Comparative Study between Ultrasound Guided Lateral and Anterior Approach for Stellate Ganglion Block


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Abstract

Background: This study evaluated the safety and complications between the ultrasound guided lateral and anterior approach to administrate the local anesthetic for stellate ganglion block.

Methods: Sixty two patients scheduled for ultrasound guided stellate ganglion block randomized into two equal comparable groups. The first group (Group I) received stellate ganglion block through anterior approach while the second group (Group II) received stellate ganglion block through lateral approach. Evaluated variables included number of skin punctures, the time interval from initial skin puncture to local anesthetic injection and complications e.g. hoarseness, dysphagia and a foreign body sensation in the throat, upper extremity weakness, and hematoma formation.

Results: The study groups were comparable as regards technical feasibility and safety. There was significance difference between the two groups in number of skin punctures (p = 0.014) more punctures needed in Group I. There was no statistically difference between both groups in time from skin puncture to local anesthetic administration in the target. Complications were more in Group I.

Conclusions: Our findings suggest that the ultrasound guided lateral approach can be a potentially safer approach for SGB than anterior approach.

Key Words: Ultrasound – Stellate ganglion – Neuropathic – Block.

Introduction

STELLATE ganglion formed by fusion of the inferior cervical and first thoracic ganglion, extends from the level of the head of the first rib to the inferior border of the transverse process of C7 and the vertebral artery traverses over the stellate ganglion and enters the vertebral foramen. Other significant structures in close proximity to the stellate ganglion are the subclavian artery, inferior thyroid artery, intercostal arteries, and recurrent laryngeal nerve [1]. Injection of local anesthetic around the stellate ganglion interrupts the sympathetic outflow to the head, neck, and upper limbs. This block has also been used for the treatment of phantom pain, postherpetic neuralgia, cancer pain, cardiac arrhythmias, orofacial pain, and vascular headache [2]. Various modalities used to localize stellate ganglion including fluoroscopy, computerized tomography and magnetic resonance imaging. However, these techniques may not be practical in clinical practice as they are time consuming, not cost benefit, involve radiation exposure, and may cause damage to the important structures situated near the stellate ganglion [3,4].

Ultrasound has emerged as a popular modality image-guidance in various disciplines because of its numerous advantages. It is generally more affordable and portable than other image modalities while avoiding any radiation exposure. Ultrasound provides direct visualization of various tissue structures. Real time ultrasound guidance of needle placement and medication administration provides an advantage in ensuring accuracy [5]. Ultrasound is far better than fluoroscopy for visualization of soft tissue. The esophagus is often seen deviated from the midline and lies ventral to the medial part of the transverse process, which is part of the needle path with high risk to puncture it with serious consequences [6]. Certain arteries, especially the inferior thyroidal artery, can be seen passing in front of the prevertebral fascia right in the needle path. The consequence of not recognizing this variation will be the formation of hematoma. At the C7 level, the vertebral artery was visualized as a pulsating structure with an arterial Doppler.
signal that could be followed in a cranial direction where it entered the foramen transversarium [7].

Bhatia et al., compared out of plane anterior approach with an in-plane lateral approach for SGB. It is an observational study for evaluation of sonoanatomy relevant to performing stellate ganglion block using anterior and lateral stimulate approaches. In 100 patients, ultrasound was used to scan the regional anatomy of neck at bilateral sixth and seventh cervical vertebrae. They concluded that ultrasound guided lateral approach at C6 level conferred a greater margin of safety for performing SGB [7].

**Patients and Methods**

This study conducted at National Cancer Institute from 2013 – 2015.

After obtaining approval from the local ethical committee and patients consent, sixty two patients suffering from upper limb neuropathic pain will be randomized into two equal comparable groups. The first group (Group I) received stellate ganglion block through anterior approach while the second group (Group II) received stellate ganglion block through lateral approach both under ultrasound guidance.

1- **Inclusion criteria:**
   A- Age of the patient between 20 to 60 years.
   B- Patient complains of post-mastectomy neuropathic pain.
   C- Patient with Numeric Pain Intensity Scale (NPIS) > 4 who failed to respond to 4 weeks of conservative treatment with opioids (Tramadol oral max 400mg per day) and adjuvant (Pregabalin oral max 600mg per day).

2- **Exclusion criteria:**
   A- Coagulopathy.
   B- Local infection.
   C- Recent myocardial infarction and pathological bradycardia.
   D- Glaucoma.

3- **Technique:**
   A- **Patient preparation:** History taking, physical examination, CBC and coagulation profile will be done for all patients. The affected limb was examined for signs of sympathetic over activity such as hyperalgesia, allodynia, changes in skin color, texture, and trophic changes in hair, nails, and sweating abnormality using LANSS scale (Leeds Assessment of Neuropathic Symptoms and Signs) in Arabic language for patients in pain clinic.

