (148, 151-156). Transforaminal ESI should always be performed under fluoroscopic guidance but, to improve the safety of transforaminal injections, real-time fluoroscopy during injection, digital subtraction angiography, and oblique views may enhance safety (McLean 2009, Jeon and Kim 2018, El Abd 2014, Lee 2010, Kim 2013, Hong 2014, Park and Kim 2019, Hong 2019, Kim 2015). Use of real-time fluoroscopy and digital subtraction imaging allow visualization of needle advancement, contrast distribution, allowing for modifications to improve accuracy and reduce complications (162-164).

Good Clinical Practice Statements

a. Fluoroscopic guidance for epidural injections through interlaminar and transforaminal routes should be used because it greatly improves accuracy and safety versus anatomic-landmark guided injections. It ensures procedures at the correct vertebral level, mitigates the risk of injection into non-epidural compartments especially in patients with spinal pathology, and allows visualization of injectate flow.

b. For caudal epidural, the use of fluoroscopy guidance is recommended. Given the limited access of fluoroscopy in the community, the use of ultrasound guidance to locate the sacral hiatus may be acceptable.

Notes: Real-time fluoroscopy and or digital subtraction imaging during epidural injections can further enhance accuracy and reduce complications.

Frequency of lumbar epidural injections through interlaminar / transforaminal / caudal routes

There is evidence to support the frequency of lumbar epidural steroid injections. In the diagnostic phase (acute setting, to identify an inflamed nerve root) a patient may receive 2 procedures at intervals of no sooner than 2 week or preferably 4 weeks. In the therapeutic phase (chronic pain setting) the suggested frequency should be 2 months or longer between each injection, provided that 50% or greater pain relief is obtained for 2 months (129,130).

Good Clinical Practice Statements

In the diagnostic phase (acute setting, to identify an inflamed nerve root) a patient may receive 2 lumbar epidural injection procedures at intervals of no sooner than 2 weeks or preferably 4 weeks. In the therapeutic phase (chronic pain setting) the suggested frequency should be 2 months or longer between each injection, provided that 50% or greater pain relief is obtained for 2 months.

PARAVERTEBRAL NERVE AND ERECTOR SPINAE PLANE INJECTIONS FOR CHRONIC PAIN

Paravertebral nerve injections

A paravertebral nerve block (PVNB) is an interventional technique where an injectate of LA, with the possible addition of adjuvants (e.g., steroid) are deposited just adjacent to the thoracic spine within the paravertebral space. This space is bordered posteriorly by the costotransverse ligament, medially by the vertebral body, and anterolaterally by the parietal pleura (41). A PVNB is believed to result in a conduction block of exiting nerve roots and sympathetic nerves at that level with possible spread to the adjacent levels above and below the site of injection, through the epidural space. It also needs to be clarified that injections of local anesthetics in the paravertebral muscles (trapezius, multifidus, erector spinae) are not paravertebral nerve injections. Historically, PVNB block has been primarily performed for perioperative pain control after surgery but has also been performed widely for acute and chronic pain management

PVNB can be used for chronic pain disorders involving the thoracic spine or chest wall. However, there is a paucity of studies documenting their safety and efficacy. Given the anatomical location of the procedure, patients are at risk of complications such as pneumothorax, particularly without image guidance. Two studies were identified in the systematic search, an RCT and an analysis of health administrative data (166,167). The RCT, assessed at a low risk of bias, sought to evaluate the preventative effects of a thoracic or lumbar PVNB performed with the assistance of a nerve stimulator during the initial phases of a herpes zoster infection on the development and intensity of post-herpetic neuralgia (166). Repeated paravertebral blocks every 48 hours for one week during the initial stages of herpes zosters significantly reduced pain associated with post-herpetic neuralgia up to 1 year after the procedure. The second study was a retrospective cohort study that identified patients in Ontario, Canada who had received "paravertebral injections" for back pain using provincial billing codes from July 2013 to March

2018 (167). Opioid consumption was obtained from 33,821 patients, and an analysis did not indicate that paravertebral injections reduced opioid use. This result should be viewed within the context that 49% of patients in this cohort obtained between 1 and 9 repeat paravertebral injections, with 26% of patients receiving 10 or more injections. Furthermore, the number of speciality physician visits in the study cohort increased significantly from the 1-year prior to the injections to the 1-year post injections (2.92 ± 3.61 versus 9.64 ± 11.77 visits). Of note, it is unclear the identity of the anatomic structures targeted by these injections. Given the general lack of imaging or nerve stimulator guidance for these injections in Ontario (CPSO, 2023), it appears the injections were essentially trigger point injections in the paravertebral tissues.

