Scalp Block: Techniques and Applications

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KEY POINTS

- The scalp block can be used for surgical and pain-management purposes.
- Branches of the trigeminal and the cervical nerves are blocked.
- The scalp is highly vascular, hence negative aspiration is needed before every injection to avoid intravascular injection.
- Complications include direct nerve damage and injection into blood vessels which closely accompany the nerves.

INTRODUCTION

The scalp is the soft tissue which covers the cranial vault excluding the facial bones. It is made of 5 layers and has a generous vascular and sensory nervous supply. Blocking these nerves can provide effective anaesthesia of the scalp.

A scalp block is a regional anaesthetic technique targeting the nerves that innervate the scalp. Scalp block is used for head and neck procedures, in surgery (such as neurosurgery, plastic surgery) and in acute and chronic pain management.

In neurosurgery, supplementing general anaesthesia with a scalp block can blunt painful response to pin application and scalp incision, and can reduce opioid requirements, promoting early emergence for neurological assessment. Modern advances in neurosurgery, especially awake craniotomy, have brought a resurgence in the use of this block.

This review presents the anatomy, technique, advantages, indications, contraindications, and complications of the scalp block.

INDICATIONS AND CONTRAINDICATIONS

See Tables 1 and 2 for indications and contraindications, respectively.

ANATOMY

The scalp has 5 layers: skin, connective tissue, aponeurosis and muscle, loose areolar tissue, and periosteum.[3] The trigeminal and spinal nerves from the superficial cervical plexus provide sensory innervation through 6 different nerves on each side of the scalp (Table 3).The ophthalmic, maxillary, and mandibular branches of the trigeminal nerve supply the anterior scalp, whereas the greater and lesser occipital nerves supply the posterior scalp behind the ear (Figure 1).

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Procedure	Description
Neurosurgery	• Perioperative management of awake craniotomy for surgeries near eloquent areas, epilepsy surgeries, stereotactic radiosurgeries, and deep brain stimulation • Adjunct with general anaesthesia for supratentorial or infratentorial craniotomies for perioperative analgesia • Other procedures like frontal ventriculoperitoneal shunt placement and Ommaya reservoir placement
Other surgical procedures	• Supraorbital and supratrochlear blocks are useful for lower forehead and upper eyelid surgery (eg, repair of a laceration, plastic surgical procedures like excision of anterior scalp pigmented nevus, benign tumour with skin grafting, or dermoid cyst excision) • Can be combined with a nasal block for nasal fractures
Short procedures in emergency department	• Closure of scalp lacerations including skin grafting, rotational flaps, and foreign body removals
Pain management	• Chronic pain management • Greater occipital nerve blocks used for treatment of occipital neuralgia, migraines, cluster headaches, and cervicogenic headache • Reported use in a few cases of post–lumbar puncture headache[1] and refractory trigeminal neuralgia • Steroids like triamcinolone or methylprednisolone sometimes used in combination with the local anaesthetic agents • Branches of the ophthalmic nerve can be blocked for the management of acute ocular and retro-ocular migraine and in the treatment of acute herpes zoster pain[2]

Table 1. Indications for the Scalp Block

Parameter	Description
Absolute	• Proven or suspected allergy to local anaesthetics • Absence of bone flap due to craniectomy
Relative	• Local site infections • Bleeding disorders • Scarring due to previous craniotomy

Table 2. Contraindications for the Scalp Block

Origin	Nerve	Area Supplied
Ophthalmic branch of cranial nerve V	Supraorbital nerve Supratrochlear nerve	Forehead and anterior scalp
Maxillary branch of cranial nerve V	Zygomaticotemporal nerve	Forehead and temporal region
Mandibular branch of cranial nerve V	Auriculotemporal nerve	Temporal areas, lower lip, lower face, auricle, and the scalp above the auricle
Posterior ramus of C2	Greater occipital nerve	Posterior scalp and skin over the auricle
Ventral rami of C2,C3	Lesser occipital nerve	Scalp in the lateral area of the head posterior to the auricle

Table 3. Nerves Involved in the Scalp Block and Their Properties

The frontal nerve enters the orbit through the superomedial aspect of the superior orbital fissure and divides into a larger lateral supraorbital nerve and a smaller medial supratrochlear nerve. Both these nerves supply the forehead and the anterior scalp. The supraorbital nerve travels anteriorly above the levator palpebrae superioris and exits the orbit through the supraorbital notch lateral to the supratrochlear nerve. The supratrochlear nerve leaves the orbit between the supraorbital notch and the trochlea, passing in a superior direction over the forehead.[4]

