

## CPD

## Essential regional nerve blocks for the dermatologist: Part 1

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## Summary

The aim of this two-part series is to provide an up-to-date review of essential regional nerve blocks for dermatological practice. In Part 1, we give a concise overview of local anaesthetics and their potential complications, as well as the relevant anatomy and cutaneous innervation of the face and scalp. This culminates in a step-by-step practical guide to performing each nerve block.

## Introduction

Effective local anaesthesia is an integral part of dermatological surgery. The introduction of local anaesthetics (LAs) in the early 20th century increased the complexity of procedures that could be performed with the patient awake. The use of regional nerve blockade (RNB) produces efficient anaesthesia of a large area with only a minimal amount of LA, thereby minimizing the risk of LA toxicity and avoiding deformation of the operative site. Performed correctly, RNB provides a longer duration of anaesthesia compared with infiltrative techniques. It can minimize the pain of infiltration at sensitive sites, and reduce the number of injections needed. Perhaps most importantly, the use of RNB decreases postoperative pain, and improves patient care and satisfaction.<sup>1,2</sup>

Regional nerve blocks provide anaesthesia of a larger field, which makes them suited to procedures such as complex excisions, intralesional Bleomycin, photodynamic therapy as well as full-face laser resurfacing and laser surgery.

In Part 1, we will describe the relevant anatomy and cutaneous innervation, then explain the techniques for essential regional nerve blocks of the face and scalp.

## Local anaesthetics

LAs consist of an aromatic ring attached to a terminal amine. They can be split broadly into two groups: esters and amides, relating to the difference in the link between the aromatic ring and the amine group (Fig. 1).

The mechanism of action is universal and consists of two stages. Initially, the LA has to pass through the phospholipid membrane of the cell, to do this the LA has to be in the un-ionized (lipid-soluble) state. Once in the neuronal axoplasm, the LA is protonated and becomes ionized. It is then able to bind to the inner pore of the sodium (Na<sup>+</sup>) channels, preventing them

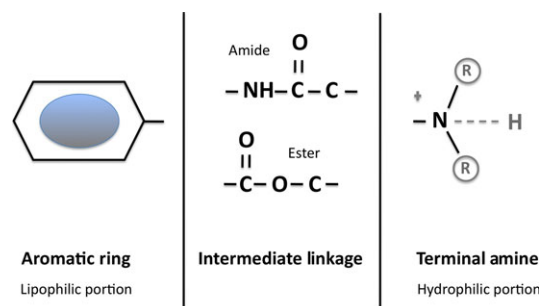


Figure 1 Structure of local anaesthetics.

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from leaving their open (inactive) state, thus stopping  $\text{Na}^+$  influx. This consequently attenuates the upward slope of the action potential, inhibiting depolarization of the nerve cell and therefore neuronal transmission. Because they have an affinity for  $\text{Na}^+$  channels in their open state, cells that frequently depolarize are preferentially targeted.<sup>3</sup>

Amides are the most commonly used class of LAs in clinical practice because of their stability in solution and lower incidence of allergy. The different physiochemical properties of the LAs confer speed of onset (acid dissociation constant; pKa), potency (lipid solubility), duration of action (protein binding) and potential for toxicity (metabolism). The pKa alters speed of onset because it determines the percentage of the drug that is un-ionized at physiological pH (Table 1).

Amide metabolism is determined by hepatic blood flow and the cytochrome P450 enzymes.<sup>4</sup> Therefore, caution is advised with patients taking drugs that inhibit this system or patients who have hepatic failure.

**Table 1** Properties of the most commonly used amides (adapted from Peck *et al.*<sup>4</sup>).

| Property                            | Lidocaine | Bupivacaine |
|-------------------------------------|-----------|-------------|
| Speed of onset, min                 | 5–10      | 10–15       |
| pKa*                                | 7.9       | 8.1         |
| Percentage un-ionised at pH 7.4, %* | 24        | 15          |
| Duration of action, min             | 30–120    | 120–240     |
| Protein binding, %†                 | 70%       | 94%         |
| Lipid solubility‡                   | 150       | 1000        |
| Toxic dose, mg/kg                   | 3         | 2           |
| Toxic dose (with adrenaline), mg/kg | 7         | 2           |

\*Relates to onset; †relates to duration; ‡relates to potency.

