OPEN ACCESS ATLAS OF OTOLARYNGOLOGY, HEAD & NECK OPERATIVE SURGERY

THYROIDECTOMY UNDER LOCAL OR REGIONAL (CERVICAL PLEXUS BLOCK) ANAESTHESIA

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Thyroidectomy or parathyroidectomy can safely be performed under local and/or regional anaesthesia. It is useful in low resource centers when safe general anaesthesia is not available, or when patients are unsuitable for general anaesthesia. It is also performed in developed world centers especially for minimally invasive thyroid and parathyroid surgery. Patient selection is however important. Advantages of local and/or regional anaesthesia include:

- Quicker and cheaper
- Can monitor voice and breathing during surgery
- Does not require anaesthetist (although preferred)
- Avoids risks of general anaesthesia
- Favorable for day case surgery

Massive goiters without retrosternal extension are also suitable for resection under local anaesthesia if done by experienced surgeons [1].

With ***more extensive thyroid resections*** performed under local anaesthesia, additional cervical plexus blocks facilitate deeper dissection and minimise the need for repeated injections of local anaesthetic during surgery.

Patient selection

Not all patients are suited to undergoing thyroid surgery under local and/or regional anaesthesia with/without sedation.

Exclusion criteria (relative and absolute)

1. Age
   - Children <18yrs tend to be too anxious and less understanding
   - Older patients can be problematic as dosages of sedative drugs need to be adjusted and cautiously titrated to avoid excessive sedation
2. Fearful or uncooperative
3. Severe claustrophobia or anxiety
4. Unable to communicate with patient
5. Sleep apnoea
6. Allergy to local anaesthetic agents
7. Recurrent laryngeal nerve paralysis
8. Tumour factors
   - Retro-oesophageal/retrotracheal goiter
   - Retrosternal extension
   - Locally invasive cancer
   - Need for neck dissection
9. Previous thyroid or neck surgery, neck abscesses or radiation therapy: Apart from surgery being more difficult, fibrosis and scarring may affect delivery of local anaesthetic
10. Lack of surgical expertise
11. Thyrotoxicosis: Epinephrine (adrenaline) causes cardiovascular stimulation and can induce dysrhythmias, tachycardias, and a thyrotoxic crisis. If local anaesthesia is required, only minimal doses of epinephrine should be used, with aspiration prior to injection to avoid intravascular injection
12. Patients with severe respiratory disease may not be able to lie still and frequent coughing will be disruptive to the surgery

An even more selective approach should be adopted when one is unable to convert to general anaesthesia during the surgery for unexpected intraoperative pathology, patient discomfort, and a toxic reaction to lidocaine *etc*.

Choice of local anaesthetic agent

(Also refer to *Open Access Atlas* chapters: *Local and Regional Anaesthesia Techniques for Otologic (ear) Surgery* and *Otolo-*

gy Outreach Surgery under Local and Regional Anaesthesia)

Duration of action

Thyroid procedures generally do not exceed 3hrs, so any of the more commonly used agents *e.g.* ***Lidocaine*** or ***Mepivacaine***, can be used. Addition of epinephrine increases the duration of action of Lidocaine to about 4hrs. The duration of action of Mepivacaine with epinephrine is about 6 hrs. Lidocaine and Mepivacaine both have rapid onsets of action. Note that ***Procaine*** has a relatively short duration of action: 45 minutes without and about 90 minutes with epinephrine/adrenaline.

Maximum dose

With 1% (10 mg/ml) ***Lidocaine*** the maximum dose should not exceed 4.5mg/kg; when used with epinephrine/adrenaline the maximum dose can be as high as 7mg/kg body weight. Ropivacaine can be used to a maximum dose of 3mg/kg plain, and 4mg/kg with adrenaline/epinephrine (maximum total adult dose is 225mg). The maximum dose of Bupivacaine is 2mg/kg plain and 3mg/kg with epinephrine/adrenaline (maximum total adult dose is 175mg). With ***Mepivacaine***, the maximum dose is 5mg/kg without, and 7mg/kg with epinephrine. If a large area of skin is to be anaesthetized, then a relatively low concentration of agent should be used to avoid exceeding the maximum dose *e.g.* the concentration of Lidocaine can be reduced from 1% or 2%, down to 0.5%.