The zygomaticotemporal nerve innervates a small area of the forehead and the temporal region. It originates from the maxillary branch of the trigeminal nerve. It passes through a small canal in the zygomatic bone and then arrives into the temporal fossa, where it passes superiorly between the bone and the temporalis muscle.[4] It arises midway between the supraorbital and the auriculotemporal nerves and passes through the temporalis muscle to enter the temporalis fascia.

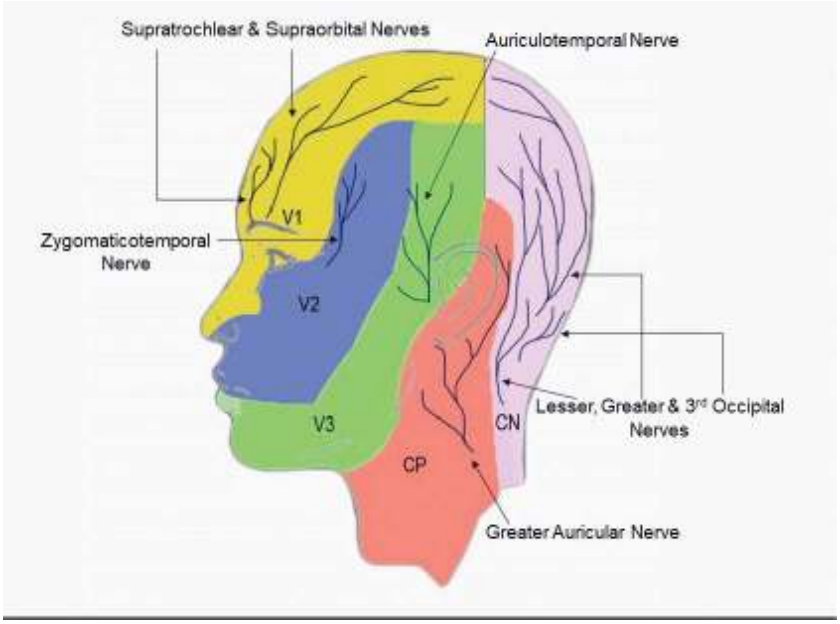

Figure 1. Dermatomes of the head and scalp . V1,V2,V3 indicate divisions of the trigeminal nerve; CP, cervical plexus; and CN, cervical spinal nerves.

The auriculotemporal nerve innervates the temporal areas, lower lip, lower face, auricle, and the scalp above the auricle. It arises as 2 roots from the posterior division of the mandibular branch of the trigeminal nerve. This nerve crosses over the root of the zygomatic process of the temporal bone and lies posterior to the superficial temporal artery.[5]

The occipital nerves are a collection of nerves that originate from the cervical spinal nerves C2 and C3. They are located in the posterior neck and scalp regions and are interconnected through communicating branches. The greater occipital nerve runs between the obliquus capitis inferior and semispinalis capitis muscles. It then pierces the semispinalis capitis muscle and runs alongside the occipital artery to innervate the posterior scalp and skin over the auricle. The lesser occipital nerve runs superiorly towards the skull along the posterior aspect of the sternocleidomastoid muscle, then piercing the deep cervical fascia to emerge onto the posterior aspect of the occipital bone.[6] It ascends along the posterior border of the sternocleidomastoid muscle innervating the scalp in the lateral area of the head posterior to the auricle.

The scalp block has been reported to include an additional nerve, the great auricular nerve. It is the largest of the ascending branches of the cervical plexus. It arises from the C2 and C3 nerves, and its posterior branches supply the skin of the mastoid process and part of the back of the auricle. Minor contributions from the greater auricular nerve and third occipital nerve rarely encroach into the surgical field. While the landmarks where these nerves exit the skull are well defined, the dermatomal distribution exhibits enormous variability.

TECHNIQUE

Equipment

The equipment needed for a scalp block includes the following: topical chlorhexidine 2% skin disinfectant solution, sterile gloves, gauze pieces, 25 gauge needle for injection, 20 mL syringe, and local anaesthesia (LA) drugs.

