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Stellate ganglion block as an adjunct in cancer pain management: mechanisms, evidence, and clinical applications

Abstract

SGB (SGB) – a peripheral sympathetic chain intervention, administered at the level of cervical vertebrae (C6-C7) has emerged as an important adjunctive therapy for the management of pain in patients with cancer, especially those whose tumors are located in the head/neck or upper extremity. Pain from cancer often comprises more than one component including nociceptive, neuropathic and sympathetically mediated. These components of pain may not respond adequately to standard pharmacological therapies. The interruption of sympathetic efferent flow via SGB can influence pathways of aberrant pain transmission, improve regional blood flow and relieve refractory pain syndromes. Historically, SGB was primarily utilized in complex regional pain syndrome, but it is now being investigated in oncology due to its potential to reduce opioid requirements and enhance quality of life. This article will provide an overview of the evolving role of SGB in the management of cancer-related pain, including current evidence, indications and clinical considerations.

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Anatomy

Gross anatomy and morphology

The stellate ganglion—also known as the cervicothoracic ganglion—forms from the fusion of the inferior cervical and first thoracic sympathetic ganglia.[1] It typically lies ventral to the longus colli muscle, dorsal to the vertebral artery, and superior to both the apical pleura and the subclavian artery near the origin of the internal thoracic artery.[2] The ganglion is situated anteroinferior to the ventral rami of the C8 and T1 spinal nerves and anteroinferior to the neck of the first rib, medial to its tubercle (Figure 1).[2] Gross morphology of the stellate ganglion is variable; a minority of specimens show histologically discontinuous structure, suggesting that reliance on gross examination alone may overestimate the true prevalence of ganglionic fusion.[3]

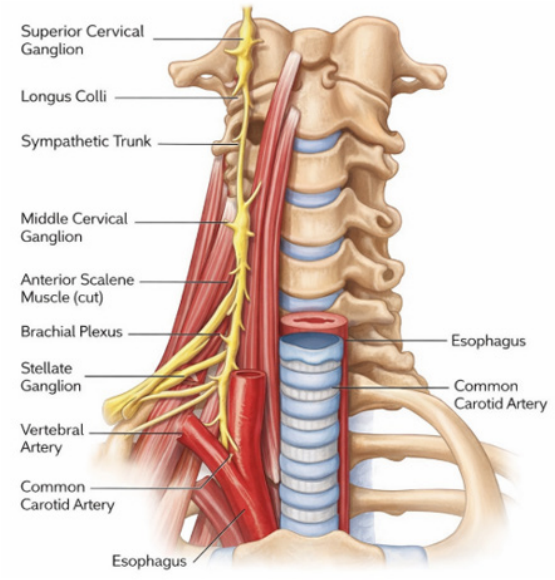

Figure 1 Anatomy of Stellate Ganglion (Created using OpenAI with author input.)

Imaging and clinical relevance

Advanced three-dimensional magnetic resonance imaging at 3.0 T has improved visualization of the stellate ganglion and its surrounding structures, including the vertebral artery, subclavian artery, brachial plexus, and cervical pleura.[2] These images show that the stellate ganglion is oriented obliquely in the anteroposterior plane, positioned just above the apical pleura, with angulated relationships relative to the vertically ascending vertebral artery.[2]

These anatomical relationships have important clinical implications for performing SGBs. Targeting the stellate ganglion at the T1 level may permit a more direct needle trajectory but carries an increased risk of pneumothorax, as the apical pleura can extend cranially to the level of the subclavian artery near the first rib.[2] As such, lower cervical levels (C7 or C6) are typically targeted for performing SGBs. Notably, the vertebral artery is vulnerable at the C7 level where the anterior tubercle of the transverse is typically absent.[2] In contrast, the vertebral artery is largely covered by the overlying anterior tubercle of the transverse process at the C6 level, which thereby represents a safer option.

