Narrative Review

Ultrasound Guided Regional Blocks For Oculoplastic Surgical Procedure

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Abstract

Ocular surgery has progressed beyond the first enucleation for retinoblastoma performed using peribulbar blocks. This includes both therapeutic and cosmetic surgery for the ocular, extraocular, and periorbital areas. The peribulbar block is sufficient for most ocular procedures; nevertheless, it is often insufficient for extraocular oculoplasty involving the eyelids, lacrimal glands, skin growths, or tumors. These anatomical locations are innervated by various branches of the trigeminal nerve's ophthalmic and maxillary divisions. Regional anesthesia using ultrasound has advanced tremendously and is now extensively used for multiple surgical procedures. However, ultrasound-guided regional anesthesia for oculoplasty is still in its early stages. We present an overview of ultrasound-guided regional anesthesia for oculoplasty.

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Introduction

In 1884, Karl Koller first described the use of topical cocaine, and in the same year, Herman Knapp injected cocaine into the retrobulbar space for enucleation to achieve complete ocular anesthesia. In 1985, Davis et al. reported another milestone peribulbar block. These regional techniques revolutionized ophthalmic anesthesia, and most ocular surgical procedures have been performed under the same blocks for four decades. [1–3]

Ophthalmic surgery has progressed beyond first enucleation for retinoblastoma under peribulbar block. It includes surgery of orbital tumors, eyelids, orbit, extraocular tumors, lacrimal gland, and duct and is classified as oculoplasty surgery.

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It also involves various grafts for therapeutic, functional, and cosmetic repair. These grafts may be used from the amniotic membrane or extracted from the buccal mucosa, lower lips, posterior auricular, or lateral thigh in the form of the facia lata.[4]

Oculoplasty surgery is very painful, and regional anesthesia techniques may play a crucial role in providing analgesia to patients undergoing such surgery.[5] Despite the great progress of oculoplasty surgery, regional anesthesia in ophthalmology has largely been limited to peribulbar block. Peribulbar block, although a complete anesthetic technique for ocular surgery is widely insufficient for extraocular oculoplasty. Literature related to regional anesthetic techniques for extraocular oculoplasty involving periorbital surgeries or different grafts used for extraocular surgeries is relatively scarce and is also only limited to landmark techniques.[6]

Ultrasound (US) guided blocks has become the mainstay of regional anaesthesia, recommended and practised around the globe. US increases the accuracy, success, reliablity, decreases the required injectate and even decrease the complications.[7] We hereby intend to describe some US guided regional techniques that may help provide analgesia for extraocular surgeries.

Relevant Nerves

The relevant anatomy for ocular blocks can be studied as for periorbital blocks or grafts. Periorbital blocks include techniques to anesthetize nerves that supply the region around the eye. These include the supraorbital, infraorbital, supratrochlear, zygomaticofacial nerves. Oculoplasty also includes grafts from various other sites distant from the eye. This includes muscle mucosal grafts from the lower lip and periauricular skin grafts from around the ear.[8,9] (Figure 1A,B)

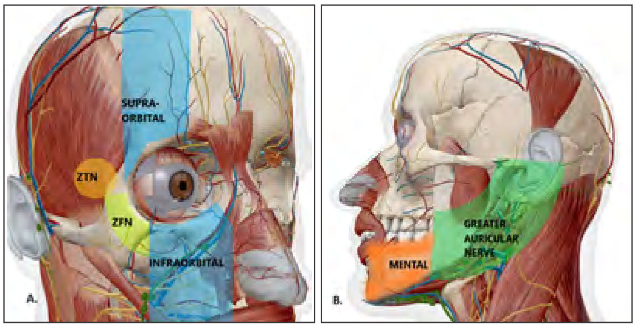

Figure 1. A Sensory innervation around eye. Zygomaticotemporal nerve (ZTN), Zygomaticofacial nerve (ZFN) B. Sensory innervation for grafts

Equipments And Preparations

A consent from the patient or the legal guardians of the children should be taken before proceeding for any procedure. All of these procedures are superficial, therfore needs a high frequency (6-13Hz) linear probe. Neural targets for blocks for oculoplasty are quite small and superficial and needle of 25-30mm length and US with a depth setting of 1.5-2 cm suffice for most of the blocks. In our centre, we often perform our blocks with 26G, 21mm long bevelled needle easily available in our theatres. These needles are less painful, but are difficult to visualise and may increase risk of nerve injury.[10] A sterile betadine soluton of 1%, safe for ophthalmic application is recommended to clean the site of injection. It is also recommended to always cover the ultrasound probe with a sterile cover for any regional or invasive procedures.

