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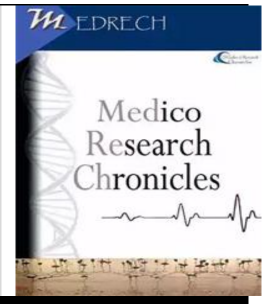

Cervical Plexus Nerve Block: A Review Of Techniques And Applications In Oral And Maxillofacial Surgery

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The Cervical Plexus Nerve Block (CPNB) presents a viable alternative to general anesthesia (GA), offering numerous advantages including cost-effectiveness, reduced physiological stress, and lower complication rates. This review delves into the anatomy, classification, and varying techniques of CPNB, such as superficial, deep, and intermediate blocks, and their specific applications in oral and maxillofacial surgery. While CPNB has been effectively utilized in several head and neck procedures, its role in oral and maxillofacial surgery is gaining attention due to its potential to improve patient comfort and reduce opioid dependency. Despite these benefits, the technique does carry risks, particularly with deeper blocks, such as hemi-diaphragmatic dysfunction and respiratory distress. The review concludes that CPNB is a crucial component in the field of regional anesthesia for head and neck surgeries, advocating for further research and clinical application to enhance its safety and efficacy.

I. INTRODUCTION

An adequate level of anesthesia has been an instrumental component of surgery since ancient times. The state-of-the-art techniques in medicine relate to the usage of general anesthesia (GA) as a rather safe, useful and simple way to achieve surgical anesthesia [(1)]. However, GA has several significant drawbacks, including high costs, the need for extensive resources and skilled personnel, and potential risks of morbidity and mortality. On the other hand, regional anesthesia offers a number of advantages over GA which include stress free anesthesia due to lower catecholamine release, reduced hemorrhage through local vasoconstriction, lower rates of postoperative pulmonary embolism and thrombus, easy to perform techniques, lower morbidity rates and less resource intensive administration [2,3].

The cervical plexus nerve block (CPNB) as a regional anesthesia technique was first introduced by Halstead in 1884 and has shown to provide effective anesthesia and analgesia for the head and neck region [4]. Over the years, the block has been successfully applied clinically for performing carotid endarterectomy, lymph node dissection, thyroidectomy, minimally invasive parathyroidectomy, and tympano-mastoid surgery [5]. However, applications in the oral and maxillofacial surgery seem to be limited as evidenced by scarce literature of applications of CPNB reported in oral and maxillofacial surgery. Nevertheless, there has been a renewed interest in the usage of CPNB in oral and maxillofacial surgery in the past decade or so.

Traditionally, CPNB's are classified as superficial and deep, but in 2004, Telford and Stoneham suggested the intermediate CPNB [6]. The superficial cervical plexus block (SCPB) is a safer way to achieve sensory anesthesia of peri-mandibular and neck region [5]. The deep cervical plexus block (DCPB) targets the deeper structures of the cervical plexus, also targeting motor supply and thus providing more extensive anesthesia suitable for surgeries involving deeper tissues and more complex procedures [7]. It is particularly effective for procedures such as cervical lymph node biopsy and deeper plane abscesses. The DCPB can offer effective pain control and reduce the need for postoperative opioids, contributing to enhanced recovery. The intermediate plexus block has been the subject of discussion for a long time. It is argued that the intermediate plexus block is more effective than the superficial plexus block because it places the anesthetic solution closer to the nerve roots, beneath the investing fascia [8]. According to Pandit et al., a subcutaneous deposit does not penetrate the dense investing layer [9]. However, anatomical and histological studies have shown that the investing layer is incomplete, suggesting that both superficial and intermediate blocks should be equally effective [10].

This comprehensive review article first describes the anatomy of the cervical plexus followed by the classification, techniques and effects of CPNB's and lastly the applications in oral and maxillofacial surgery. None of the previously published literature has reported on the possible applications of CPNB in oral and maxillofacial surgery as of now. The authors have also added a note on the possible complications encountered with the use of CPNB techniques.