Indications in cancer pain

Head and neck cancer (HNC) is the seventh most common malignancy worldwide and accounts for approximately 325,000 deaths annually.[4] Pain represents the most frequent presenting symptom in 20% to 50% of patients with cancer overall, with reported prevalence rising to as high as 85% among individuals with HNC.[5] While high-quality evidence exists for CRPS, data in cancer pain remain heterogeneous and indication-specific. There are reports in the literature concerning perioperative pain, chronic post-operative pain syndromes, cancer-related lymphedema, vasomotor symptoms in cancer survivors and central cancer pain, all of which vary in terms of their strength of evidence. A systematic review of 12 RCTs indicates that SGB significantly reduces the pain intensity associated with head and neck cancer, with a weighted mean difference (WMD) of −6.24 mm on VAS relative to controls.[6] There is evidence of high degree of pain relief with low incidence of adverse events in a large retrospective analysis of 809 ultrasound-guided SGB procedures performed in 105 patients with CRPS and related neuropathic pain

disorders.[7] Across cohorts, 61% of patients with CRPS reported >50% pain relief after SGB, and 85% of responders maintained some level of pain relief for 1-4 weeks or longer.[8] Given the established efficacy of stellate ganglion block in alleviating sympathetically mediated pain in complex regional pain syndrome, it is plausible that similar mechanisms may underlie its emerging utility in managing cancer-related pain syndromes of the head and neck and breast. Prospective studies have confirmed that SGB achieves clinically significant median pain relief and identify pain phenotype as the only predictive factor of successful treatment outcome.[9] As such, the American Academy of Pain Medicine recommends SGB as part of a multi-disciplinary approach to treating CRPS, especially when used in conjunction with active physical rehabilitation.[10]

Perioperative and acute cancer pain

There are multiple reports of the use of SGB in perioperative settings. A meta-analysis of 10 randomized trials (ultrasound-guided SGB) concluded that there were statistically greater proportions of patients who had clinically significant postoperative pain relief with SGB than with controls (Relative Risk = 7.81; 95% CI, 5.43 – 10.19), and fewer opioids consumed, and improved quality of life.[11] Preoperative SGB has also been associated with reduced postoperative acute pain and reduced opioid usage in patients undergoing surgery for breast cancer, and similar benefits have been reported with transoral robotic surgery for oropharyngeal carcinoma.[12,13] In a pilot study, Sharbel et al. reported reduced postoperative pain and reduced opioid use in patients undergoing lateralized head and neck cancer procedures.[14]

Chronic post-surgical pain syndromes

The chronic post-surgical pain syndrome (PMPS) represents the most well-studied chronic cancer pain condition treated with SGB. A randomized trial comparing pulsed RF with RFA of the stellate ganglion showed that RFA provided better pain scores, reduced opioid/pregabalin usage and increased sustained pain relief from one week to six months.[15] In subsequent work, Thabet et al. showed that chemical neurolysis with alcohol was superior to RFA in patients with chronic PMPS, and therefore provides additional support for neurolytic approaches in carefully selected patients with refractory symptoms.[16] The NCCN Guidelines for Survivorship provide evidence for the use of SGB as an interventional approach to treat upper limb post-amputation pain syndrome in cancer survivors, thus extending its application beyond PMPS to include other post-surgical neuropathic pain conditions in this population.[17]

Breast Cancer–Related Lymphedema: BCRL has emerged as a new indication for SGB, and is supported by an increasingly large number of controlled studies. A randomized controlled trial of 38 patients demonstrated that SGB resulted in decreases in arm circumference and quality of life comparable to Complete Decongestive Therapy (CDT).[18] A retrospective matched cohort study of 60 patients demonstrated that SGB resulted in equivalent or greater reductions in upper arm circumference than CDT.[19] Choi et al. demonstrated that thoracic sympathetic ganglion block resulted in positive responses in 65.7% of 35 patients with BCRL, and that the efficacy of SGB was greater in patients with more severe disease.[20] Additionally, Seo et al. demonstrated that lymphoscintigraphic patterns may help predict whether SGB will be more effective than CDT based upon imaging characteristics of lymphatic function in BCRL patients.[21] Mechanistically, the potential effectiveness of SGB in BCRL is thought to result from the sympathetic modulation of lymphatic contractility and vascular permeability, thereby providing a biologically plausible rationale for its efficacy in addition to pain relief.

