Pediatric Anesthesia

Pediatric Anesthesia ISSN 1155-5645

REVIEW ARTICLE

Head and neck blocks in infants, children, and adolescents

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Keywords
head; neck; peripheral nerves; block; postoperative pain control

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Accepted 17 August 2011

Section Editor: Per-Arne Lonnqvist

doi:10.1111/j.1460-9592.2011.03701.x

Summary

This review will discuss the use of peripheral nerve blocks of the head and neck and its application to the practice of pediatric anesthesia using simple, landmark based approaches.

Introduction

Regional anesthesia is gaining popularity in children. Head and neck blocks are used more frequently in children than in adults and offer excellent analgesia with little or no adverse effects. These blocks may also facilitate a significant decrease in the need for additional opioids or analgesics, thereby decreasing adverse side effects including nausea and vomiting (1). The wide array of common surgical procedures performed in children allow the application of head and neck blocks in plastic surgery, otolaryngology, dermatology as well as neurosurgery. This review will deal with commonly performed head and neck blocks with an evidence-based approach to the use of these blocks for common use. As most of these blocks are sensory in nature, not only is it easy to perform but they also require less equipment and have very few adverse effects. A basic understanding of the anatomy of the distribution of sensory nerves of the head is essential for the understanding of these blocks.

Anatomy and innervations of the head and neck

The sensory supply of the head and neck is primarily made by three major branches of the trigeminal nerve: ophthalmic, maxillary, and mandibular along with the C2–C4 cervical roots, which supply the neck and the occipital portion of the scalp.

The terminal sensory nerves of the trigeminal nerve V1 (supraorbital), V2 (infraorbital), and V3 (mental and auriculotemporal) become superficial when they exit the facial bones through the corresponding foramina that usually lie in the midline (generally recognized as the midpoint of the pupil with the head in the neutral position) (Table 1).

We will discuss individual nerves, the specific indication, and the technique for the performance of these blocks.

Supraorbital and supratrochlear blocks

The terminal branches of V1, the supraorbital and supratrochlear, supply the sensory innervation of

Table 1 Head and neck blocks

Nerves	Anatomy	Innervation	Indication
Trigeminal nerve	'The great sensory nerve of head and neck' Arises from the trigeminal ganglion	Innervates the face and the scalp up to the coronal sutures through three major divisions: ophthalmic (V1), maxillary (V2), and mandibular (V3)	
V1 – Ophthalmic supraorbital, supratrochlear nerves	Exit the cranium through the superior orbital fissure Divide into three branches: lacrimal, frontal, and nasociliary Frontal nerve branches into supraorbital and supratrochlear Supraorbital and supratrochlear emerge through the notches	Innervate the frontal scalp, forehead, median portion of the upper eyelid, and bridge of the nose	Scalp nevus excision, midline dermoid excision, and ventriculoperitoneal shunt
V2 – Maxillary infraorbital nerve	Exits the cranium through the inferior orbital fissure Infraorbital nerve is the largest and appears through the infraorbital foramen Divides into multiple branches, the biggest are: the inferior palpebral, the external nasal, and the superior labial	Innervates the lower lip, lateral portion of the nose, median cheek, the roof of the mouth, upper teeth, and maxillary sinus	Cleft lip repair and endoscopic sinus surgery
V2 – Greater palatine nerve	Arises from pterygopalatine ganglion Emerges through the greater palatine foramen Lies in the groove of the hard palate	Innervates the gums and the mucous membrane of the hard palate	Cleft palate repair
V3 – Mandibular division of the nerve	Sensory and motor nerve Exists the cranium through the foramen ovale and branches into several nerves The major branches are the buccal nerve, the lingual nerve, the inferior alveolar nerve, and auriculotemporal nerve	Innervates anterior 2/3 of the tongue, lower teeth, lower lip, and chin skin of the temporal-parietal area of the scalp Motor innervation to the muscle of mastication	Temporoparietal incision of the scalp
V3 – Mental nerve	A branch of the inferior alveolar nerves Emerges through the mental foramen in the mandible	Innervates the skin of the chin, lower lip, anterior teeth, and buccal mucosa	Lower lip surgery
Greater occipital nerve	Arises from the posterior rami of C2, C3 nerve roots Becomes superficial at the level of the superior nuchal line and travels cephalad and medial to the artery	Innervates the skin of the posterior scalp	Occipital neuralgia and posterior fossa surgery
Superficial cervical plexus	Forms by the ventral rami of C2–C4 Becomes superficial when emerges from the midpoint of the posterior border of sternocleidomastoid muscle At that point, divides into four distinctive nerves: the lesser occipital, the great auricular, the transverse cervical, and the supraclavicular nerve	Innervates the anterior-lateral skin of the neck, lateral scalp, posterior auricular area, and parotid gland	Tympanomastoid surgery, ear surgery, anterior cervical surgery, and thyroid surgery

the forehead and can be blocked effectively in children.