Contradictions

There are no specific contradications for regional blocks for oculoplasty. Regional blocks should generally be avoided in patients with known allergy to local anaesthtics (LA), local site infection, risk of vascular injury. These are superficial blocks and therefore can be carried out even in patients with coagulopathy.[11] Regional techniques should be absolutely avoided in patients or their legal guardians not giving consent.

Nerves And Techniques

1. Supraorbital nerve

a. Anatomy- Frontal nerve, a branch of ophthalmic divison of trigemiinal nerve enters the orbit through superior orbital fissure and divides into two terminal branches- supraorbital and supratrochlear nerve. Supraorbital nerve emerge at the foramen/notch of lateral two third and medial one third of superior orbital ridge and supplies most of the upper eyelid and area of forehead above eyelid. The notch or the foramen is the site of injecting LA to block supraorbital nerve.[8,12] (Figure 2A)

b. Indication- This nerve block can alleviate pain in any surgery involving upper eyelid. This includes surgery for ptosis, blepharoplasty, anterior orbitotomy with an incision from upper eyelid, tarsorraphy, flap from forehead etc.

c. Probe position and Technique- High frequency probe is placed in a transverse plane over the forehead above the eyebrows and slowly moved in a caudal direction to reach upto super orbital ridge.(Figure 2B)

d. Sonoanatomy and injection- A continous white hyperehoic line is observed on US, when the probe is placed over the frontal bone of forehead. (Figure 2C) As the probe is moved caudal to reach superior orbital ridge, a breach in the continuity of hyperechoic line appears which signifies the location of supraorbital notch or foramen. (Figure 2D) Occsionally supraorbital vessels can also be visualised to confirm the location. We advocate an out of plane needle insertion to reach the notch and inject 0.25-0.5 ml of LA to the site after a negative aspiration.[12] (Video-2,3)

Figure 2. Supraorbital nerve A. Supraorbital nerve with vessels at notch. B. Probe position for the block. C. Sono anatomy at Frontal bone. D Sonoanatomy at notch

2. Infraorbital nerve

a. Anatomy- Infraorbital nerve is a branch of maxillary divison of trigeminal nerve.

It arises from the infraorbital foramen half to one cm below the lower orbital margin at the junction of medial one third and lateral two third. (Figure 3A) It corresponds to an imaginary line righ below the lateral pupillary margin. The infraorbital nerve provides sensory innervation to the lower eyelid, lateral aspect of the nose etc. [8,13]

b. Indication- It can be used in any surgery involving lower eyelid or lateral part of nose. This includes blepharoplasty, mid facial lift, tarsorapphy, inferior orbitotomy, dacrocystorhinostomy, rotational flap for lower eyelid repair etc.

c. Probe position and technique - We place the linear probe in the transverse plane 1.5-2cm below inferior orbital margin and slowly advanced in a cephalad direction to reach inferiororbital foramen. (Figure 3B)

d. Sonoanatomy and injection- A continous hyperechoic line is observed as the probe is initially placed over the maxillae. (Figure 3C) As the probe is advanced and reaches infraorbital foramen, there appears a breach in the medial side of hyperechoic line. This marks the infraorbital foramen. (Figure 3D) One can also visualise occasional infraorbital vessels at the site confirming the foramen. We routinely use an out of plane approach to reach the foramen. Needle position can also be confirmed after hydrodissection with a small volume of 0.1-0.2ml. A volume of 0.25-0.5ml of LA can then be injected at the site after negative aspiration for blood.[14]