Sensitivity/allergy

A key factor to consider when selecting a local anaesthetic agent is a history of sensitivity or allergic reaction to a local anaesthetic. Ester-type local anaesthetics (*e.g.* procaine, tetracaine) carry a much higher risk of adverse or allergic reactions, compared to the amide class (*e.g.* lidocaine, bupivacaine, and mepivacaine). We suggest using Ropivacaine, if available. Bupivacaine is more dangerous in larger doses, or with accidental intravenous administration. Intractable arrhythmia or seizures is a possibility.

Adrenaline (epinephrine)

This provides haemostasis and a drier surgical field. Half a ml (half an ampoule) of adrenaline 1:1000 is added to 9ml of lidocaine drawn up into a 10ml syringe to achieve a lidocaine:epinephrine concentration of 1:30,000. It is well tolerated, although rarely a patient might develop tachycardia that usually subsides within <5 minutes. Patients with ischaemic heart disease can usually not afford a severe tachycardia; therefore, caution is required, and lower doses or complete avoidance of epinephrine is advised.

Sedatives and anxiolytics

Preoperative or intraoperative sedation or anxiolytics can be used in combination with local or regional anaesthesia. However, if conscious sedation is to be employed, this requires careful ***monitoring by an anaesthetist***, as oversedation can make a patient uncooperative, or cause respiratory depresssion, airway compromise, and a need to convert to general anaesthesia. Additional monitoring *e.g.* ECG and pulse oximetry must be used, and resuscitation equipment must be available. Rescue drugs such as Naloxone/Narcan® should also be at hand.

Benzodiazepines are used to reduce anxiety. The 3rd author (GT) generally uses *diazepam (valium)* or *Midazolam* (*Versed*). Diazepam has advantages of slower onset and longer action. *Midazolam* is generally more readily available in developing countries and has a much more rapid induction and

shorter duration of action but has a higher risk of causing respiratory depression.

Note: ***A combination of benzodiazepines and opioids can have an additive effect***. Caution should be exercised when combining these medications and a titrated approach is advised, starting with smaller doses. There are many good techniques for procedural sedation. A simple example: 1mg *Midazolam* + 5ug *Sufentanil* IVI for a baseline. Augmented by *Alfentanil* (1mg diluted in 10 ml saline) as small, titrated IVI boluses while the local anaesthetic is administered. The *Midazolam* can be topped up as needed during the procedure. ECG, pulse oximetry and noninvasive blood pressure monitoring are mandatory when using this technique.

Systemic analgesics

Systemic analgesia may be administered intravenously *e.g. Fentanyl*, morphine sulphate, or *Meperidine (Pethidine*/*Demerol*). It is ***imperative to monitor the patient's breathing and oxygen saturation***.

The choice of intravenous analgesics often depends on availability. *Fentanyl* is often available in developing countries. In the average person weighing 60-70kgs, one can start by titrating 50µg of *Fentanyl*. An additional 50µg bolus can be added if the patient tolerates the initial dose well without hypoventilation. In patients with a body mass approaching 90kgs one can use up to125-150µg (titrated). With *Meperidine (Demerol)*, one generally administers about 75mg for an average-sized person (>60kg). With morphine sulfate one can administer 7.5-10mg. Titration, rather than a single empiric large dose of opiate upfront, is recommended

Fasting

Patients should be starved for 6 hours prior to surgery, even if general anaesthesia is not anticipated.