   **B- The procedure:** All the blocks were performed in the operating room where all resuscitation equipment available with SonoSite M-Turbo ultrasound machine using 6-13 MHz probe. Intravenous midazolam in a dose of 0.05mg/kg was given to all patients and fully monitored by ECG, blood pressure and pulse oximetry. The patient was placed in the supine position with neck turned to the opposite side with neck extension on a pillow placed under the shoulders. Mouth is slightly opened to relieve neck tension. After asepsis of the neck and the transducer, the transducer was placed on the neck to enable the cross-sectional (transverse) visualization of anatomical structures at the level C6 and C7 vertebrae as a preprocedure scan. The cricoid cartilage, carotid artery, internal jugular vein, vertebral artery, thyroid gland, trachea, longus colli covered with prevertebral fascia, anterior tubercle of the C6 transverse process (Chassaignac's tubercle) which is specific to determine the C6 transverse process and the transverse process of C7 were visualized by downward sliding of the probe. The color Doppler mode was used before needling to avoid penetration of vertebral artery and inferior thyroid vessels. In Group I, immediately anterior to the transducer 2ml of 2% lignocaine was infiltrated. Under real-time, a 22 atraumatic needle (Stimuplex D) was inserted using in-plane technique to reach the longus colli while in Group II the needle inserted posterior to the probe in in-plane technique Fig. (1).

![Fig. (1): Ultrasound image of the neck at the sixth cervical vertebral level.](image)

**Legend:**
- **SCM:** Strenomastoid Muscle.
- **LC:** Longus Colli Muscle.
- **AT:** Anterior Tubercle of C6.
- **T:** Air column.
- Red arrow: Needle path of anterior approach.
- Blue arrow: Needle path of lateral approach.
Once needle entered the prevertebral fascia of longus colli 1ml of saline was injected after confirming negative aspiration for blood and cerebrospinal fluid. If the spread was appropriate, as evident by clear separation of tissue planes 5ml 0.25% bupivacaine was injected. However, if the spread was observed above the fascia or within the muscle, the needle was gently repositioned.

C- After the procedure: Immediate reposition the patient in sitting position and hematoma formation is prevented by manual compression in the injection site for 5 minutes. Thirty minutes later, the patient’s neck was re-examined by the ultrasound to check for hematoma formation before his/her discharge.

Both groups will be compared for:

1- Number of skin punctures.
2- The time interval was recorded from initial skin puncture to local anesthetic injection.

3- Complications e.g. hoarseness, dysphagia and a foreign body sensation in the throat, upper extremity weakness, and hematoma formation.

Results

The demographic data showed no statistically difference between both groups. In our study we compared number of skin punctures by the needle to reach the target; there was significance difference between the two groups. As in Group I sometimes we needed more than one puncture to reach our target ($p=0.014$) Fig. (2).

We also compared time from skin puncture to local anesthetic administration in the target (Table 1).

All patients were observed for 2 hours post the block to detect any complications in the form of hoarseness, hematoma, sensory and motor affection (Table 2) and Figs. (3-5).
Table (1): Time from puncture to local anesthetic administration.

<table>
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<tr>
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<th>Group II</th>
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<td>SD</td>
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<td>Minimum</td>
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<td>Time from puncture</td>
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<td>.75</td>
<td>2.00</td>
<td>1.00</td>
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Table (2): Complications in both groups.

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Discussion

Michael Gofeld et al., performed three-dimensional sonography on 10 healthy volunteers, and image reconstruction was completed. They found that the cervical sympathetic trunk is located below the prevertebral fascia, on the surface of the longus colli muscle. The longus colli muscle is thicker than can be inferred from the literature. Therefore, they concluded that routine blind injection may result in intramuscular deposition of the injectate. Visualization of the soft tissue, vessels, and cervical sympathetic ganglia make ultrasound imaging guidance superior to fluoroscopy [8].

In our study we used ultrasound only without fluoroscopy from the beginning to reach the target for local anesthetic administration and to avoid injury to any structure. Narouze et al., emphasized the importance of ultrasound guidance during SGB performed under fluoroscopy. The needle had passed through the skin and subcutaneous tissue with fluoroscopic guidance aiming at C6 transverse process, ultrasound was used to verify needle placement. The needle was aiming at thyroid tissue anteriorly and esophagus posteriorly, which was not visible in fluoroscopy. At this point, the needle was withdrawn and reinserted, and then advanced with real-time imaging into prevertebral fascia. The use of sonography improved patient safety by avoiding soft tissue structures in needle path [9].