Indications
Frontal craniotomy, ventriculoperitoneal shunt, Omayya reservoir placement, dermatologic procedures (2–4).

Position
Supine, with the patient's head in midline.

Equipment
0.25% bupivaciane or 0.2% ropivacaine; 30-G needle; 3-ml syringe; sterile preparation either with chlorhexidine or with betadaine.

Technique
The supraorbital foramen is located as described previously at the superior part of the orbital rim in the midline, in line with the pupil. After careful preparation using betadaine or chlorhexidine (note: please cover the eye and make sure that it is protected), a 30-G needle is used to inject subcutaneously with the needle oriented in a lateral-to-medial direction. After careful aspiration, 1–2 ml of 0.25% bupivacaine with 1 : 200 000 epinephrine is injected, gentle massage followed by pressure application to the eyebrow is provided to prevent the formation of a hematoma. We prefer using an epinephrine-containing solution to facilitate vasoconstriction to prevent excessive bleeding from the injection site. If surgery for a midline dermoid is performed, it is important to place the needle more medial to block the supratrochlear nerve (Figure 1).

Complications
Intravascular injection and hematoma formation. It is rare to see any persistent paresthesia in this distribution even if paresthesia was obtained at the time of injection.

Infraorbital nerve

The V2 branch of the trigeminal nerve exits the infraorbital foramen and supplies the sensory supply to the upper lip, tip of the nose, and the maxillary process. Anatomically, the infraorbital foramen location has been demonstrated in cadavers as well as CT imaging and the distance from midline is located at approximately 21 mm + 0.5× age (in years) (5,6).

Indication
Cleft lip repair (7,8), endoscopic sinus surgery (9), nasal septal surgery, and trans-sphenoidal hypophysectomy (10). The use of this block has been demonstrated to be efficacious for cleft lip repair while allowing the children to adequately feed (7). This block has far-reaching implications especially when there is a paucity of the availability of opioids for pain control especially in developing countries.

Figure 1 The supraorbital foramen is located at the level of the mid-pupillary line, a 30-G needle is used and subcutaneous injection of local anesthetic solution is placed, gentle massage follows the injection to prevent a hematoma formation and allow spread of the local anesthetic solution.

Position
Supine with a shoulder roll to extend the head.

Equipment
27-G needle, 0.25% bupivacaine or 0.2% ropivacaine, and sterile gauze.

Technique
There are two approaches to the infraorbital nerve, an intraoral technique and an extraoral technique. The intent of this block is to deposit the local anesthetic solution at the level of the infraorbital foramen where the maxillary division of the trigeminal nerve exits. Our preference is to utilize the intraoral approach because it has two advantages: there is (i) absence of a needle stick and the potential of a hematoma formation on the skin surface and (ii) the potential for a more adequate blockade of the maxillary division. The upper lip is everted and the mucosa is cleaned with a sterile gauze. A 27-G needle is inserted with the needle directed toward the infraorbital foramen. A finger is placed at the level of the infraorbital foramen to decrease any potential for greater cephalad placement of the needle. After aspiration, 0.5 ml (for infants with cleft lip) to

Figure 2 The infraorbital nerve is blocked as it exits the infraorbital foramen using an intraoral technique with a 27-G needle, after aspiration 0.5 ml to 2 ml of local anesthetic solution is injected.

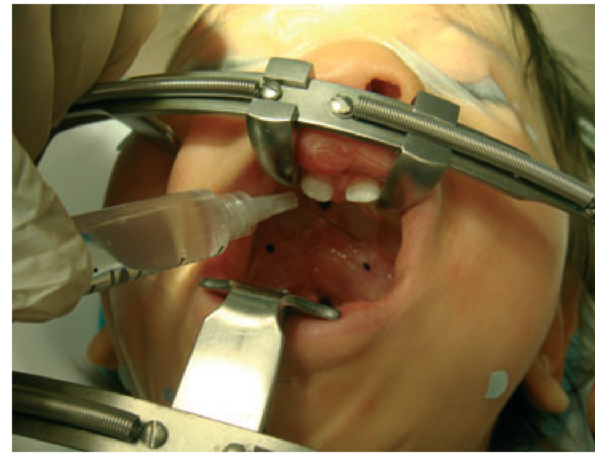

Figure 3 The greater palatine foramen is identified, a 27-G needle is inserted with anterior to the foramen in the mucosa, after aspiration, 1 ml of local anesthetic solution is injected.