II. ANATOMY

Cervical plexus

The ventral rami of the first four cervical nerves make up the cervical plexus (C1-C4). On the transverse processes of the cervical vertebrae, these rami form grooves along the costotransverse bars, situated between the anterior and posterior tubercles. Three separate loops are formed as the plexus's roots join together. The muscles of the levator scapulae and scalenus medius are located posteriorly and arise from the posterior tubercle of the transverse process. The internal jugular vein, the sternocleidomastoid, and the prevertebral fascia are all located in close proximity to the plexus anteriorly.

The cervical plexus branches into superficial and deep sections. The superficial branches serve primarily to innervate the skin and superficial structures of the head, neck, and shoulders. The deep branches, meanwhile, focus on the deeper structures of the neck, such as the anterior neck muscles [11].

Superficial Cervical Plexus

The superficial cervical plexus arises from the ventral rami of nerve roots C2 to C4. These nerves provide sensory innervation to the skin and superficial regions, including the auricle of the ear, the acromioclavicular joint, the clavicle, and the anterolateral neck. The sensory branches emerge near the midpoint of the posterior border of the sternocleidomastoid muscle (SCM), at the level of the thyroid cartilage notch. The plexus forms four terminal branches: the lesser occipital nerve, greater auricular nerve, transverse cervical nerve, and supraclavicular nerve. These nerves exit from behind the posterior border of the SCM. The superficial cervical plexus can sometimes be visualized as hypoechoic oval structures deep or lateral to the SCM, which can aid in the precise administration of local anesthetics near the sensory branches [12–14].

Deep Cervical Plexus

The deep cervical plexus is formed by the dorsal rami of the C1 to C4 spinal nerves. It emerges from the vertebral column between the longus capitis and middle scalene muscles, lying deep to the internal jugular vein. The deep cervical plexus includes the ansa cervicalis, which provides motor innervation to the infrahyoid muscles. It also has connections with cranial nerves X, XI, and XII, as well as the sympathetic trunk. The phrenic nerve, arising from the C3, C4, and C5 spinal nerves, is closely associated with the deep cervical plexus and plays a crucial role in diaphragmatic function. The deep cervical fascia, which surrounds these structures, consists of three layers: the superficial layer (investing fascia), the middle layer (visceral or pretracheal fascia), and the deep layer (prevertebral fascia). These layers provide additional protection and structural support to the cervical plexus and associated muscles and organs [12–14].

III. CLASSIFICATION

There are three different CPNB's - superficial, intermediate, and deep [15][16].

Superficial Cervical Plexus Block: The injectate is deposited in the subcutaneous tissue superficial to the superficial layer of the deep cervical fascia (SLDCF/investing fascia).

Intermediate Cervical Plexus Block: The injectate is deposited between the investing fascia and the prevertebral fascia.

Deep Cervical Plexus Block: The injectate is deposited between the prevertebral fascia and the cervical transverse process.

IV. TECHNIQUE

Superficial Cervical Block.

The technique can be performed using either anatomical landmarks or ultrasound guidance.

Landmark based Superficial cervical block

The patient is positioned supine with a small towel under the head, which is turned slightly toward the side that will not be blocked. The anesthetist applies gentle resistance while the patient is instructed to lift their head and perform a slight Valsalva maneuver to accentuate the sternocleidomastoid muscle and make the external jugular vein more visible. The midpoint of the posterior border of the sternocleidomastoid muscle, where the external jugular vein crosses, is identified and marked. A 22-gauge, 4-cm needle is then inserted 1-2 inches both superiorly and inferiorly along the border of the muscle into the subfascial layer, and 5-10 mL of local anesthetic is infiltrated. Paresthesia is not sought during this procedure. It is recommended to wait ten to fifteen minutes after the local anesthetic injection to assess the effectiveness of the block. It should be noted that due to the proximity of the accessory nerve (cranial nerve XI), the ipsilateral trapezius muscle may be temporarily paralyzed for the duration of the superficial cervical plexus block [17].