Drugs Used

Long-acting LA agents (0.25% bupivacaine, 0.75% ropivacaine, or 0.25% levobupivacaine) are administered with or without 5 μg/mL of 1:200,000 epinephrine. The addition of epinephrine serves to cause vasoconstriction and limit systemic absorption of local anaesthetic in intensely vascularised areas like the scalp. The volume of LA administered at each injection site can vary from 2 to 5 mL.[7]

Additives to LA such as clonidine 2 μg/kg or dexmedetomidine 1 μg/kg[8] have also been described, although such uses are unlicensed in some countries such as the United Kingdom.

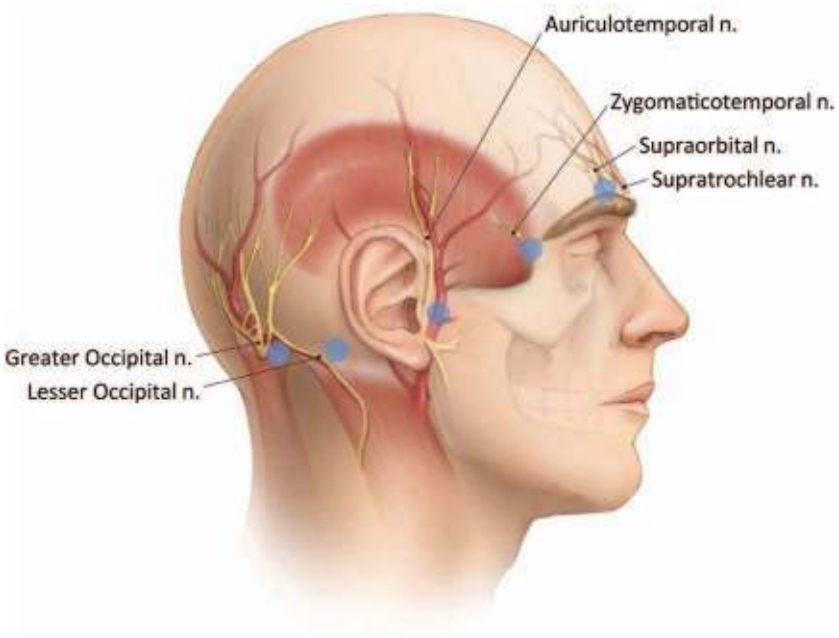

Figure 2. Injection points for nerves of the scalp block shown by blue dots.Source: Kemp et al,[3] under the Creative Commons attribution 2.5 license, 2006.

Technique of Block[7,9]

Take the following precautions as preliminary steps:

- The technique of the block should be explained to the patient and informed consent obtained.
- A "stop before you block" or "time-out" procedure should be performed to ensure correct site and laterality of the intended block.
- For surgical patients, this block can be performed after induction as an adjunct to general anaesthesia or at the end of surgery for postoperative analgesia.
- The injection sites should be disinfected with 2% chlorhexidine. Care should be taken to protect the eyes during this step.

The patient lies supine on the table while the performing operator usually stands at the head end facing the feet. Sedation is recommended during administration of the block as it can be painful. Oxygen can be provided by a nasal cannula with moderate sedation and capnometry should be used. A combination of propofol and/or remifentanil or dexmedetomidine can be used for sedation. Doses of sedatives should be titrated to achieve a Ramsay sedation score of 2 to 3 to prevent oversedation and hypoventilation, especially in elderly patients and those with neurological deficits.

Most of the injections are superficial subcutaneous injections and should produce a wheal on injection. Gentle massage after injection with a piece of gauze helps in the spread of LA. Figure 2 depicts the injection sites, described below.

Supraorbital Nerve

This block is performed with the patient's head facing forward and eyes closed. The supraorbital nerve can be blocked as it exits through the orbit. The supraorbital notch is located by palpation, and the needle is introduced perpendicularly 1 cm medial to the notch. About 2 to 3 mL of LA is injected just superficial to the periosteum.

Supratrochlear Nerve

The position for this block is similar to the supraorbital block. The supratrochlear nerve runs parallel to the supraorbital nerve about 1 fingerbreadth medial to it above the eyebrow. Once the supraorbital nerve is blocked, the needle is directed medially through the same insertion point and a subcutaneous injection of 2 to 3 mL here will block the supratrochlear nerve (Figure 3).