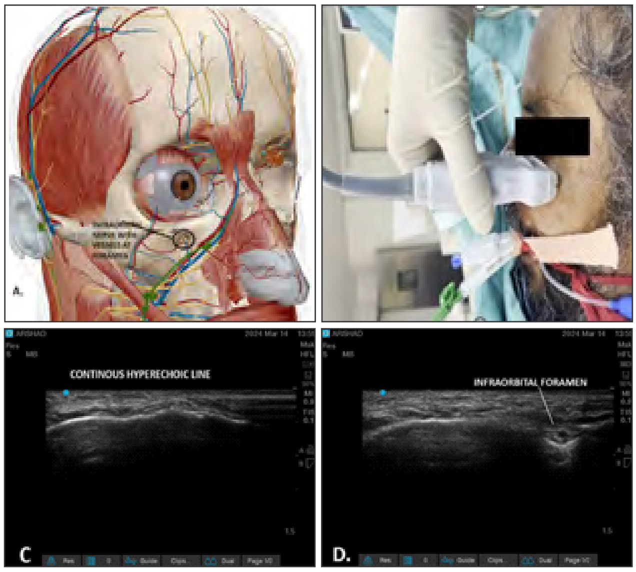

Figure 3. Infraorbital foramen. A. Anatomy B. Probe Position C. Sono-image just below inferior orbital margin D. Sono-image at infraorbital foramen

3. Zygomaticofascial nerve (ZFN)

a. Anatomy- Zygomatic neve is a branch of maxillary divison of trigeminal nerve. It enters the orbit through inferior orbital fissure divides in two terminal branches: zygomaticotemporal and zygomaticofascial nerve. Zygomaticofascial nerve exits the orbit to emerge from zygomaticofascial foramen along with the satellite vessels of same name. (Figure 4A) It then pierces the orbicularis oculi muscle to innervate a small inferolateral part eyelid and prominenece of cheek.[15]

b. Indication- ZFN block can be used to supplement infraorbital neve for complete analgesia for surgeries involving lower eyelid. It also plays a relevant nerve block in surgeries involving lateral canthus like canthoplasty, angular dermoid etc.

c. Probe position and technique- High frequency probe is placed in a transverse plane inferior and below the lateral canthus over maxillae and slowly advanced towards the eye to reach the zygomaticofascial foramen. (Figure 4B)

d. Sonoanatomy and injection- Maxillae appears as bony hyperechoic line and discontinuity in the hyperechoic line may mark the presence of zygomaticofascial foramen. (Figure 4 C,D) If one fails to find any foramen, 0.5-1ml of LA can be deposited below orbiculari oculi muscle and above maxillae.

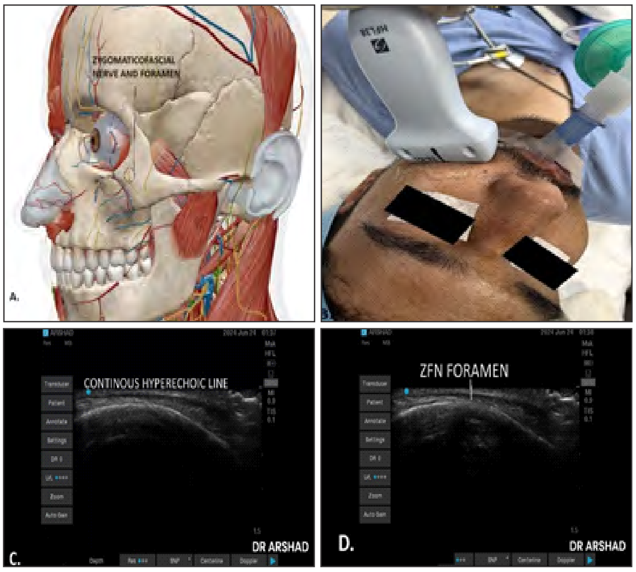

Figure 4. Zygomaticofacial foramen (ZFN) A. Anatomy B. Probe Position C. Sono-image just below foramen D. Sono-image at ZFN foramen

4. Zygomaticotemporal nerve (ZTN)

a. Anatomy- It is a terminal divison of zygomatic nerve inside the orbit. It leaves the orbit at the lateral wall and enters the temporal fossa deep to temporalis muscle. (Figure 5A) It pierces the tempoaralis muscle and courses between two layers of deep temporalis fascia along with middle temporal vessels to provide sensory innervation to an area of 3cm, 1-1.5cm lateral to lateral canthus and parasympathetic nerve supply to lacrimal gland.[16](Figure 5B)

b. Indication- ZTN does not innervate any part of eyelid. It becomes essential to block this neve for surgery around lateral canthus wher incision and surgery actually extends beyond lateral canthus. This includes angular dermoid, Neurofibroma, mid facial lift or extended blepharoplasty surgeries etc.