We compared in our study anterior and lateral approach both in-plane technique not out of plane as in-plane technique provide to us to see the whole length of the needle with its tip and decrease the risk to injury the surrounding structures. In our study, three patients in group one developed hoarseness while no patients developed hoarseness in group two. In Ghai et al., study, four patients complained of hoarseness from twenty patients underwent ultrasound guided SGBs using lateral in-plane technique at C7 level were given to patients suffering from chronic pain in upper extremity, head, and neck; this could be explained by spillage of the drug to the area of recurrent laryngeal nerve. One patient complained of paresthesia during the performance of block, which subsided with redirection of needle [10]. Shankar and Simhan reported paresthesia in one patient during ultrasound guided SGB due to poor visualization of the needle tip. The paresthesia resolved after the needle was reintroduced at a different angle [11].

The incidence of neuronal injuries following ultrasound guided regional anesthesia has been reported to be around 0.04%. Symptoms of paresthesia were reported by the patient due to neuronal contact evident secondary to poor needle tip visualization. The transient neuronal injury could have been avoided, if the trajectory planning had included the possibility of contacting the brachial plexus with the in-plane approach. Needle redirection and avoidance of injection subsequent to patient report of paresthesia, probably, averted a more severe or permanent nerve injury [12]. In our study two patients in group one developed paresthesia following injection that subsided gradually over 2 hours but in group two no sensory affection developed, in our results no motor affection in both groups.

Validity of scanning and hydrolocalization techniques in regional anesthesia was starting to get acknowledged as “standard of care”. Intravascular injection of local anesthetic may result in neurological as well as cardiovascular symptoms and signs. Aspiration for blood, prior to injection, is not always reliable. Hydrolocalization, during real time imaging with the use of normal saline or...
Dextrose, may facilitate identification of accidental intravascular injections [13].

We performed a prescan of neck in short axis view before performing the block to identify relevant anatomy, using color Doppler flow to detect any vessels and plan a safe path for needle placement. Injuries to the vertebral or the inferior thyroidal arteries have been reported during stellate ganglion block and hence trajectory planning may also have to include the location of these vessels [14].

Time taken to administer the block from skin puncture to local anesthetic administration was 3.75 ± 1.86 minutes in Ghai et al., study, [10] while in our study was 2.29 ± 0.75 minutes in Group I while in Group II was 2.03 ± 0.31 minutes with no statistical difference between the two groups.

Conventional SGB requires a large volume of local anesthetic. The large volume of local anesthetic with the complex anatomy of the cervical fascia leads to increase the incidence of complications. Also, the large volume of the local anesthetic can cause upper cervical block (C1-C6) and can spread to block the recurrent laryngeal nerve, causing hoarseness [3]. In our study we used 5ml of bupivacaine 0.25% this amount was sufficient to do appropriate SGB and ensure the cephalic and caudal spread.

Limitation of our study is that no contrast has been utilized. Accordingly, we could not conclude whether both techniques provide the same pattern of spread or not.

Conclusion:

The ultrasound guided lateral approach can be a safer approach for SGB than anterior approach where the esophagus is absent, and there is a relatively low chance of encountering the vertebral artery or an aberrant vessel. It allows the use of smaller volume of local anesthetic thus decreasing the chance of spread of LA to the adjacent structures, as RLN and cervical nerve roots.

References


تم اكتشاف العقدة النجمية السيمبتارية في الرقبة عام 1949 وسدة هذه العقدة أدى إلى علاج وتشخيص أمراض كثيرة منها قصور الشريان في الطرف العلوي. وتوجد طرق كثيرة لسد هذه العقدة وذلك بحقن المخدر الموضعي. ومن أولا هذه الطريقة هو حقن العقدة بالطريقة الروتينية وفقا للمعايير التشريحية مما قد ينتج عنه مضاعفات كثيرة منها حقن داخل الأوعية الدموية وتشلل الامتصاص. في حين أن الموجات فوق الصوتية الموجبة يؤدي إلى استخدام كمية أقل من المخدر الموضعي ورؤية مسار الإبرة المستخدمة مما له أكبر الأثر في تقليل المضاعفات الناتجة عن الحقن بالطريقة التقليدية. وتم إجراء هذا البحث على اثنيين وستين مريض في المعهد القومي للأورام يعانون من أم في الطرف العلوي المجموعة الأولى باستخدام الطريقة الأمامية والمجموعة الثانية باستخدام الطريقة الجانبية وتم المقارنة بين المجموعتين من حيث فاعلية الحقن والآثار الجانبية المترتبة على الحقن وأوضح الدراسة فاعلية وامان استخدام الطريقة الجانبية لسد العقدة النجمية السيمبتارية مع استخدام جهاز الموجات فوق الصوتية عن الطريقة الأمامية.