Vasomotor Symptoms in Cancer Survivors: Vasomotor symptoms, including hot flashes, are a common and often undertreated side effect of endocrine therapy in breast cancer survivors. SGB has emerged as a potential therapy for hot flashes. A landmark pilot study in The Lancet Oncology demonstrated marked reductions in hot flash frequency and nocturnal awakenings in women treated with SGB.[22] In a randomized controlled trial of 40 patients, Othman and Zaky found SGB to be more effective than pregabalin for controlling hot flashes.[23] Haest et al. demonstrated a 64% decrease in hot flash scores at one week and a sustained 47% decrease at 24 weeks in a cohort of 34 patients with hot flashes, and noted concomitant improvement in sleep quality.[24] More recently, Soecknick demonstrated that SGB with procaine reduced hot flash frequency by 58.8%, and sleep disturbances by 50.8%, at 24 weeks in a cohort of 29 breast cancer survivors receiving endocrine therapy.[25]

While vasomotor symptoms fall outside the classical definition of cancer pain, they clearly affect the quality of life of patients and can lead to the early discontinuation of endocrine therapy — thus potentially leading to an increased risk of cancer recurrence. Therefore, the use of SGB to treat vasomotor symptoms in cancer survivors is an important area of application within supportive care.

SGB as a therapeutic intervention for centrally mediated and refractory cancer pain

The literature is increasingly indicating that SGB can serve as an effective method of providing palliative relief from pain associated with malignancies that are centrally mediated. There are several case reports describing success using SGB for treatment of thalamic pain syndrome due to malignancy which demonstrated reduction in headaches, facial pain, and upper extremity pain. Other cases have described the use of SGB for treatment of central post-stroke pain. The mechanism for this effect is believed to extend beyond sympatholysis at the level of the peripheral nervous system and involves modulation of central noradrenergic pathways. SGB has been shown to decrease cerebrospinal fluid concentrations of norepinephrine, a similar pathway to that involved in the well-documented use of SGB for treatment of post-traumatic stress disorders. Lipov et al. have suggested that SGB may modulate the immune response through sympathetic innervation of immune organs.[22] This potential mechanism may be particularly relevant to individuals with cancer who experience complex interactions between their immune systems, sympathetic tone, and the development of pain sensitization.

These studies collectively suggest that SGB represents an appropriate intervention strategy for a wide range of cancer related pain syndromes. Although there is the greatest volume of clinical evidence in support of SGB in the perioperative setting, where it is used successfully to treat refractory post-operative pain syndromes including post mastectomy pain syndrome (PMPS), there is emerging evidence to indicate utility in other areas, including breast cancer related lymphedema (BCRL) and vasomotor symptoms, and thus in the survivorship period. The NCCN Adult Cancer Pain Guidelines identify sympathetic nerve blocks as a key indication for consultation for interventional procedures in adult patients with cancer suffering from chronic or neuropathic pain who are likely to benefit from neural blockade. The American Society of Pain and Neuroscience has included sympathetic blocks within a broader framework of interventions for treating cancer pain. Patient selection for SGB should ideally be based on both the characteristics of the pain experienced by the patient (pain phenotype), the location of the sympathetic nerves relative to the site of injection, and the alignment of the timing of the procedure with the patient's overall oncologic trajectory and goals of care (Figure 2).

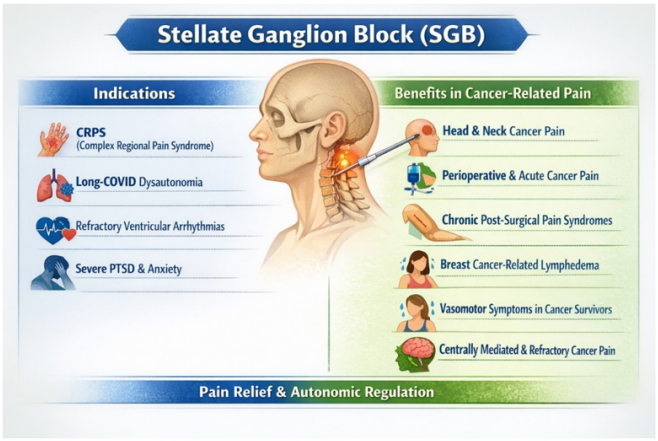

Figure 2 Indications and benefits of Stellate Ganglion Block (Created using OpenAI with author input.)