Ultrasound guided superficial cervical block

patient placed in the lateral decubitus position with the operative side uppermost. A linear probe of ultrasound machine was used to scan the coronal section of the midpoint of sternocleidomastoid muscle. The intermuscular plane is revealed between sternocleidomastoid and scalene muscle. Using a lateral to medial in-plane technique and a 1.5-inch, 25-gauge needle, 10 mL of lidocaine 1.5% with 5 Kg/mL of epinephrine was deposited in the intermuscular plane [18].

Deep Cervical Plexus Block

The technique can be either landmark based or guided using ultrasound, fluoroscopy or nerve stimulated.

Landmark based Deep cervical plexus block

The patient is positioned the supine with a small towel under the head, turning it slightly toward the side opposite the block. The mastoid processes and the most prominent tubercle of C-6 (Chassagne's tubercle) are identified. Cervical processes are located about 0.5-1 cm posterior to the line from the mastoid to C-6, with C-2 lying 1.5 cm below the mastoid process, marking each with an "X." The transverse processes of C-3 and C-4 are palpated and marked similarly. The skin wheals at the "X" marks are raised and three separate 5-mL syringes with local anesthetic are used, introducing 22-gauge needles through the wheals, directing them medially and caudally to avoid the intervertebral foramen. The endpoint is the transverse process at a depth of 1.5-3.0 cm, ensuring the needle tip avoids the vertebral artery. After aspiration to check for cerebral spinal fluid and blood, 4-5 mL of anesthetic is injected at each point [(18)].

Ultrasound guided Deep cervical plexus block

The patient's shoulder and head are supported with pillow and the head is turned to the opposite side. A linear transducer is positioned axially along the posterior border of the sternocleidomastoid (SCM) at the cricoid cartilage level, corresponding to the C6 vertebrae and is moved upward until the carotid artery bifurcation at the C3-C4 level is visible. Adjust for a clear view of the C4 transverse process, longus capitis, and scalene muscles, noting the hyperechoic tubercles with posterior shadowing. The C4 nerve root is identified between these tubercles. Usage of color Doppler can be done to avoid vessels and nerve roots, followed by insertion of a 22-25G block needle in-plane from posterolateral to anteromedial until it reaches the prevertebral fascia at the posterior tubercle of C4. The needle is slightly retracted, followed by injection of 1-2 mL of local anesthetic to verify placement, followed by 10-15 mL after confirming negative aspiration. The typical volume for injection is 10-15 ml [(12)].

Fluoroscopy guided Deep cervical plexus block

The mastoid process and Chassagne's tubercle are first identified and then connected with a line followed by drawing a second line parallel and approximately 1 cm posterior to the first. On this second line, points are marked at 2 cm, 4 cm, and 6 cm caudal to the Mastoid process. Using a 5 cm 22-gauge needle, insertion is performed at the first point, 2 cm caudal to the mastoid process, directing the needle perpendicular to the skin. Fluoroscopic imaging is employed to confirm that the needle has reached the transverse process of C2 at a depth of about 2 cm. After verifying the position both fluoroscopically and clinically, 4 cc of a mixture containing 1% lidocaine and 0.25% bupivacaine is injected, slightly withdrawing the needle beforehand. The technique is repeated to confirm the transverse processes of C3 and C4, injecting 4 cc of the same mixture at each point [(19)].

Nerve stimulator guided Deep cervical plexus block

This method avoids direct anesthetic administration to phrenic nerve and reduces the systemic toxicity by lowering peak serum concentration. The technique involves the patient in semi-sitting position with head turned to the contra-lateral side. Transdermal injection of 0.25ml of 1% lignocaine, 1cm posterior to the posterior border of sternocleidomastoid muscle corresponding to the transverse processes of C2, C3 and C4 is performed. A short beveled 50mm needle is inserted perpendicularly at C2 level, which is connected to the nerve stimulator to elicit muscle contraction. This is repeated at C3 and C4 level. When 0.5mA current induces a neck muscle response, the position is confirmed. A 5ml of local anesthetic solution (0.5% bupivacaine and 2% lidocaine) is injected after negative aspiration over 2-3 mins [20].