c. Probe position and technique- Probe is placed in a transverse plane above the zygomatic arch with one end over lateral orbital rim. (Figure 5C)

d. Sonoanatomy and injection- Following structures can be identified superficial to deep. Skin, subcutaneous fat, temporoparietal fascia, intermediate temporal fat pad, superficial layer of deep temporal fascia, deep layer of deep temporal fascia, deep temporal fat pad, temporalis muscle, and periosteum. (Figure 5D) ZTN can be identified within the layers between superficial and deep layers of deep temporal fascia along with middle temporal artery or vein. A needle is advanced from lateral to medial in an in plane approach, deep to superficial layer of deep temporal fascia to reach ZTN and a volume of 0.5-1ml of LA is injected after negative aspiration.[17]

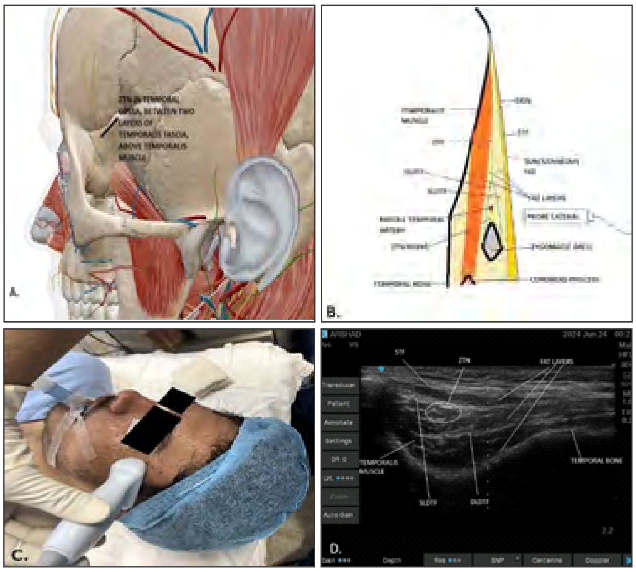

Figure 5. ZTN-Zygomaticotemporal nerve, STF-Superficial temporal fascia, DTF-Deep temporal Fascia, SLDTF-Superficial layer of deep temporal fascia, DLDTF-Deep layer of deep temporal fascia. A. Origin of ZTN in Temporal fossa. B. Location of ZTN between two layers of DTF. C. Probe position for Scanning D. Sonoanatomy for ZTN Block.

5. Mental nerve

a. Anatomy-It is a terminal branch of inferior alveolar nerve. Inferior alveolar nerve enters the mandibuar foramen on the medial surface of ramus of madible and exits through the mental foramen as mental nerve. (Figure 6A) It supplies the ipsilateral half of chin and lower lip.[18]

b. Indication- Mental nerve block can be used to provide anaesthesia for lower lip which is a common site for mucosal grafts used for oculoplasty.

c. Probe position and Technique- We start with probe in a transverse plane over lower border of body of mandible, keeping in mind that mental foramen is located below the angle of mouth. (Figure 6B) Probe is slowly advanced in a cephalad direction to identify mental foramen in ultrasound.

d. Sonoanatomy and injection- Mental foramina is located as a discontinuity in hyperechoic line as the probe is moved cephalad from lower border below the corner of mouth.(Figure 6 C,D) A needle can be inserted in an out of plane to reach the foramina. A volume of 0.5-1ml is needed to block the nerve.[19]

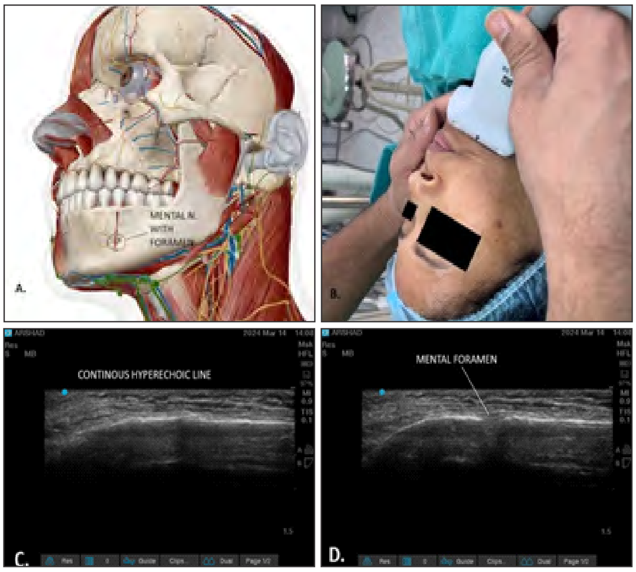

Figure 6. Mental Nerve A. Anatomy B. Probe Position C. Sono-image just below foramen D. Sono-image at Mental foramen