Procedural approaches and techniques

Land-mark based method

In recent years, the traditional (palpation-guided), landmark-based method for performing a SGB has lost popularity as a preferred method of performing this procedure. The main reasons that landmark-based methods have been disfavored by modern practitioners is due to concern with anatomical variability and lack of procedural precision. As well, use of surface landmarks to perform an SGB alone increases the risk of accidentally damaging other important structures located close to the target area such as; the carotid artery, the esophagus, and the pleura. The increased utilization of ultrasound to guide the performance of SGBs has greatly enhanced visualization of the surrounding anatomy which allows for real time placement of needles and distribution of the injectable. In addition, use of ultrasound has also significantly enhanced the safety of the patient as well as the success rate of the block. Fluoroscopy is used in certain situations to provide additional confirmation of the correct placement of the needle and/or the proper distribution of the injectable. Therefore, image guided procedures have become the standard of care for SGBs and landmark based methods have been relegated to limited or resource challenged areas.

To perform the land-mark based SGB, the patient is positioned supine with the neck slightly hyperextended and the jaw relaxed to allow easier palpation of cervical structures. The clinician identifies the cricothyroid notch with their finger and moves laterally to retract the carotid sheath and sternocleidomastoid muscle, locating the anterior transverse process of C6 (Chassaignac's tubercle). A 22 or 23-gauge needle is inserted medial to the palpating finger until it contacts the C6 transverse process at about 1 cm depth. After negative aspiration, approximately 3-5 mL of 1–2% lidocaine without epinephrine is injected, and contrast may be used to confirm appropriate spread within the cervical sympathetic fascial plane. Successful blockade is indicated by signs such as development of Horner syndrome, increased skin temperature, and changes in thermography or plethysmography.[26]

Ultrasound-guided technique

Ultrasound-guided C6 transverse approach: The patient is placed in the supine position with the neck in slight extension. A high-frequency linear transducer (6–13 MHz) is placed at the level of C6 to allow cross-sectional visualization of anatomic structures, including the transverse process and anterior tubercle of C6, longus colli muscle and prevertebral fascia, and carotid artery and thyroid gland. The carotid sheath and the sternocleidomastoid muscles are retracted laterally with the help of the ultrasound transducer. Gentle pressure is applied to reduce the distance between the skin and the tubercle. A 22–25-gauge needle is inserted towards the Chassaignac's tubercle. After contacting the tubercle, the needle is withdrawn about 1 to 2 mm to bring it in the area of the prevertebral fascia. The internal jugular vein can be visualized by decreasing the probe pressure and avoided by "pushing" away with the needle. After negative aspiration, approximately 2 mL of the local anesthetic is injected, and the spread is carefully visualized with the use of the ultrasound. Once the visualization confirms subfascial drug deposition, the clinician can administer the remainder of the local anesthetic (total of 5 mL). Visualization of the spread of injectate under real-time scanning is important, as the absence of this may suggest unsuspected intravascular injection.[27]

Ultrasound-guided C7 anterior approach: C7 anterior approach method carries a slightly higher risk of pneumothorax and vertebral artery injury. However, it provides a much more consistent blockade as the needle lies closer to the ganglion. A smaller volume of local anesthetic can bring about a more consistent block with this technique. It is particularly useful in cases of failed blocks at the C6 level. The C7 approach always needs imaging as the C7 vertebrae have a vestigial tubercle which is not readily palpable. The patient is positioned in supine with the neck slightly extended. The anterior surface of the C7 transverse process, which is often identified as having a single posterior tubercle, differing from C6, which has both anterior and posterior tubercles. A linear probe is placed transversely to visualize the C7 transverse process, longus colli muscle, and carotid sheath. An in-plane approach is often used, advancing the needle laterally to medially, aiming for the prevertebral fascia overlying the longus colli muscle. After contacting the bone and withdrawing 1–2 mm, the needle tip is positioned in the subfascial plane, and 5-10 mL of the local anesthetic is injected to ensure caudal spread toward the ganglion. Real-time ultrasound allows for visualization of vascular structures and confirms the spread of the anesthetic to avoid complications like recurrent laryngeal nerve palsy or intravascular injection.[28]