Counselling and consent

Counselling about administration of local and / regional anaesthesia is very important. The patient MUST be aware of what the procedure entails and be well prepared for the duration of the surgery and discomforts involved. An uncooperative patient can be disastrous.

Intraoperative monitoring

Patients receiving IV sedation with local anaesthesia need to be carefully monitored

Pulse oximetry: Oxygen saturation should be maintained at 90-100%. When supplemental oxygen is not available, monitoring is even more critical to avoid oversedation, depressed breathing, hypoxia and hypercarbia. One may even have to assist ventilation with an Ambu bag. Treatment of low oxygen saturation with supplemental oxygen is only a short-term solution and can mask a greater problem *i.e.* that of hypoventilation and hypercarbia. If it is possible, communicate with the patient and encourage deep breathing manoeuvres.

Blood pressure: Hypertension can be severely exacerbated by systemic absorption of adrenaline/epinephrine. In such cases consideration may have to be given to using local anaesthesia without adrenaline, or to postpone surgery until the patient is normotensive. Beware of low blood pressure, especially in anxious patients (vasovagal response).

ECG monitoring: The pulse and ECG tracing may reveal tachycardia following injection of epinephrine. The tachycardia is usually short-lived and generally settles after 3-5 minutes. Alternatively, gentle massage of the carotid bulb may help. Rarely, a short-acting beta-blocker is administered. Severe arrhythmias have been reported when using *Bupivacaine*.

Resuscitation equipment

Resuscitation equipment to be used in the event of an adverse reaction to any of the local anaesthetic agents or sedatives must not only be present and in working order, but the practitioner needs to be familiar with their use and function. Equipment includes a powerful suction machine and airway suction device *e.g.* Yankhauer sucker, a working intubating laryngoscope (with spare bulbs and batteries), endotracheal tubes of appropriate sizes, and an Ambu bag.

Emergency drugs

Emergency drugs must be at hand and include Adrenaline/Epinephrine, Atropine, steroids, antihistamines and reversal agents.

Reversal agents: The doctor must be familiar with Opioid and Benzodiazepine reversal agents, and their uses and doses in the event of over-sedation:

- *Naloxone:* 1 ampoule = 0.4mg. Dilute with 4ml saline and titrate 1ml/0.1mg IVI every 2-3 minutes until the patient recovers consciousness and airway reflexes
- *Flumazenil:* Comes as a 0.1 mg/ml preparation. Dosage: 0.2mg IVI titrated every 2 minutes until consciousness is regained
- *Overdosing* with either of these drugs can cause hypertension and severe pain

Local anaesthesia technique

- Premedicate with *e.g.* diazepam or *Midazolam*
- Insert an intravenous infusion line
- Consider mild intravenous sedation or intravenous analgesic
- Position the patient for thyroidectomy with neck extended
- Mark the collar skin incision line
- Inject 1% lignocaine hydrochloride with adrenaline to a maximum dose of 7mg/kg body weight into skin and subcutaneous tissue along the incision line
- Proceed with the surgery
- Inject additional local anaesthetic as required
- Mobilise the thyroid gland with gentle traction on the trachea to avoid coughing and laryngeal spasm
- Infiltrating the pretracheal fascia with local anaesthetic can reduce coughing and laryngeal spasm

Regional cervical plexus block

The ***transverse cervical nerve and its branches*** originate from the cervical plexus and innervate the skin of the anterior neck *(Figure 1).* Therefore, a ***cervical plexus block*** for thyroid surgery must block the transverse cervical nerve and its branches.