LAs can be combined to achieve a mixture of their preferential properties (e.g. rapid onset of action and long duration); however the toxic effects are additive, not synergistic. For example, giving 75% of the maximum dose of bupivacaine plus 25% of the maximum dose of lidocaine is the limit of safe dosing. If Lidocaine without Adrenaline is being used as the LA of choice, we would encourage use of the 1% preparation as it provides reliable anaesthesia and provides greater flexibility in the potential maximum volume that can be administered. This is an increasingly important safety consideration to minimize the risk of LA toxicity in an increasingly ageing patient population with multiple comorbidities.

## General principles of regional nerve blockade

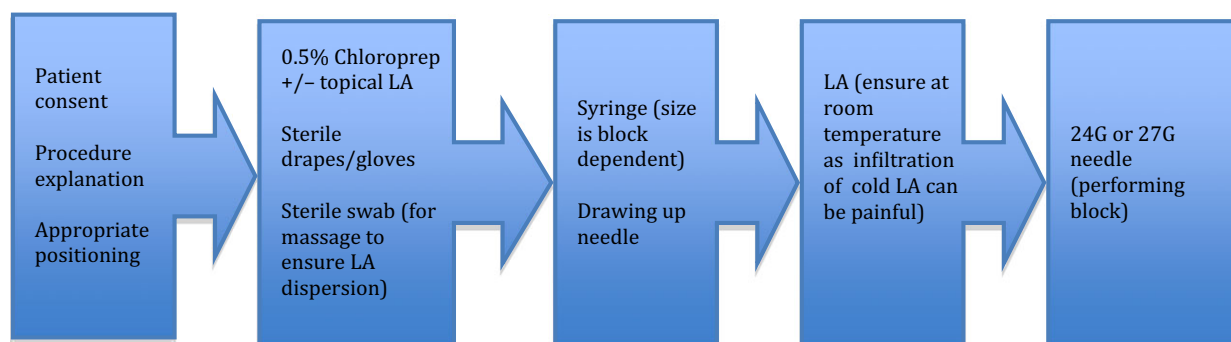
### General complications

Absolute contraindications to RNB include infection at the site of injection, allergy to the LA and patient not consenting to RNB (Fig. 2; Table 2).

## Regional nerve blocks for the face

### Supraorbital and supratrochlear nerves

The ophthalmic nerve, a branch of the trigeminal nerve, divides into three sensory nerves as it passes through the superior orbital fissure: the frontal, lacrimal and nasociliary nerves. The supraorbital and supratrochlear nerves (Table 3) are both terminal branches of the frontal nerve.<sup>13</sup> The supraorbital nerve exits the frontal bone via the superior orbital foramen, which lies in the mid pupillary line adjacent to the supraorbital ridge, which is found approximately 25 mm lateral to the glabellar midline.