Fluoroscopy-guided technique

The patient is placed in a supine position, and an anteroposterior view is obtained with the C-arm to identify C6 by counting up from T1. Then the C-arm is tilted to line up the superior aspect of the C6 vertebral body and is rotated obliquely at approximatively 25 to 30 degrees ipsilaterally to obtain a foraminal view. The target is the junction of the vertebral body and the uncinate process of C6. Under an oblique view, the needle is inserted laterally with a lateral to medial trajectory and remains over the vertebral body or slightly medial to avoid injury to vessels, spinal nerves, and disc. The position needs to be checked through the anteroposterior and lateral views. A small amount of contrast media (0.5 to 1 ml) can be injected first to localize the needle. A tiny test dose of local anesthetic is then administered to reduce the risk of intravascular injection further. Then 10 ml of a local anesthetic such as lidocaine 1% is injected. The same procedure can be performed at the C7 level if needed, but the physicians must be aware of the higher risks of vascular puncture at the C7 level.[29]

Local anesthetic selection and dosing

The choice of local anesthetic for a SGB, is primarily based upon the desired time frame for onset and duration of action. Therefore, most common choices include Lidocaine as it produces a rapid acting, short duration block and Bupivacaine or Ropivacaine for longer

durations of post-operative pain relief. Volume of injectate can vary anywhere from 4 mL to 10 mL, depending on whether the technique being used is ultrasound assisted; lower volume of injectate are preferred when using ultrasound-assisted techniques to maximize the targeted distribution of drug with minimal potential for unintentional blockade of adjacent structures. Using lower concentrations of drug will also minimize the risk of adverse effects of systemic toxicity and still provide effective clinical results. Individualization of dosing is essential, based upon patient factors, the procedural goal(s), and cumulative local anesthetic exposure, with careful attention to established safe dose ranges. Ropivacaine (0.2%–0.75%): Considered an excellent choice due to its long-acting nature and wide margin of safety. It is highly effective for therapeutic, longer-duration blocks.

- Bupivacaine (0.25%–0.5%): Another long-acting choice, similar to ropivacaine, but with a potentially slightly higher risk of systemic toxicity.
- Lidocaine (1%–2%): Provides a rapid onset of sympathetic block but has a shorter duration. Often used for diagnostic purposes.
- Mepivacaine (1%–1.5%): Offers a faster onset of action (54.96s time constant) compared to lidocaine (92.08s time constant).[30]
- Optimal Volume: Studies indicate that 2–4 mL is the ideal volume for USG SGB, providing effective pain relief and sympathetic block (measured by Horner's syndrome and temperature rise) while minimizing spread to adjacent structures.
- Volume Comparison: While 5–10 mL was historically common, recent evidence shows 4 mL (4–6 mL) of local anesthetic is just as effective as 6–8 mL or higher for producing a therapeutic sympathetic block.
- Safety Profile: Higher volumes (e.g., 8 mL+) increase the risk of side effects, including transient hoarseness and dysphagia, without enhancing the therapeutic benefits.
- For cancer pain and related syndromes, a lower volume (e.g., 3-4 mL) reliably provides sympathetic block, making it the preferred approach for reducing side effects and complications (Figure 3).[31]

Continuous infusion technique

SGB is performed in the operating suite under ultrasound guidance using a lateral approach to improve visualization of the needle and anesthetic spread. The trans-scalene approach to stellate ganglion is designed to enhance the block accuracy and reduce the risk of injury to nearby structures. For continuous infusion, a catheter was placed near the ganglion, followed by a 10 mL bolus of 0.25% bupivacaine. Then, a continuous infusion of 0.125% bupivacaine (280 mL) will be initiated. The infusion will start at 2 mL/hour. A mechanical pump is used for the continuous infusion during hospitalization and later transitioned to an elastomeric pump at discharge. A daily telephone follow-up to monitor pain, side effects, and catheter position is highly recommended until removal.[32]