6. Greater auricular nerve (GAN)

a. Anatomy- It is the largest ascending cutaneous branch of cervical plexus comprising of second and third cervical nerve. Cervical plexus lies between investing layer of sternocleidomastoid (SCM) and prevertebral fascia covering sclane and other muscle of the back of neck. Cervical fascia wraps around posterior border of SCM and gives rise to four cutaneous branches. Greater auricular nerve is the largest cutaneous ascending brach of cervical plexus. It ascends from posterior border of SCM courses anteriorly and cephalad on the surface of SCM to terminate in to two terminal branches. (Figure 7A) It provides sensory innnervation to tragus, ear pinna, mastoid angle of mandible.[20,21]

b. Indication- GAN block is considered in surgeries requiring posterior auricular grafts

c. Probe position and technique- A high frequency probe is placed on the posterior border of SCM in a transverse plane at the level of thyroid cartilage to locate cervical plexus. It is moved cranially to identify GAN. (Figure 7B)

d. Sonoanatomy and injection- Superficial cervical plexus is imaged below and posterior to midpoint of SCM muscle. The GAN can then be identified as a small nerve on the surface of SCM, coursing in an anteromedial direction as the US probe is moved cranially. (Figure 7C) Once identified, the nerve can be blocked in either out of plane or inplane approach with a volume of 0.5-1ml LA.[20,21]

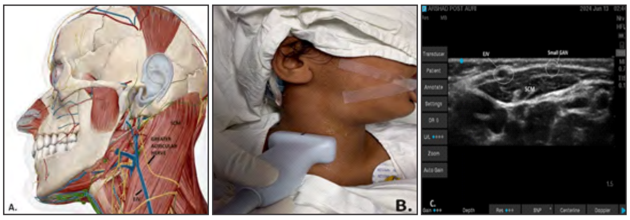

Figure 7. Greater Auricular Nerve. GAN-greater auricular nerve, EJV- External Jugular Vein, SCM-Sternocleidomastoid. A- Anatomy and location of GAN, B- Probe position to scan GAN, C-Sonoanatomy

Drug And Volume

Unlike other surgeries, regional blocks in opthalmology and oculoplasty needs an immediate onset and analgesia for at least intraoperative period. Surgery for oculoplasty may vary from 30 mins to 3-4 hours. It is therfore common to use a final combination of 1%l ignocaine and 0.25% bupivacaine or 0.375% ropivacaine for regional in ophthalmology. Addition of adjuvants to LA is highly desirable to increase the beneficial effects of regional, however, study on adjuvants in regional anaesthesia in ophthalmology is still in nascent stage and still to early to advise any adjuvant drug. Regional targets or the neural structures are very small and may not even be visible on US. A volume of 0.25-1ml is sufficient for majority of blocks to achieve a desired effect.

Complication

Nerves blocks discussed above mostly targets smaller end nerves or the terminal branch of the nerves. This decreases the risk of complications. The dose used for these blocks are also minimal which also minimizes the risk of LA sysytemic toxicity. However, one has to be cautious about the safe dose of LA, when given along with peribulbar block. These nerves are often accompanied by associated artery or vein. These artery or vein are often difficult to identify even with colour doppler in ultrasound. Therfore there is always a risk of vascular puncture leading to local haemorraghe or haeematoma. These vessels are superficial and small so they are amenable to compression and prevent haematoma. These bleeding however small sometimes, can be a deterrant to microscopic surgery in oculoplasty. There is always a concern of nerve injury with nerve blocks and US has not proven to be benefecial in preventing the injury. Injection into the foramen penetration and can also lead to nerve injury and paraesthesia.

Conclusions

Oculoplasty is the branch of ophthalmic surgery associated with severe pain. Regional anaesthesia can be effective technique in managing pain in patients undergoing oculoplasty. There is relatively few literature availble on landmark based regional techniques and comlete lack of studies on use of US for these regional techniques. These US guided regional techniques my provide an effective treatment option for pain management. There is a need to explore the associated pain, role of US based regional techniques, effect of adjuvants and continous infusion for managing perioperative pain in patients undergoing oculoplasty.

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Conflicts of interest

There are no conflicts of interest.

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