Intermediate Cervical Plexus Block

The ultrasound is routinely employed when performing the intermediate CPNB.

Ultrasound guided Intermediate Cervical plexus block

A linear ultrasound transducer is placed transversely on the neck. The transducer is used to track from the C7 vertebral level to the C4-5 intervertebral level. At the C4-5 level, a 23-gauge, 60-mm needle is inserted laterally to medially using an in-plane technique. An injection of 0.2 ml/kg of 0.2% ropivacaine is administered into the interfacial space between the sternocleidomastoid muscle and the prevertebral fascia [21].

V. APPLICATIONS IN ORAL AND MAXILLOFACIAL SURGERY

The CPNB serves a variety of clinical applications across multiple procedures, enhancing patient comfort and reducing reliance on opioids. It is instrumental in incision and drainage of submental, submandibular, and submasseteric abscesses, providing necessary analgesia for these interventions [3]. In the realm of cosmetic procedures, SCPB significantly improves pain tolerance during facial rejuvenation treatments, such as monopolar radiofrequency treatments [22]. This technique also plays a crucial role in head and neck surgeries, effectively managing pain during cervical lymph node biopsies, mandibular fracture reduction and fixation, and the suturing of superficial neck wounds [5,23]. Additionally, SCPB combined with trans-tracheal instillation of local anesthetic offers excellent analgesia for semi-emergency tracheostomies, enhancing patient stability and comfort [24]. Postoperative pain management is another area where SCPB contributes significantly, reducing the need for opioids and facilitating quicker recovery [25]. Moreover, it is effective in the treatment of herpes zoster, managing acute pain and itching in the C2-C4 dermatomes and helping to prevent post-herpetic neuralgia [26]. In dental procedures, SCPB addresses residual pain experienced despite successful mandibular blocks during interventions such as molar extractions, implant placements, or root canal treatments [27].

VI. COMPLICATIONS

The deep cervical plexus block, although effective for pain management, carries a significantly higher risk of failure and complications, including a fivefold likelihood of conversion to GA [7]. This block is not only technically challenging but also associated with twice the complication rate compared to other blocks [7]. Notable complications include pronounced hemi-diaphragmatic dysfunction, which can complicate the clinical management of patients [16].

Acute respiratory distress is another serious complication, often resulting from both ipsilateral plexus blockade and pre-existing conditions such as asymptomatic contralateral recurrent laryngeal nerve paralysis, particularly in patients with a history of thyroid surgery. This underscores the necessity for a comprehensive preoperative airway check, especially in individuals with prior respiratory or neck surgeries, to mitigate risks during the block [28].

Additionally, about 10% of patients undergoing cardiac surgery may experience postoperative electrophysiological abnormalities in phrenic nerve conduction. This complication demands that anesthesiologists remain vigilant and prepared to manage potential respiratory failures post-block [29].

Superficial cervical plexus block (SCPB) can also lead to complications like Horner's Syndrome (HS), partial brachial plexus blocks, and blocks of the phrenic and recurrent laryngeal nerves [30]. These issues typically arise from the inadvertent deep spread of local anesthetic intended for superficial injection, affecting the ipsilateral cervical sympathetic chain. It is crucial for clinicians to be familiar with the anatomy of the cervical plexus and adhere to precise injection protocols to prevent deep tissue penetration. Ensuring injections remain shallow and at the correct anatomical levels can help reduce the occurrence of these complications. If HS develops, it is important for healthcare providers to reassure patients of its temporary nature and confirm that it is not indicative of more severe or permanent damage [30].

VII. CONCLUSION

The CPNB, including its superficial, intermediate, and deep variations, provides significant advantages in regional anesthesia for head and neck surgeries. Its applications in oral and maxillofacial surgery are extensive, offering effective pain management and reducing the need for general anesthesia. Despite some complications, the benefits make them valuable tools in modern surgical practice, warranting further research and applications.

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