Recommendations

a. PVNB can be used for thoracic back or chest wall pain disorders. However, there is a paucity of studies documenting their safety and efficacy. Given the anatomical location of the procedure, patients are at risk of complications such as pneumothorax, particularly without image guidance. PVNB can be performed for the prevention of post-herpetic neuralgia during the acute phase of herpes zoster; Grade C recommendation, low level of certainty.
b. Paravertebral injections should not be performed for the treatment of chronic back pain; Grade D recommendation (harms outweigh benefits), low level of certainty.

Erector Spinae Plane Injections

Erector Spinae Plane (ESP) block was first described in 2016 (42). It consists of an injection of local anesthetic in the fascial plane between the erector spinae muscle group and the transverse processes of the vertebrae. The erector spinae muscle group is a group of muscles that run along

the length of the spine, providing stability and movement to the back. The block can be done at the cervical, thoracic, and lumbar levels. ESP has been mostly well-studied in the perioperative setting to reduce pain after surgery, with few investigations into chronic pain disorders. ESP block has been growing in popularity given the ease of performing the procedure and the reportedly low complication rate. The analgesic mechanism is uncertain but it is believed that local anesthetic from the ESP spreads into the thoracic paravertebral space and exerts an effect on neuraxial spinal structures (nerve root, dorsal rami). There also seems to be a myofascial relaxant effect; and with larger volumes, the injectate can spread into the epidural space (43). ESP blocks must be performed under ultrasound guidance to avoid complications. The ESP block has similar complications compared to other types of regional anesthesia, but there is a potential increased risk of local anesthetic toxicity from the absorption of large volumes of local anesthetics that are injected in the fascial plane. However, the rate of complications is estimated to be 2/10,000 patients (44). Potential complications include pneumothorax, motor weakness or motor blocks (particularly in high-volume injections), and local anesthetic toxicity.

The evidence for ESP blocks for chronic pain has been limited generally to anecdotal reports and to studies of limited quality. ESP blocks used in patients with a diagnosis of myofascial pain syndrome reduced pain intensity in two observational studies (168, 169).

Recommendations

No recommendations can be provided at this time because of a lack of evidence; Grade I recommendation.

PRACTICE ASPECTS RELATED TO SPINAL PROCEDURES TO RELIEVE PAIN

These statements are listed in **Error! Reference source not found.**.

Training and credentialing requirements

Given the potential for significant harm if suboptimal techniques are used and for preventing complications, only physicians or surgeons who have been trained in a formal academic training program for pain interventions for at least 12 months should perform these interventions. It is recommended that physicians/surgeons gain expertise with lumbar procedures before starting to perform cervical procedures. The introduction of Pain Medicine residency training in Canada (Morley-Foster 2014, Morley-Foster 2015) and the competence by design approach to assessment mandates a 12 to 24 months of training in Pain Medicine in multidisciplinary settings to ensure physicians understand the role of image-guided interventions within a multimodal approach (Miller 2024). Similar duration of training is also required for gaining certification in Pain Medicine in other countries (Training and Curricula, Faculty of Pain Medicine, UK; Pain Medicine Training Program, ANZCA). There is also good evidence to suggest a minimum of 30 procedures (for each technique) are required to attain proficiency (Pekkafahli 2003). Assuming a trainee trains in a procedure suite one day per week with hands on-exposure to eight procedures per day under the supervision of a mentor, around 48 working weeks will be required to become proficient in 12 different procedures. For physicians unable to access the Pain Medicine residency training of the Royal College of Physicians and Surgeons of Canada, Pain Medicine fellowship training programs for a minimum of 12 months at academic centres in the Canada, or an Accreditation Council for Graduate Medical Education recognized Pain Fellowship program in the United States of America may be an option (CPSO).