**Figure 2** Procedure outline and equipment list.

**Table 2** General complications of regional nerve blocks.

| Complication                   | Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bleeding and haematoma         | Usually settles with direct pressure to the injection site. It is suggested that patients should have an INR $\leq 1.5$ and platelet count $\geq 80 \times 10^9/L$ . It has been recommended that Clopidogrel should be discontinued 7 days prior to blockade, Aspirin is not a contraindication to RNB. <sup>5</sup> RNB should not be performed until at least 12 h after administration of low molecular weight heparin, and further doses should not be given until 4 h after RNB.                                                                                                                                                                                                |
| Infection                      | A sterile procedure must be employed, with preoperative or postoperative antibiotics if appropriate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Failure/incomplete anaesthesia | Review LA dose or use supplemental infiltrative LA. Owing to the larger calibre of the nerves being blocked, additional time (10–15 min) may help to increase the density of the block and maximise the anaesthetic effect.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Pain/paraesthesia              | If pain, paraesthesia, or increased pressure is experienced on insertion/injection, withdraw and redirect as this may indicate intraneural needle placement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Vascular puncture              | Always aspirate before injection and after every 5 mL of LA administered to avoid inadvertent intravascular injection.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Nerve injury                   | Peripheral nerve injury is an uncommon complication of regional anaesthesia, <sup>6</sup> therefore details of nerve damage for individual regional blocks are difficult to estimate accurately. Most nerve injuries are often transient and subclinical. <sup>6</sup> Patients with pre-existing nerve pathology, such as diabetes and neurological disorders are more susceptible to peripheral nerve complications. <sup>7</sup> The incidence of transient paraesthesia in the initial post-nerve block period can be as high as 10%. <sup>8</sup> However, permanent neurological injury has been reported to occur in only 1.5 per 10 000 peripheral nerve blocks. <sup>9</sup> |
| Systemic LA toxicity           | Toxicity is linked to peak plasma concentrations, therefore even when working within maximum safe doses, partial intravascular injection, especially around the head or neck, can lead to toxicity. Typically, central nervous symptoms precede cardiac symptoms. Early warning signs are circumoral paraesthesia, tinnitus and light-headedness. Late symptoms are <i>grand mal</i> seizures and cardiovascular collapse. The incidence is estimated at 0.075–0.025%, and necessitates prompt assessment, resuscitation and transfer to an appropriate site for treatment, which includes supportive measures, Intra-lipid and CPR as appropriate. <sup>10</sup>                     |
| Postoperative injury           | Advice should be given on discharge about action to be taken in cases where there is development of an insensate extremity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Ischaemia                      | Current evidence does not contradict the use of adrenaline-containing preparations in digital blocks for the appropriate patient cohort (without vascular comorbidities). <sup>11,12</sup> However, it is still common practice to avoid such combinations during regional anaesthesia of end-arterial territories because of the theoretical risk of digital necrosis.                                                                                                                                                                                                                                                                                                               |

CPR, cardiopulmonary resuscitation; INR, international normalized ratio; LA, local anaesthetic; RNB, regional nerve block.

### Infraorbital nerve

The infraorbital nerve is the largest branch of the maxillary nerve, which itself is a branch of the trigeminal nerve (cranial nerve V).<sup>13</sup> The nerve exits the maxilla via the infraorbital foramen, and although the exact position may vary slightly in different populations, the nerve is found in the mid pupillary line approximately 10 mm below the infraorbital ridge.<sup>14</sup> The RNB can be performed by the intraoral route or percutaneously. We will describe the intraoral route, as studies have shown this approach to have a higher success rate, longer duration of anaesthesia and increased patient comfort.<sup>15,16</sup> An infraorbital nerve block should provide full anaesthesia of the nasal ala in the majority of patients. In those patients for whom

this is insufficient, supplementary anaesthesia with an external nasal nerve block can be used.<sup>17</sup>

### External nasal nerve

The nose is supplied by the first two divisions of the trigeminal nerve; the ophthalmic (V1) and maxillary (V2) nerves. The external nasal nerve is a branch of the ophthalmic division (V1) of the trigeminal nerve.<sup>13</sup>

### Mental nerve

The mental nerve is a branch of the mandibular nerve, which is a division of the trigeminal nerve.<sup>13</sup> It