Neurolytic and neuroablative techniques

Neurolysis

Under strict aseptic conditions, 4–5 SGBs were performed on alternate days at the C6 level using a 22-gauge spinal needle under C-arm fluoroscopic guidance. Correct needle placement was confirmed with anteroposterior and lateral fluoroscopic views and craniocaudal dye spread while ensuring no intravascular injection. Each block used 0.25% bupivacaine, with 4 mg dexamethasone administered once bilaterally. Following these blocks, chemical neurolysis was performed at the C7 level using a mixture of 2 mL of 8% phenol, 2 mL of 0.25% bupivacaine, and 1 mL of nonionic contrast (iohexol 300), again under continuous fluoroscopic guidance. Neurolysis on each side was spaced 10 days apart to reduce the risk of complications such as bradycardia and bilateral recurrent laryngeal nerve palsy. Successful needle placement was confirmed at the junction of the vertebral body and transverse process with appropriate dye spread. After the procedure, patients showed increased hand temperature, improved vascularity, and reduced swelling and pain, along with transient signs such as eyelid drooping, enophthalmos, and conjunctival congestion.[33]

Figure 3 Summary of local anesthetic selection and dosing **(**Created using OpenAI with author input.)

Neuroablation

Pulsed Radiofrequency Ablation: CT guided procedure: Neuroablative procedures are performed under CT or ultrasound guidance. For the CT-guided procedure, patient is placed in a supine position, and a needle is positioned at the base of the C7–T1 parapophysis using a carefully planned route under CT guidance to avoid vascular injury. After skin disinfection, a 22G needle or radiofrequency needle was inserted at the predetermined angle and advanced under CT guidance until it contacted the base of the C7–T1 parapophysis, then withdrawn slightly by 1–2 mm. Proper placement was confirmed by the absence of blood or cerebrospinal fluid on aspiration. Sensory and motor tests were performed to ensure no nerve involvement before treatment. Pulsed radiofrequency was then applied at 42°C for 300 seconds with specific pulse parameters and repeated for two cycles. After the procedure, the needle was removed, pressure was applied to the puncture site, and patients were returned to the ward once their vital signs were stable.[34]

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US guided procedure: The patient is positioned supine with mild neck extension and the head slightly rotated contralaterally. After sterile preparation, the skin and subcutaneous tissue were infiltrated with lidocaine. A 5–12 MHz linear ultrasound transducer is used to obtain a short-axis view to identify the anterior tubercle of the C6 transverse process and the longus colli muscle. The transducer was then moved caudally to trace the longus colli muscle toward the C7–T1 levels, where the stellate ganglion was visualized as a continuous, strongly hyperechoic nodular structure along the surface of the longus colli muscle under ultrasound guidance. Color Doppler imaging is used to identify and avoid vascular structures along the anticipated needle trajectory. Following local anesthetic infiltration, a 22-gauge, 10-cm radiofrequency needle with a 5-mm active tip was advanced in-plane from the lateral aspect of the probe toward the target. The needle tip was positioned at the hyperechoic structure overlying the longus colli muscle beneath the prevertebral fascia. Sensory and motor stimulation are performed at 50 Hz and 2 Hz, respectively, and the patient is assessed for paresthesia or motor response to confirm appropriate needle placement and exclude malposition. Pulsed radiofrequency (PRF) treatment is then delivered for 900 seconds at 45 °C with a pulse width of 20 ms and a voltage of 70 V. After completion of PRF therapy, 2 mL of 1% lidocaine is injected through the needle, the radiofrequency needle is withdrawn, and the procedure is concluded.[35]

Thermal RF

Continuous radiofrequency (CRF), also called radiofrequency thermal coagulation, uses high-frequency electrical current to generate heat and produce controlled tissue damage. Depending on the treatment site, electrical impedance, stimulation response, and patient tolerance, temperatures are typically set between 60–95°C for 60–180 seconds. Temperatures below 75°C are generally considered less likely to damage motor nerve fibers.

A diagnostic SGB was performed using an oblique fluoroscopic approach with the patient in the supine position and the neck extended. The fluoroscope was rotated from the anteroposterior position toward the right to obtain a foraminal view. A 25-gauge spinal needle was advanced toward the C7 vertebral body at the base of the uncinate process, positioned just anterior to the neural foramen. After appropriate needle placement, 2 mL of radiopaque contrast dye was injected under continuous fluoroscopy to confirm the characteristic contrast spread. Subsequently, 5 mL of 0.5% preservative-free lignocaine was administered. Approximately 5 minutes after injection, the patient reported significant pain relief. The patient was then monitored for 2 hours and scheduled to return 2 days later for radiofrequency (RF) ablation of the stellate ganglion.