Physicians training in interventional pain procedures should track their progress by maintaining a record of the procedures performed (Assessments and Logbook. Faculty of Pain Medicine, UK; Pain Medicine Training Program, ANZCA) and specify whether the procedure was performed independently, under supervision, or required assistance from the trainer. These records provide trainees an objective and measurable record of their progress. At the end of their training, physicians should also consider gaining certification in interventional pain procedures offered by international pain organizations (Fellow of Interventional Pain Practice; Certified Interventional Pain Sonologist Examinations).

Good Clinical Practice Statement

A minimum of 12 months in clinical and interventional pain management is necessary to gain proficiency in commonly performed interventional axial procedures for pain.

Corticosteroid dose and safety in axial interventions for pain

Corticosteroids are commonly used in spine pain interventions. Corticosteroids have several purported mechanisms that primarily results in an anti-inflammatory effect which is mechanistically therapeutic especially when considering that damaged intervertebral discs result in release of various inflammatory mediators that trigger inflammatory cascade in the epidural space (173). As a result, repeated ESIs became more common in practice (174). However, there has recently been an increased body of literature surrounding the detrimental effects of corticosteroids that should influence practitioners on how much and how frequently corticosteroids are injected.

Several guidelines exist to guide practitioners on the frequency of ESI including those from the American Society of Interventional Physicians (ASIPP), North American Spine Society (NASS), World Institute of Pain (WIP) epidural safety working group, and Spine Intervention Society (SIS). ASIPP guideline from 2021 recommend 2 ESIs at intervals no sooner than 2 weeks and preferably 4-6 weeks for the diagnostic phase (175). Frequency of interventional technique is recommended to be 2.5 to 3 months or longer between each injection, to a maximum of 4 times per year per region (175). NASS working group in 2013 recommended no more than two injections be used to attempt to achieve a beneficial response in the first instance (176). NASS recommended to use up to three injections in a six-month period to reinstate and maintain benefit once it has been achieved. WIP group in 2018 recommended repeat injection within 3 months can provide cumulative benefit and that repeat ESI may be performed for recurrence of radicular pain (177). Recommendations made by these groups were made primarily based on efficacy of ESIs and not on the detrimental systemic effects of corticosteroid use. SIS has published several Fact Finder documents related to the topic that summarizes much of the recent literature from a safety standpoint on the frequency of ESIs, annual maximum dose of corticosteroid injection, and cumulative lifetime corticosteroid exposure (178–180).

Common acute systemic adverse effects of corticosteroid use include suppression of the hypothalamic pituitary adrenal (HPA) axis, hypertension, and hyperglycemia. HPA suppression occurs in most patients who receive ESIs and most patients fully recover within 2-4 (181–183). HPA suppression can lead to numerous non-specific symptoms including weakness, fatigue, malaise, nausea, abdominal pain, and headache (185). Hyperglycemia is generally well tolerated for non-diabetic patients and it is usually resolved within 14 days (187–190). However, further hyperglycemia in patients with pre-existing diabetes may compromise patient's immune system

and increase risk of infection (191). Systolic blood pressure has been noted to increase and generally resolve within 3 weeks (193). Clinically, the degree of elevated blood pressure likely has limited systemic effects in healthy individuals unless there is pre-existing cardiovascular disease. Care must be given to corticosteroid use in patients whose cardiovascular disease may worsen following increased systemic blood pressure such as history of congestive heart failure, coronary artery disease, and aortic valvular regurgitant lesion. Rare adverse systemic effects of corticosteroids also include psychiatric complications, ocular complications, corticosteroid-induced myopathy, osteoporosis, and epidural lipomatosis (172).

Evidence on oral corticosteroid use indicates it leads to early and rapid bone loss and the risk of fragility fracture increases after the first dose of corticosteroids (194). Fractures associated with osteoporosis lead to impairment in mobility and an increase in mortality. Major risk factors for osteoporotic fractures are female sex, old age, lower bone mineral density (BMD), and history of previous factures (195). Patients with low back pain may have lower BMD because they engage in less physical activity (172). Dubois et al. reported there was an absence of a relationship between cumulative epidural corticosteroid use and BMD in health men and women treated with at least 3g of methylprednisolone (196). However, post-menopausal women have been found to be particularly at risk for significant decrease in hip and spine BMD after ESI (107,197). A systematic review of this topic noted that significant reductions in BMD were associated with a cumulative methylprednisolone dose of 200 mg over a one-year period and 400 mg over three years, but not in doses of less than 200 mg of MP equivalents for postmenopausal women (198).