**Table 3** Regional nerve block techniques for the face.

| Nerve                                    | Cutaneous innervation*                                                                                                                                                                                               | Anatomical landmarks                     | Technique                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Supraorbital nerve, supratrochlear nerve | Skin and conjunctiva of medial upper eyelid, skin of anterolateral forehead and scalp up to vertex. <sup>13</sup> Skin and conjunctiva of medial aspect of upper eyelid, skin of anteromedial forehead <sup>13</sup> | Supraorbital ridge                       | <ol style="list-style-type: none"> <li>1. Locate the supraorbital notch.</li> <li>2. Insert the needle in a medial direction at 45 degrees to the eyebrow at the level of the supraorbital foramen, and inject 2 mL of LA slowly.</li> <li>3. Withdraw to the skin and advance subcutaneously, parallel to the brow towards the bridge of the nose.</li> <li>4. After negative aspiration, inject 3 mL of LA while slowly withdrawing the needle.</li> <li>5. Massage the area to encourage the LA to enter the foramen and bathe the supratrochlear nerve (Fig. 4).</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Infraorbital nerve                       | Medial cheek, lateral nose and nostrils/nasal alae, lower eyelid and upper lip <sup>13</sup>                                                                                                                         | Infraorbital ridge, infraorbital foramen | <ol style="list-style-type: none"> <li>1. Apply topical LA to the mucobuccal fold of the first premolar.</li> <li>2. With the patient looking straight ahead, use the non dominant hand to palpate the infraorbital ridge (mid pupillary line).</li> <li>3. At 10 mm inferiorly to the infraorbital ridge, palpate the infraorbital foramen. Leave the finger in situ and use the non dominant thumb to retract the buccal mucosa.</li> <li>4. Insert the needle 5 mm from the first premolar and into the mucobuccal fold. The bevel of the needle should be towards bone.</li> <li>5. Advance the needle approximately 15 mm along the long axis of the tooth towards, but not into, the infraorbital foramen.</li> <li>6. Inject 2 mL of LA slowly with the guide finger <i>in situ</i>.</li> <li>7. Gently massage the area to encourage the LA to enter the foramen. A further 0.5 mL may have to be introduced into the maxillary frenulum for complete upper lip anaesthesia (Fig. 5).</li> </ol> |
| External nasal nerve                     | Nasal spine, medial nasal sidewall and nasal tip <sup>13</sup>                                                                                                                                                       | Junction of nasal bone and cartilage     | <ol style="list-style-type: none"> <li>1. Inject 1.5 mL of LA bilaterally at the junction of the nasal bone and the nasal cartilage.</li> <li>2. Gently massage to help the dispersion of the LA. (Fig. 6).</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Mental nerve                             | Mucosa and skin of the lower lip and chin <sup>13</sup>                                                                                                                                                              | Mental foramen                           | <ol style="list-style-type: none"> <li>1. Apply a topical local anaesthetic agent to the mucobuccal fold over the first mandibular premolar.</li> <li>2. Insert the needle into the numbed area, then angle it to 45 degrees and advance about 5–6 mm, until the needle tip lies just outside the mental foramen.</li> <li>3. Inject 2 mL of LA slowly.</li> <li>4. Apply extraoral pressure to allow maximal dispersal of LA into the mental foramen. A further 0.5 mL of LA may have to be introduced into the mandibular frenulum for complete lower lip anaesthesia. (Fig. 7)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                             |

LA, local anaesthetic. \*See Fig 3a.

exits the mandible via the mental foramen, which is situated in the mid pupillary line. This is most reliably between the long axis of the first and second mandibular premolars, although the exact position may vary slightly, depending on ethnicity.<sup>18</sup>