RF thermal ablation was performed using the fluoroscopic approach with a 21-gauge RF cannula (10 cm length, 5 mm active tip). Correct positioning was confirmed using the swimmer's view and a small volume of dilute contrast to verify needle location while preserving visualization of anatomical landmarks. Prior to lesioning, 0.5 mL of 1% lignocaine was injected for local anesthesia. Sensory (50 Hz, up to 0.7 V) and motor (2 Hz, up to 1.5 V) stimulation were performed to confirm appropriate needle placement. During motor stimulation, the patient produced a characteristic vocal response previously described in the literature. Four thermal lesions were then created at the C7 level, each at 80 °C for 60 seconds. Following the procedure, the patient was closely monitored in the recovery area for 4 hours for any potential complications.[36]

Clinical outcomes

A study evaluated the effectiveness of stellate ganglion radiofrequency (RF) therapy in 80 patients with post-mastectomy pain syndrome (PMPS) lasting 6 months to 2 years and refractory to oxycodone and pregabalin.[37] Patients were randomized into two groups: pulsed RF (PRF) and thermal RF (TRF), with procedures performed under fluoroscopic guidance combined with ultrasound. Pain relief was assessed using visual analog scale (VAS) scores, functional improvement, and reductions in analgesic use at 1, 4, 12, and 24 weeks after treatment. Quality of life and functional capacity were also evaluated using the SF-36 questionnaire and ECOG performance scale. Results showed that the thermal RF group had a significantly higher rate of successful pain relief compared with the pulsed RF group at all follow-up points, including one week and up to six months. Patients receiving thermal RF also demonstrated greater functional improvement and required less rescue analgesia. However, no significant differences were observed between groups in overall quality of life or functional capacity scores. The findings suggest that stellate ganglion thermal RF is a safe and effective treatment for PMPS and may provide superior pain relief compared with pulsed RF. Longer follow-up studies are recommended to further evaluate the durability of these effects.

SGB may help manage cancer-related facial pain not only by direct analgesia but also through modulation of stress, as it has shown benefit in patients with PTSD, potentially by reducing sympathetic activity and lowering cerebrospinal fluid norepinephrine levels. Despite its therapeutic potential for refractory upper extremity and facial pain, SGB carries procedural risks due to the ganglion's proximity to vital structures. Documented complications include hoarseness or dysphagia, local hematoma, ipsilateral arm numbness, pneumothorax, and contralateral Horner's syndrome, though ipsilateral Horner's syndrome is a common, expected, and transient sign of successful blockade. Prolonged Horner's syndrome beyond the expected duration of local anesthetic may indicate nerve injury or hematoma and should be investigated. In clinical practice, unilateral SGB is typically performed on the side of greatest pain to reduce the risk of bilateral complications, including motor nerve blockade or vascular compromise that could necessitate intubation or resuscitation. Careful technique and awareness of potential adverse events are essential to maximize benefits while minimizing risks. Overall, SGB offers both analgesic and stress-modulating effects, but patient selection and procedural caution remain critical.

Complications and safety

Minor complications commonly reported include vascular puncture (carotid artery, internal jugular vein, inferior thyroid artery, vertebral artery), neural puncture (vagus nerve, recurrent laryngeal nerve, brachial plexus roots), pneumothorax, thyroid injury, esophageal or tracheal puncture, transient Horner syndrome, intravascular injection, unintended neuraxial, phrenic nerve, or brachial plexus spread of local anesthetic, and local infections. Literature reviews also report hematoma, blood aspiration, intrathoracic bleeding, pneumothorax, and minor infections as frequent minor complications.