Zygomaticotemporal Nerve

This block is performed with the patient's head turned to one side so that the side to be blocked faces upward. The zygomaticotemporal nerve ramifies as it pierces the temporalis fascia, hence both subcutaneous and deep injections are needed to block this nerve. Infiltration begins with 5 mL of LA at the lateral edge of the supraorbital margin and continues to the

Figure 3. Technique of the suprorbital (left) and the supratrochlear (right) nerve block. The supratrochlear block is a medial extension of the supraorbital block.

distal aspect of the zygomatic arch. The injection point is at the outermost edge of the supraorbital margin (the concave portion of the lateral orbital rim). The angle of the needle should be 90 degrees till bone is contacted, where the operator can deposit 1 to 2 mL of LA here as a deep injection. The needle is then redirected laterally to reach the outermost aspect of the zygomatic arch, and another 3 to 4 mL of LA is deposited along this trajectory (the supraorbital margin and zygomatic arch are marked with dotted lines in Figure 4).

Auriculotemporal Nerve

Position for this block is similar to the zygomaticotemporal block. This nerve can be blocked by injecting approximately 3ml of LA 1 to 1.5 cm anterior to the ear at the level of the tragus above the level of the temporomandibular joint (Figure 5). The superficial temporal artery should be palpated to avoid intra-arterial injection. Negative aspiration is a must for this block. The injection is superficial and subcutaneous as a deep plane injection can cause a facial nerve block.

Greater Occipital Nerve

This block can be performed by turning the head to the side or with the patient sitting up. The greater occipital nerve can be blocked by infiltrating LA subcutaneously halfway between the occipital protuberance and the mastoid process, 2.5 cm lateral to the nuchal median line (Figure 6). The best landmark is to palpate the occipital artery (found about 3 to 4 cm lateral to the

Figure 4. Technique of the zygomaticotemporal block. The dotted lines show the supraorbital margin and the zygomatic arch.

Figure 5. Technique of the auriculotemporal block.

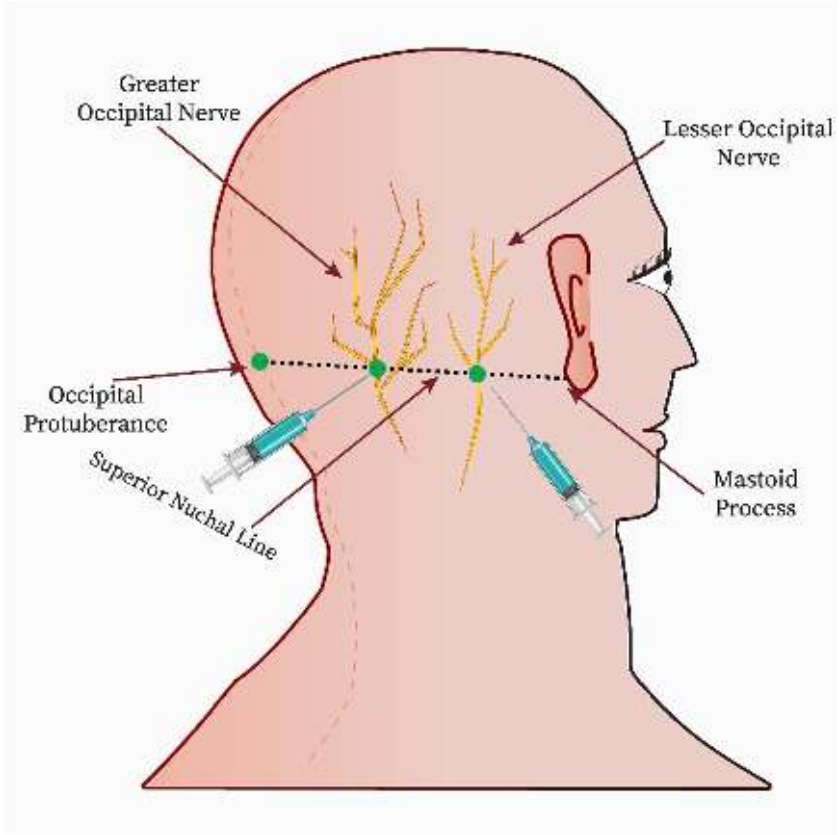

Figure 6. Technique of the greater and lesser occipital nerve blocks.

external occipital protuberance along the superior nuchal line), and inject medial to the artery after careful aspiration. This should avoid potential intra-arterial injection. The needle is inserted at a 90 degree angle towards the occiput until bony contact is obtained, then withdrawn to make a subcutaneous injection here with 5 mL of LA to block the greater occipital nerve.