2 ml (for sinus surgery) is injected into the area (Figure 2).

Complications
Hematoma formation, persistent paresthesia of the upper lip, prolonged numbness of the upper lip, and intravascular placement.

Greater palatine nerve block

The greater palatine nerve is a branch of the V2 division of the trigeminal nerve as it comes off the pterygopalatine ganglion. Blockade of this nerve is effective in producing analgesia for palate surgery. The use of this block has been shown to improve postoperative analgesia in children undergoing palate surgery. This block is particularly useful in children undergoing palatal surgery because they are prone for airway obstruction, which may be offset by the use of this block when compared with the use of opioids for pain relief.

Indications
Cleft palate surgery.

Position of the patient
Supine, with a mouth gag placed by surgeon to allow easy access to the palate.

Equipment
27-G needle, 0.25% bupivacaine, 3-ml syringe, and sterile gauze.

Technique
After the Dingman's mouth gag is placed, the palate is visualized, the demarcation between the hard and soft palate is identified. The greater palatine foramen is located lateral to the midline usually just anterior to the junction of the soft and hard palate. In patients with dentition, the nerve is located just medial to the second molar. Local anesthetic solution (1–1.5 ml) of 0.25% bupivacaine is injected anterior to the greater palatine foramen after cleaning the palate with a sterile gauze. We prefer not to inject into the foramen itself because of the potential for injecting into a vessel and also the potential for damaging the greater palatine nerve (Figure 3).

Complications
Intravascular and intraneural injection.

Mandibular division of the trigeminal nerve

The terminal branches of V3 division of the trigeminal nerve supplies two major areas that can be blocked for surgical procedures: the auriculotemporal nerve supplying the lateral portion of the scalp and the mental nerve supplying the lower lip and parts of the mandible.

Indications
Laceration of the lower lip, hemangiomas, and craniotomy for temporoparietal incisions.

Equipment
27-G needle, 0.25% bupivacaine, 3-ml syringe, alcohol wipes, and sterile gauze.

Position
Supine.

Technique
The auriculotemporal nerve is blocked at the midpoint of a line drawn between the pinna and the angle of the eye; the nerve is located superficially and can be easily blocked using a subcutaneous injection at the site. To block the mental nerve, the lower lip is everted, a 27-G needle is inserted at the level of the canine toward the mental foramen, and after aspiration, 1 ml of 0.25% bupivacaine is injected after the mucosa has been entered.

Complications
Hematoma formation and lower lip numbness.

Greater occipital nerve

The C2 nerve root as it exits the C2 foramen leads to a large branch of the greater occipital nerve, which supplies the posterior part of the scalp (the occiput). After several cadaveric dissections, Tubbs *et al.* (11) demonstrated that the nerve is located about 4 cm from the occipital protuberance. More recently, ultrasound guidance has been used extensively to perform this block.

Indications
Posterior fossa craniotomy (3,4) occipital neuralgia (12), migraine headaches, and cervicogenic headaches (13).

Position
Prone or supine with the head turned to the side opposite the one to be blocked.

Equipment
0.25% bupivacaine, 27-G needle, 3-ml syringe, and US with a linear, high-frequency probe (if US guidance is used).

Technique
1. Landmark based: The superior nuchal line is identified, the occipital artery is located just lateral to the midline inferior to the superior nuchal line. The occipital nerve is initially located medial to the artery and is then later noted to be lateral to the occipital artery. The midpoint of a line drawn between the mastoid process and the midline will be a good guide to the location of the greater occipital nerve. A 27-G needle is inserted subcutaneously and is fanned laterally, and 2 ml of 0.25% bupivacaine is injected subcutaneously as the needle is gently withdrawn.

Figure 4 A linear probe is placed over the C2 spinous process, it is then tilted and moved lateral, the obliquus capitus muscle is identified with the occipital nerve situated on top of the muscle.

2. Ultrasound technique: A newer US-guided technique has been described for the performance of occipital nerve blocks (14,15). Using a linear probe, the spinous process of the C1 vertebra is noted in the midline, the probe is then moved caudad to the C2 vertebra, which is bifid. The probe is then rotated laterally and moved laterally to notice the obliquus capitis muscle. The greater occipital nerve is located on top of the obliquus capitis muscle. Using an in-plane approach, the nerve can be easily blocked in this position. This has become our preferred method for blockade of the greater occipital nerve especially for neurosurgical procedures as well as for the treatment of occipital neuralgia (Figure 4).