Relevant anatomy

- The anterior primary rami of C2 - C4 innervate the skin of the anterolateral neck via the superficial cervical plexus *(Figures 1, 2)*
- The four branches of the superficial cervical plexus (greater auricular, lesser occipital, transverse cervical, and supraclavicular) emerge at the posterior border of the sternocleidomastoid muscle at *Erb's Point (Figure 1)*
- The transverse cervical nerve (C2, 3) and its branches track anteriorly, passing deep to the external jugular vein and then across the surface of the sternocleidomastoid muscle
- Initially the nerve is deep to platysma and the investing layer of the superficial cervical fascia of the neck
- Anteriorly in the neck it pierces the platysma to become subcutaneous where the platysma may also be absent *(Figure 2,3)*

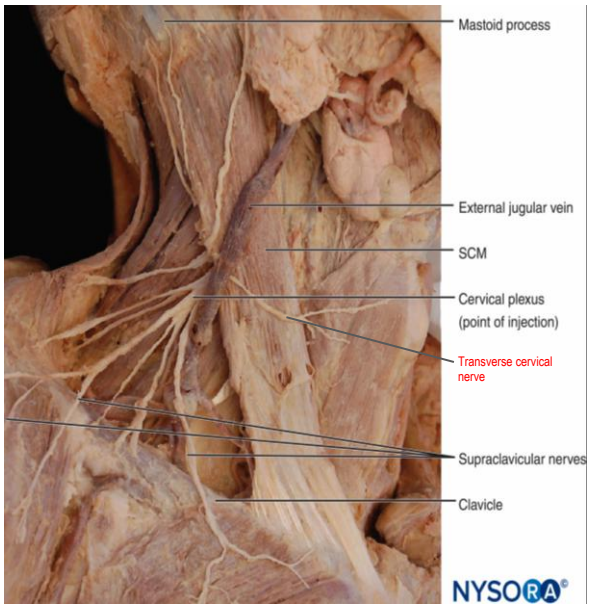

Figure 1: Anterolateral neck is innervated by the superficial cervical plexus that exits behind sternomastoid at Erb's point (circled); note position of external jugular vein relative to Erb's point (Nysora)

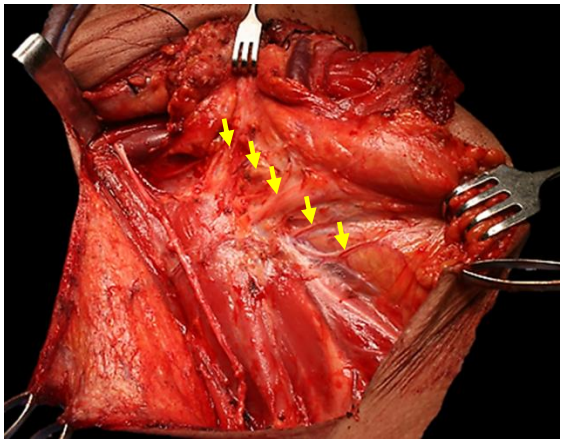

Figure 2: Anterior primary rami crossing behind and over the carotid sheath as seen during right neck dissection

Three types of nerve blocks for thyroid surgery

The transverse cervical branches of the cervical plexus can be blocked at 3 different locations along its course *(Figure 3)*

1. ***Superficial cervical plexus block***

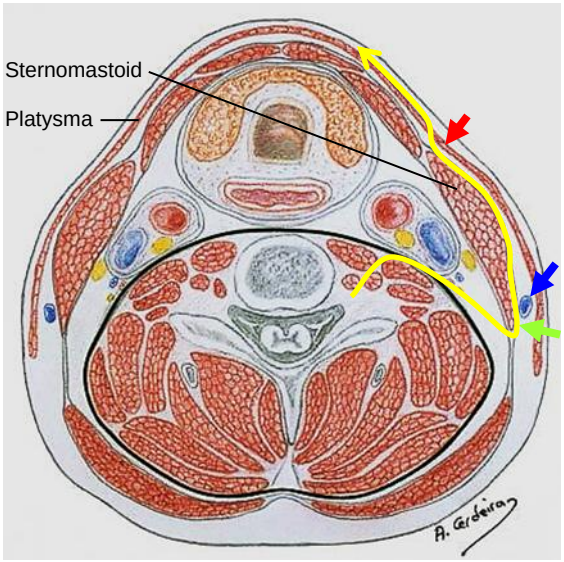

Figure 3: Course of transverse cervical nerve around posterior border of sternocleidomastoid, deep and then superficial to platysma. Note relationship to external jugular vein (blue arrow). Blocking techniques: superficial block (yellow arrow); along anterior border of sternomastoid (red arrow)