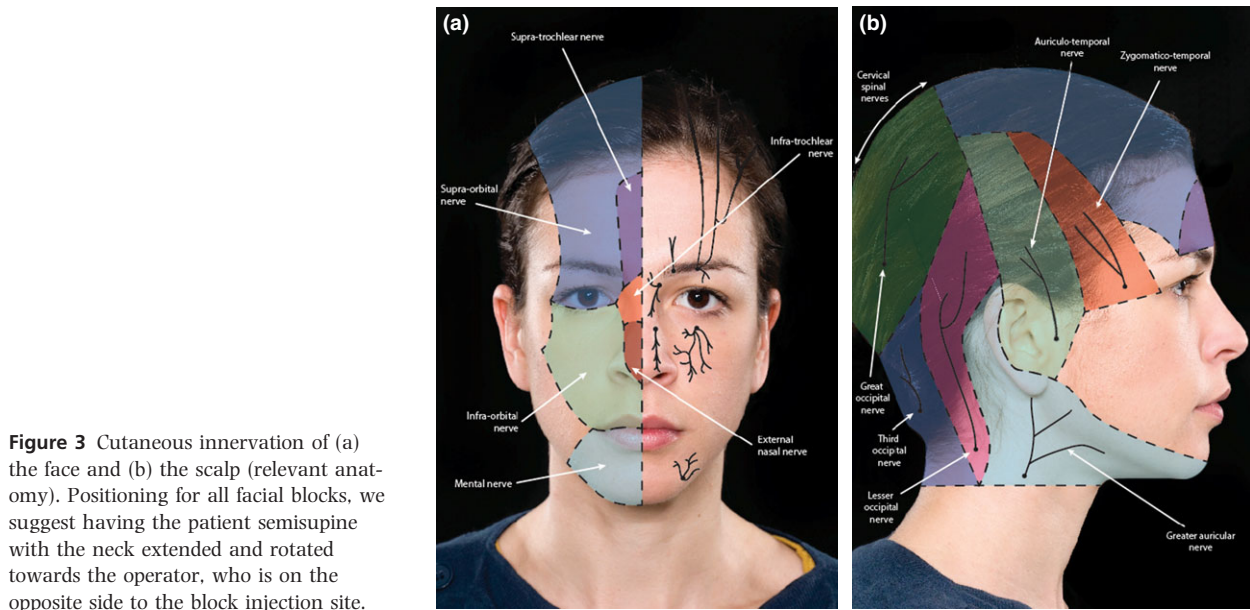
### Regional nerve blocks for the scalp

Regional nerve blockade of the scalp (Table 4) can provide effective anaesthesia for a range of dermatological procedures, from resection of large scalp lesions to providing significant reduction in the pain experienced

during photodynamic therapy.<sup>19</sup> As a result of the rich vascular supply of the scalp, pressure should be applied to the anaesthetized area once the needle is withdrawn.

The cutaneous innervation of the scalp is served by the following nerves (Fig. 3b).

- 1 The supratrochlear nerve and supraorbital nerves; blockade of these nerves has already been covered.
- 2 The zygomaticotemporal nerve and the zygomaticofacial nerve : these are terminal branches of the zygomatic nerve.<sup>13</sup> The zygomatic nerve emerges through a foramen behind the lateral orbital rim, at the level of the lateral canthus.



**Figure 3** Cutaneous innervation of (a) the face and (b) the scalp (relevant anatomy). Positioning for all facial blocks, we suggest having the patient semisupine with the neck extended and rotated towards the operator, who is on the opposite side to the block injection site.



**Figure 4** Supraorbital and supratrochlear nerve block.



**Figure 6** External nasal nerve block.



**Figure 5** Infraorbital nerve block.



**Figure 7** Mental nerve block.

**Table 4** Regional nerve block techniques for the scalp.

| Nerve                    | Cutaneous innervation*                                                                                                                                                              | Anatomical landmarks                                          | Technique                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Greater occipital nerve  | Majority of posterior scalp to the vertex <sup>13</sup>                                                                                                                             | Superior nuchal line, occipital protuberance, mastoid process | <ol style="list-style-type: none"> <li>1. Palpate the occipital artery at the level of the superior nuchal line.</li> <li>2. Insert the needle at a 90 degree angle medial to the artery, and advance until bone is reached.</li> <li>3. Inject 2–4 mL of LA. Repeat on the other side of the artery (Fig. 8).</li> </ol>                                                        |
| Lesser occipital nerve   | Scalp posterior to auricle <sup>13</sup>                                                                                                                                            | Superior nuchal line                                          | <ol style="list-style-type: none"> <li>1. After GON blockade, redirect and advance the needle laterally and slightly inferiorly, along the superior nuchal line.</li> <li>2. Inject 3 mL of LA (Fig. 8).</li> </ol>                                                                                                                                                              |
| Zygomaticotemporal nerve | Lateral canthus and skin of temporal region <sup>13</sup>                                                                                                                           | Lateral canthus, lateral orbital rim                          | <ol style="list-style-type: none"> <li>1. Palpate the depression at the posterior aspect of the lateral orbital rim.</li> <li>2. Insert the needle just behind the depression (Fig. 9).</li> <li>3. Advance the needle inferiorly along the wall of the lateral orbital rim to about the level of the lateral canthus.</li> <li>4. Inject 1–2 mL of LA at this level.</li> </ol> |
| Auriculotemporal nerve   | Skin anterior to auricle and posterior two-thirds of temporal area, skin of tragus and adjacent helix, as well as parts of EAM and skin of superior tympanic membrane <sup>13</sup> | Tragus of ear                                                 | <ol style="list-style-type: none"> <li>1. Insert the needle 15 mm in front of the tragus.</li> <li>2. Advance 10 mm, aiming laterally towards the tragus.</li> <li>3. Slowly inject 1–2 mL of LA (Fig. 10).</li> </ol>                                                                                                                                                           |

EAM, external acoustic meatus; LA, local anaesthetic; \*See Fig. 3b.

3 The auriculotemporal nerve: this is a branch of the mandibular nerve.<sup>13</sup> It runs from the parotid gland up to the temporomandibular joint and external auditory meatus and continues upwards to run along with the temporal artery, giving off smaller branches on the way.