Complications
Rare, intravascular injection with the landmark technique. While using US guidance, it is important to visualize the vertebral artery to prevent injection into the artery using color Doppler.

Superficial cervical plexus

The superficial cervical plexus is derived off the C3/C4 nerve root. It wraps around the belly of the sternocleidomastoid and terminates in four major branches, the lesser occipital nerve, the great auricular nerve, the supraclavicular nerve, and the transverse cervical nerve. Each one of these nerves has specific distributions that can help the pediatric anesthesiologist in pain management.

Indications
The lesser occipital and the great auricular nerves supply the posterior occipital area as well as the pinna.

We have used this block for providing postoperative pain control in children undergoing postauricular incisions as in tympanomastoid surgery and cochlear implants (1,16). This block can be used in addition to the greater occipital nerve block in children undergoing major craniotomies especially if they have an occipito-parietal incision. The transverse cervical nerve block can be used for thyroplasty surgery (17) as well for thyroid surgery (18,19). The supraclavicular nerve can be used for providing analgesia for the skin over the shoulder and neck.

Equipment
0.25% bupivacaine, 27-G needle, 3-ml syringe, chlorhexidine, and sterile gauze.

Position of patient
Supine with the head turned toward the side opposite to the block area.

Technique
This is one of the blocks that can be easily performed using landmark techniques. The sternocleidomastoid muscle is identified, and the C6 hyoid prominence is identified. The nerve wraps around the belly of the sternocleidomastoid at the level of the C6 prominence. After sterile preparation, subcutaneous injection of 2–3 ml of 0.25% bupivaciane is injected after careful aspiration to rule out intravascular injection. It is important to recognize the subcutaneous wheal because a small bend to the needle will allow it to stay in a subcutaneous plane. If the intent is to block the lesser occipital and the great auricular nerve, it is important to keep the needle posterior of the sternocleidomastoid muscle. After injection of the local anesthetic solution, it is important to massage the area to spread the local anesthetic solution (Figure 5).

Complications
Intravascular injection, hematoma formation, deep cervical plexus block, and diaphragmatic paresis.

Nerve of Arnold block

This is a blockade of the auricular branch of the vagus nerve that supplies the sensory innervation of the auditory canal as well as the inferior portion of the tympanic membrane. This is useful for myringotomy and tube placement as well as for older patients who may have a retained tube that may necessitate the placement of a paper patch with its associated pain. A study performed by Voronov *et al*. (20) demonstrated the block to be equivalent to fentanyl given intranasally for pain control following myringotomy and tube placement.

Figure 5 The sternocleidomastoid muscle is identified at the level of the cricoid cartilage, a 27-G needle is inserted in a subcutaneous fashion, after aspiration 2 ml of local anesthetic solution is injected.

Indications
Myringotomy and tube placement, tympanoplasty, and paper patch for ruptured tympanic membrane.

Equipment
Alcohol preparation, 0.25% bupivaciane, 30-G needle, and tuberculin syringe.

Position
Supine with the head turned toward the opposite of the side to be blocked.

Figure 6 The tragus is everted, a 30-G needle is inserted into the tragus, after aspiration 0.2 ml of local anesthetic solution is injected.

Technique
The posterior portion of the tragus is cleaned with alcohol and everted, a tuberculin syringe with a 30-G needle is used to pierce the cartilage, and after aspiration, 0.2 ml of 0.25% bupivaciane is injected. Good analgesia can be obtained by performing the block prior to the placement of the pressure equalizing tube (Figure 6).

Complications
Bleeding from the needle entry site.

Conclusion

Head and neck blocks can be used effectively for managing postoperative pain control in children undergoing a variety of painful procedures. The risk of performing these blocks is low, and hence, utilization should be greater than what is currently used in the practice of pediatric anesthesia. In addition, there is fewer equipment that is needed, allowing us to perform these blocks for major plastic procedures despite the lack of major equipment like ultrasound guidance. We hope that this review will rejuvenate the use of regional anesthesia for head and neck in infants, children, and adolescents.

Acknowledgments

As a sub-contractor in a research study with the Children's Hospital of Denver and the Children's Hospital of Boston, Dr. Suresh receives funding from the National Institute of Health.

Conflict of interest

No conflicts of interest declared.

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