Lesser Occipital Nerve

The position for this block is similar to the greater occipital nerve. The block is made subcutaneously by injecting 5 mL of LA 2.5 cm lateral to the greater occipital nerve along the superior nuchal line (Figure 6).

Great Auricular Nerve

The postauricular branches of the great auricular nerve may be blocked with an injection of 3 to 5 mL of LA subcutaneously between the skin and bone, 1.5 cm posterior to the ear at the level of the tragus. The needle is inserted at 90 degrees till bony contact is made, upon which it is withdrawn and subcutaneous injection is performed.

COMPLICATIONS

- Anaphylaxis in response to LA.
- Toxicity of LA. Epinephrine as an additive can lessen systemic absorption of LA and hence limit the acute rises in its plasma level. The anaesthetist must adhere to the maximum recommended LA dose and be vigilant in the first 15 minutes after the block to detect signs of toxicity.
- Haemodynamic changes and arrhythmias due to systemic absorption of epinephrine. Caution is advised in patients with coronary heart disease and negative aspiration recommended to avoid inadvertent intravascular injection.
- Vascular injury and hematoma formation due to proximity of nerves to blood vessels. (Note that the auriculotemporal nerve and the greater occipital nerve are adjacent to the superficial temporal and occipital arteries, respectively.)
- Pain. Intraneural injection may cause immediate severe pain. This risk is especially significant in the case of the supraorbital nerve block due to its anatomical position. A major advantage of the scalp block is that most of the nerves that innervate the scalp are superficial terminal sensory branches, and the risk of nerve damage is less than that for the deeper motor nerves.[10]
- Facial nerve palsy. This is a relatively rare complication and can occur during the auriculotemporal or zygomaticotemporal injections due to their proximity to the facial nerve. This is usually transient, due to blockade of the facial nerve by the LA rather than a permanent injury to the nerve. Causes range from deep injections, compression from a haematoma, oedema, or the pressure of an LA injection and vasoconstriction-induced neural ischaemia due to epinephrine. Facial palsy occurs at a rate of 8.6% after an auriculotemporal block.[11]
- Intracerebral or subarachnoid injection. This has been reported in patients with bony defects or previous craniectomies.[12]
- Bradycardia and hypotension. A trigeminocardiac reflex during the scalp block can present as severe bradycardia and hypotension. It can be provoked by mechanical, electrical, or chemical stimulation of any sensory branch of cranial nerve V. This has been described with peripheral branches involved in the scalp block as well. Caution is advised while anaesthetizing the trigeminal nerve as rapid LA infiltration can compress or stretch the nerve, thus triggering this reflex.[13]
- Unilateral ptosis. This may occur due to excessive LA infiltration, leading to injury or oedema in the muscles responsible for eyelid retraction.
- Infection. This is possible, though rare.

DISCUSSION

Scalp Block in Paediatric Patients

The technique is similar to that used for adults, but lower doses and volumes are advised. Usual choice of LA includes 0.25% bupivacaine or levobupivacaine (2 mg/kg) with 2.5 μg/mL of epinephrine.[14] Care is taken to not exceed the maximum LA dose according to the weight of the child.

Scalp Infiltration Versus Scalp Block

A scalp block is targeted at the nerves supplying the scalp and hence a lesser volume of drug is needed compared to scalp infiltration. A scalp block also has a longer duration of action.

Alternate Approach

In 2016, an alternate approach describing the use of a maxillary block along with greater and lesser occipital nerve blocks found better analgesia compared to a regional scalp block in craniotomy patients. This approach relies on the retrograde

spread of the anaesthetic along the maxillary nerve, leading finally to a complete block of all branches of the ipsilateral trigeminal nerve.[15]

SUMMARY

- The scalp block is a safe and easy technique having many advantages for intra and postoperative pain relief in various surgeries.
- Nerves supplying the scalp are targeted in a systematic manner on each side.
- Complications include direct nerve damage and injection into blood vessels which closely accompany the nerves.

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