Practitioners must also consider other sources of corticosteroids that patients can receive. Commonly performed pain procedures apart from epidural, facet, and sacroiliac joint injections that "often" include corticosteroid use (vs. rare or never) in a survey to the American Society of Regional Anesthesiologists and Pain Medicine and American Academy of Pain Medicine include 46% in radiofrequency ablation, 43% in peripheral nerve blocks, and 42% in trigger points (201). In addition, patients may receive corticosteroid injections for arthritic peripheral joints (i.e. knees, hips) or for headaches by other practitioners. Medical conditions requiring persistent corticosteroid use include asthma, inflammatory bowel disease, and other rheumatological conditions can also contribute significant corticosteroid burden to patients and result in greater risk of osteoporosis and fragility fractures.

Good clinical practice statements

Corticosteroid doses equivalent to a maximum of 200 to 320 mg of methylprednisolone over a period of 12 months can be utilized for axial interventions to relieve pain (epidural steroid or nerve root or facet joint or sacroiliac joint injections). Reduction in bone mineral density with an increase in risk of osteoporotic fractures may occur with annual doses of greater than 200 mg of methylprednisolone in postmenopausal females and this dose should be the upper limit in this population.

Notes: Practitioners must take into consideration lifestyle (smoking, alcohol intake, and exercise), medical comorbidities and other sources of exposure to corticosteroids and have an informed discussion with their patients about the anticipated benefits and risks.

Standards of sterility for axial interventions for pain

The risk of infection is a feared complication of any procedural intervention. The use of steroids as part of injectates poses an additional theoretical risk as it may adversely affect the immune response. Infectious complications of any axial intervention include abscess of the spinal (subdural or epidural space) and surrounding muscles, meningitis, encephalitis, discitis and osteomyelitis (202). The latest data from a large national database demonstrates an incidence rate of 5.4 per 10,000 persons and 1.0 cases per 10,000 infections (0.01%), representing one deep spinal infection per 10,000 outpatient single-shot epidural injections (203).

Patients affected by complications from procedures performed by a single interventional pain physician have been reported in Canada (206). In this report, deficiencies in the use of practitioner masking, antisepsis use, sterile field coverage, maintenance of sterile equipment in sterile setting, and hand hygiene led to multiple serious infectious complications including meningitis. Given these risks, procedural sterility and infection prevention is paramount when performing spine interventions. Extra caution should be reserved for patients who are immunosuppressed. There are limited randomized controlled studies on sterility and infection prevention but several relevant medical societies have publications on this topic.

Hand Hygiene

Hand hygiene relates to the removal of visible soil and removal or killing of transient microorganisms from the hands while maintaining good skin integrity (207). Alcohol-based hand rub (ABHR) is the preferred method to routinely decontaminate hands in clinical situations when hands are not visibly soiled. Jewellery and watches should be removed prior to engaging in hand hygiene and should not be worn during the procedure. Soap and water should be used when hands are visibly soiled. Handwashing with soap and water should include rubbing hands vigorously for at least 15 to 20 seconds, covering all surfaces of hands and fingers.

Wearing gloves for medical procedure is recommended by professional medical societies and regulatory bodies such as Centers for Disease Control & Prevention (CDC) and the Food and Drug Administration (FDA) in the United States of America (208). Given the gravity of complication in spine intervention procedures, the practice advisories from the American Society of Anesthesiologists (ASA), American Society of Regional Anesthesia & Pain Medicine (202), as well as the Spine Intervention Society (211) are clear to support the use of sterile gloves for axial spine procedures.