2. ***Along anterior border of sternocleidomastoid***
3. ***Deep cervical plexus block:*** Local anaesthetic is deposited where the nerves pass in front of the transverse processes of the vertebrae. A common indication is carotid endarterectomy. There is little benefit to employing deep cervical blocks for thyroid surgery, and it is more likely to cause phrenic or recurrent laryngeal nerve block. Hence it will not be described in this chapter

Equipment

- Marking pen
- Sterile towels
- Gauze pads
- 20-mL syringe(s)
- Sterile gloves
- Needle to draw up local anaesthetic
- 25-gauge needle for skin infiltration
- Local anaesthetic

Skin surface markings for *Erb's point*

- Position the patient supine with head turned to the opposite side
- Identify and mark the following:
  - Mastoid process
  - External jugular vein
  - Clavicular head of sternocleidomastoid
  - Posterior border of sternocleidomastoid muscle
- Draw a vertical line from the mastoid to the clavicular head of the sternocleidomastoid muscle *(Figure 4)*

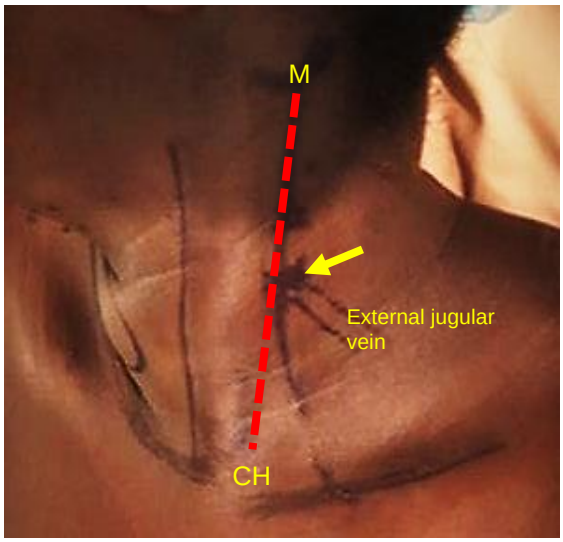

Figure 4: Superficial landmarks: M = Mastoid tip; CH: clavicular head of sternocleidomastoid; Arrow points to Erb's point

- *Erb's point* is located at the midpoint of this line at the posterior border of the sternocleidomastoid muscle, just above the external jugular vein *(Figure 4)*
- *Ultrasound* can be used to identify the cervical plexus at the posterior surface of the sternocleidomastoid (Video)

Superficial cervical plexus block technique

- The nerve block may be done before the patient enters the operating room, or by the surgeon just before making the incision
- A fan blowing room air gently across the face may reduce claustrophobia
- Premedicate with *e.g.* diazepam or Midazolam
- Insert an intravenous infusion line
- Consider mild intravenous sedation or intravenous analgesia, although unlike a deep cervical plexus block, the superficial block does not cause much discomfort
- Perform the nerve block as a sterile procedure
- Select a local anaesthetic agent according to the expected duration of the procedure, personal preference and availability
- Position the patient for thyroidectomy with neck extended
- Mark the collar skin incision line
- Position the patient with the head slightly extended and rotated away *(Figure 5)*
- Mark the anterior and posterior borders of the sternocleidomastoid muscle, the mastoid tip, clavicle, clavicular head of sternocleidomastoid and the external jugular vein *(Figure 5)*
- Mark *Erb's point (Figures 4, 5)*