Major complications are rare but have been documented and include bradycardia, dural puncture, hemomediastinum, sinus arrest due to vasovagal reflex, transient neurologic injury, LMA puncture, and asystolic cardiac arrest. Most serious events occur when proper imaging guidance is not used or due to the proximity of the stellate

ganglion to critical vascular and neural structures. Overall, SGB is a safe procedure with low risk of major complications when performed under imaging guidance by trained clinicians.[38]

Contraindications

Contraindications include active coagulopathy, recent myocardial infarction, pathological bradycardia, and glaucoma.[39]

Risk mitigation

The safe application of SGB relies on three related components: accurate imaging, anatomically correct target selection, and proper pharmacological management. US has emerged as the preferred imaging method for this purpose. US allows for real time imaging of important anatomical structures including the carotid and vertebral arteries, thyroid gland, esophagus, and longus colli muscles. This improves safety by decreasing the risk of vascular puncture and/or unintentionally damaging other critical structures during the procedure. Typically, the best location to administer the block is at the C6 level. At this level, Chassaignac's tubercle covers the vertebral artery, providing greater protection compared to the C7 level. A lateral or anterolateral approach with the needle reduces the risk of accidental damage to central structures (trachea and esophagus).

Pharmacologically, limiting both the amount of local anesthetic used and its volume limits the unintended spread of the anesthetic to surrounding neural structures thereby reducing the incidence of complications associated with the administration of local anesthetics such as recurrent laryngeal nerve blockade, phrenic nerve palsy, and rare instances of total spinal anesthesia. Guidelines from multiple organizations recommend against the use of particulate corticosteroids during SGB due to the potential for embolic events in the vertebral circulation. In addition, current recommendations suggest that local anesthetic alone is adequate for achieving effective sympathetic blockade.[40] Technique is still a key component of performing SGB safely. Therefore, all providers are expected to aspirate before injecting and to perform a test dose to identify intravascular injection, even if no blood can be seen upon aspiration.[41] Post-procedure, patients should be closely monitored for signs of local anesthetic systemic toxicity and hemodynamic instability. Swallowing function should be evaluated prior to patients resuming oral intake and patients should avoid strenuous activity for at least 24 hours after the procedure to minimize the chance of developing a delayed hematoma.[41]

For patients with cancer, procedures must also take into consideration the altered cervical anatomy secondary to their malignancy. Altered anatomy may be due to tumor burden, previous surgeries, or radiation induced fibrosis. These alterations to anatomy may make it difficult to accurately visualize sonographic landmarks and distorted tissue planes. For this reason, close coordination with the patient's oncologist is recommended to ensure that the procedure aligns with the patient's overall prognosis, treatment plan, and goal of care. When performed with modern imaging modalities and strict adherence to technique, SGB is considered safe when administered to appropriately selected cancer patients. Additionally, SGB may offer significant relief from analgesia and symptoms in cancer patients suffering from a variety of cancer-related conditions.

Clinical Considerations

SGB may be considered as an adjunctive interventional strategy for the management of refractory sympathetically mediated pain involving the head, neck, upper extremity, or upper thorax, particularly in patients with tumors, treatment-related neuropathies, or post-surgical syndromes affecting cervical sympathetic pathways. Careful patient selection is essential, with attention to coagulopathy, thrombocytopenia, anticoagulant use, and distorted cervical anatomy from tumor burden, radiation fibrosis, or prior surgery, which may increase procedural risk. Imaging guidance—most commonly ultrasound—should be utilized to improve accuracy and minimize complications such as vascular puncture, esophageal injury, pneumothorax, or recurrent laryngeal nerve blockade. In cancer patients, clinicians should also consider immunosuppression and infection risk, as well as the potential need for repeated blocks or neurolytic techniques in cases of severe, persistent pain. Coordination with the oncology team is important to align the intervention with overall treatment goals, prognosis, and palliative care objectives, ensuring that the potential analgesic and quality-of-life benefits outweigh procedural risks in this medically complex population.

Conclusion

The growing body of research provides some support for early-stage introduction of stellate ganglion blocks into the treatment plan of patients with cancer-related pain. The potential to rapidly modulate sympathetic-mediated pain along with providing the possibility of reducing the need for opioids is substantial. Therefore, incorporating SGBs at an early point in the treatment regimen could provide additional improvements in both quality of life and function for these patients. This potentially changes the role of SGBs from that of a "rescue" therapy to a meaningful strategy used in conjunction with other treatments as part of a multi-modal approach to manage cancer-related pain.

Acknowledgments

None.

Conflict of Interest

None.

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