Personal Protective Equipment

Mask

Outbreaks of bacterial meningitis among patients undergoing various spine procedures some years ago have raised the concern and investigation by the CDC. The strain of bacteria isolated from the CSF of patients with meningitis was identical to the strain recovered from the oral flora of the healthcare providers who performed the procedure (213–215) and some procedures were performed by a healthcare provider who did not wear a face mask (213). The risk of these infections can be reduced by wearing a facemask (216). The Health Infection Control Practices Advisory Committee (HICPAC) and American Society of Anesthesiologists (ASA) recommended that wearing of masks covering both mouth and nose for spinal procedures (217,218). Any proceduralist and others should wear a mask including others who are in close proximity to the injection site or injection material (213,217,218).

Gown

The Center for Disease Control (CDC) recommends that gowns should be used during procedures and patient-care activities when contact of clothing or exposed skin with blood or bodily fluids is anticipated (213). This level of contact is generally not the case for common interventional procedures for spine pain.

Cap

No cases of infection have been identified to originate from the scalp or hair flora in interventional spine procedures for pain. Providers may consider wearing caps especially given that fact that caps are low cost and there are no expected side effects from wearing them (219).

Imaging Equipment

All ultrasound transducers should be cleaned (wiped of obvious debris) between patients (220) All transducers in external procedures, such as percutaneous spine intervention procedures, should be cleansed with low-level disinfectants (LLD) and be used in conjunction with a single-use transducer cover. The LLD is usually achieved with a commercial chlorhexidine disinfectant wipe (221) Sterile single use gel packets should be used for acoustic coupling for image-guidance for axial procedures with percutaneous insertion of needle. Care should be taken to avoid the fluoroscopy C-arm touching the patient or the interventionalist's hands to minimize contamination of the sterile field (222).

Antiseptic Solution

Common solutions utilized to disinfect clean intact skin are povidone-iodine (PVI) and chlorhedixine gluconate (CHG) and the latter is available as either an aqueous or alcohol-based

solution. Solutions with CHG has many advantages over PVI: faster onset, longer duration of action, few incidence of skin reactions, better penetration and adhesion to the stratum corneum skin layer, and better efficacy in a blood-contaminated surgical field (223). Further, CHG 2% in alcohol 70% has consistently been associated with superior reduction of surgical site infections in systematic reviews and meta-analyses (224,225). The use of CHG 2% in alcohol 70% is widely endorsed by pain societies (The American Society of Regional Anesthesiologists, American Society of Anesthesiologist, Association of Anaethetists of Great Britain & Ireland, and Spine Intervention Society) and global health bodies (Center for Disease Control in the United States of America and the World Health Organization) recommend the use of chlorhexidine in alcohol for skin antisepsis because of its superior effectiveness and speed of application (13,202,226,227). Concerns have arisen due to risk of neurotoxicity, including arachnoiditis, following the use of chlorhexidine in alcohol with central neuraxial blockade. The use of 0.5% chlorhexidine in 70% alcohol has been proposed as the safest compromise between the risk of infection and the risk of neurotoxity (226). Providone-iodine in alcohol is a reasonable alternative to chlorhexidine in alcohol prep for patients sensitive to CHG (228).

Directions for using the CHG 2% in alcohol 70% include: systematically paint (not scrub) the area for 30 seconds or 2 minutes for moist sites, paint in a direction of sterile to unsterile, avoid solution pooling, allow at least 3 minutes for complete drying (229). Procedure equipment and medications should be kept away from antiseptic solution and it should be covered until the patient's skin has been prepared with antiseptic (13).

Procedure Equipment

Any equipment and its attachments that has penetrated the skin should be considered potentially contaminated. This includes syringes, needles, and intravenous tubing. When the needle and a syringe are used as a unit, contamination extends to the syringe when injections are administered (230). Skin infiltration needles, syringes, spinal needles, and other disposable single use items that come in contact with the patient should be discarded at the end of the procedure. Critical items as classified by the Spaulding system are ones that enter sterile tissue or the vascular system and should be sterile prior to use (e.g., radiofrequency probe) (207).