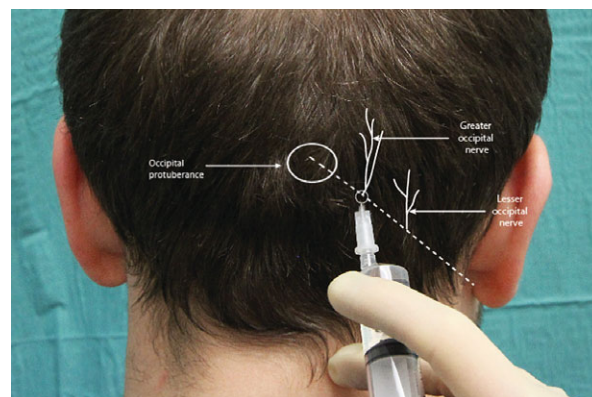
4 The greater occipital nerve: this originates from the posterior ramus of the spinal nerve, C2. It pierces the fascia under the superior nuchal ridge and emerges on the superior nuchal line along with the occipital artery. It can be located about one-third of the distance along a line drawn from the occipital protuberance to the mastoid process.<sup>20</sup>

5 The lesser occipital nerve: this arises from the second and third cervical nerves. It courses superiorly at the posterior region of the sternocleidomastoid.<sup>13</sup>

We will not be describing the block technique for the following:

1 The great auricular nerve : this is the most reliably anaesthetized by using the more delicate superficial cervical plexus block. This nerve arises from the second and third spinal nerves, and travels vertically across the SCM to supply the skin over the angle of the mandible and parotid area, and the inferior part of earlobe.<sup>13</sup>

2 The third occipital nerve: this provides cutaneous innervation to the lower occiput and suboccipital area. It is a branch of the posterior ramus of C3. Visualization under ultrasound is needed to ensure safety and anatomical accuracy in the region of the cervical spine, because of the proximity of the vertebral vessels.<sup>21</sup>

**Figure 8** Greater and lesser occipital nerve block.



**Figure 9** Zygomaticotemporal nerve block.



**Figure 10** Auriculotemporal nerve block.

### Learning points

- Amides are the most commonly used LAs due to their more favourable side effect profile.
- Appropriate patient assessment and suitability for safe RNB must first be established.
- It is imperative to have knowledge of the potential complications of RNBs and their management.
- Successful RNB can lead to improved patient care and satisfaction.

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- b) The platelet count is 50.  
c) The patient takes aspirin.  
d) There is an infection over the injection site.  
e) Low molecular weight heparin (LMWH) was administered 5 h ago.

#### Question 4

Which of the following is the nerve that supplies partial sensory innervation to the upper eyelid?

- a) The lacrimal nerve.  
b) The infraorbital nerve.  
c) The mental nerve.  
d) The supratrochlear nerve.  
e) Anterior ethmoidal nerve.

### CPD questions

#### Learning objective

To consolidate knowledge of the mechanism, safe administration and possible complications of local anaesthetics in RNBs, and to review the anatomy of the face.

#### Question 1

The speed of onset for local anaesthetics is determined predominantly by which of the following?

- a) High lipid solubility.  
b) Having a high ionized fraction at physiological pH.  
c) High protein binding.  
d) Having a pKa closer to that of physiological pH.  
e) Low hepatic metabolism.

#### Question 2

Calculate the maximum safe volume of plain 2% lidocaine that can be given to a patient weighing 70 kg.

- a) 7 mL.  
b) 10.5 mL.  
c) 21 mL.  
d) 24.5 mL.  
e) 56 mL.

#### Question 3

Identify the scenario in which a regional nerve block can be performed safely.

- a) The international normalized ratio (INR) is 1.6.

#### Question 5

Which of the following statements regarding complications of regional anaesthesia is true?

- (a) The incidence of permanent neurological injury is 1 in 5000 cases.  
(b) Aspiration is vital before injection and after every 10 mL of LA to prevent intravascular injection.  
(c) Cardiac symptoms precede central nervous system symptoms in LA toxicity.  
(d) Even partial intravascular injection around the head/neck area can lead to systemic LA toxicity.  
(e) After infiltration of LA, it only takes 5 min to achieve a dense block.

### Instructions for answering questions

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