Good Clinical Practice Statements

a. A physician performing spine interventions should apply an alcohol-based hand rub to decontaminate hands when hands are not visibly soiled. Handwash with soap and water should be used when hands are visibly soiled. Sterile gloves should be worn for spine interventions. The proceduralist and others including those who are in close proximity to the injection site or injection material should wear a mask.

b. Providers may consider wearing caps during procedures especially given that fact that caps are low cost and there are no expected side effects from wearing them. Gowning is not necessary for most of the spine intervention procedures except advanced procedures that require lengthy access to the epidural space, such as percutaneous stimulator insertion, intrathecal pump insertion and discography.

c. The procedure site should be prepped with chlorhexidine-alcohol mixture. Providone-iodine in alcohol is a reasonable alternative to chlorhexidine in alcohol prep for patients sensitive to chlorhexidine. Chlorhexidine should be applied systematically for 30 second (2 minutes for

moist sites), while avoiding solution pooling and allowing at least 3 minutes for complete drying.

d. For percutaneous spine intervention procedures under ultrasound-guidance, the probe should be cleansed with low-level disinfection and used in conjunction with a single-use transducer cover. Care should be taken to avoid making contact with the fluoroscopy C-arm to minimize contamination of the sterile field. The C-arm should be appropriately covered to protect the integrity of the sterile field in higher risk procedures (e.g., spinal cord stimulator or intrathecal pump insertion).

Image-guidance for Spine Interventions

Image-guided spinal injections are commonly performed in patients to decrease pain severity, confirm the pain source, and delay or avoid surgery (231). By utilising fluoroscopy, the interventionalist can determine the accuracy of needle placement and also understand the pattern of injectate flow (231). Additionally, a targeted injection can improve the effectiveness and the steroid dose can be decreased, minimising its potential short- and long-term adverse effects (233,234). Image guidance has also allowed enhanced accuracy for a number of procedures, including epidural injections through different routes (interlaminar, transforaminal, caudal), nerve root blocks, facet joint injections, sacroiliac joint injections, and local injection for spondylolisthesis secondary to pars interarticularis defects (235).

Although the importance of fluoroscopy guidance for epidural steroid injection has been clearly emphasized a few decades ago, (236) many clinicians still perform this technique “blindly”, also

called anatomic-landmark guidance. A recent survey in Canada revealed that only 52% of providers performed spine interventions with image guidance (8). Besides fluoroscopy, other imaging modalities such as computed tomography (CT) and ultrasound have been adopted for image-guided spine intervention (237,238). The rationale of using image-guidance for spine intervention are to improve the accuracy and enhance safety.

The World Institute of Pain's Working Group on Infection Prevention suggested possible safety measures to prevent major neurologic injuries with epidural steroid injections. As they concluded that the chance of a vascular puncture at the lumbar level is between 8% and 15.5% (21.3% at S1) and at the cervical level 19.4%, they deemed the use of fluoroscopy with real time contrast administration while performing epidural injections as mandatory (177). Additionally, for the transforaminal approach they recommended to approach the inferior part of the neuroforamen, especially above L3, as the artery of Adamkiewicz rarely traverses this part of the foramen (Kambin triangle) (177). For further safety, apart from the anterio-posterior fluoroscopic image the working group suggested at least one lateral view or contralateral oblique and injection of contrast (177). In their recommendations there was no final decision regarding DSA due to unclear extent of prevention and higher radiation exposure (177).

The American Society of Interventional Pain Physicians (ASIPP) issued guidelines for epidural interventions in the management of chronic spinal pain. They suggested an algorithm for the management of chronic low back, neck, and thoracic pain, where all the epidural procedures should be performed under fluoroscopy, according to the evidence assessment based on contemporary practice (175). Regarding facet joint injections, the same society recommended fluoroscopic or computed tomography (CT) guidance for all facet joint interventions (level of

evidence is I with strong strength of recommendation). Similarly, consensus opinion from a multidisciplinary working group and national organizations supports the use of fluoroscopy guidance for all interlaminar epidurals, while transforaminal may need an adequate DSA imaging (243). Further, Furman et al. recommended the contralateral oblique combined with anterior-posterior view during fluoroscopy because it provides multi-planar imaging and should be considered when a lateral view is unable to demonstrate target landmarks clearly for all level spinal procedures (cervical, thoracic, and lumbar interlaminar procedures) (244). The contralateral oblique view at 45 degrees in the lumbar spinal epidural access was also supported by Gill et al. due to better visualization of the needle tip, of the important radiological landmarks and a more precise relationship of the needle tip to these landmarks (245).