Figure 5: Landmarks identified and marked

- Injection technique
  - Superficial cervical plexus blocks require 10–15ml of local anaesthetic
  - Inject at *Erbs point* at the posterior edge of sternocleidomastoid *(Figure 6)*

Figure 6: Injection at Erb's Point

  - Inject just above the surface of sternocleidomastoid (nerves run deep to platysma) and behind sternocleidomastoid muscle
  - Avoid deep needle insertion of >1 to 2cms
  - Use a "fan technique" to inject along the posterior border of the sternocleidomastoid muscle 2–3 cm below and then above the needle insertion site to achieve blocks of all major branches of the superficial cervical plexus *(Figure 7)*
  - When directing the needle anteroinferiorly, avoid injecting into the external jugular vein by first drawing back on the syringe
- ***Infiltrate local anaesthetic along the anterior border of the sternocleidomastoid*** muscle to block anterior branches of the transverse cervical nerve *(Figures 3, 8)*

Figure 7: Fan injection technique

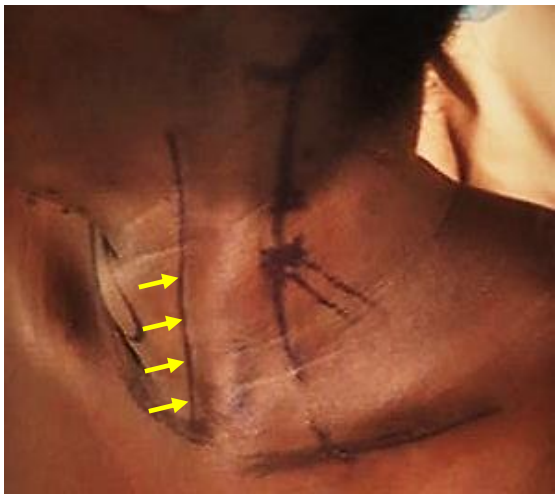

Figure 8: Local anaesthetic injected along the anterior border of the sternocleidomastoid muscle to block anterior branches of transverse cervical nerve

- Infiltrate the skin and subcutaneous tissue as a local field block in the area of the planned collar incision
- Check for signs of reduced sensation in the distribution the cervical plexus; this should occur within 10–15 minutes
- ***Although the 2nd author (AK) does not find it necessary, others suggest repeating the procedure on the opposite side*** to block nerves crossing the midline [2]
- ***Beware of transient paralysis of the recurrent laryngeal nerve(s) when performing bilateral deep cervical blocks***. Therefore, before proceeding to block

the opposite side, test the voice to confirm that the recurrent laryngeal nerve has not been paralysed to avoid inadvertent airway compromise

Transverse cervical nerve block along anterior border of sternocleidomastoid

- Infiltrate local anaesthetic along the anterior border of sternocleidomastoid muscle
- This blocks the anterior terminal branches of the transverse cervical nerve *(Figures 3, 8)*

Additional comments

- The superior poles of the thyroid gland may be more difficult to anaesthetise, and the surgeon should be prepared to further infiltrate this area after exposing the gland before ligating the superior pole vessels
- Although a nerve block provides anaesthesia, sensations of pressure are not blocked
- Use gentle traction when mobilising the thyroid gland from the trachea to avoid coughing and laryngospasm
- Infiltrating pretracheal fascia with local anaesthetic can reduce coughing and laryngospasm
- If sedation is employed, an anaesthetist should monitor the patient, as oversedation can cause a patient to become uncooperative, and can cause respiratory depression, airway compromise, and a need to convert to general anaesthesia
- In order to not mis-assess the volume of local anaesthetic required and to avoid exceeding 7mg/kg Lidocaine, it is useful to have the full volume drawn up and available from the start
- It may be useful to infiltrate a longer-acting local anaesthetic for postoperative analgesia *e.g.* Bupivacaine / Epinephrine (3mg/kg) or Ropivacaine / Epinephrine (4mg/kg) towards the end of the procedure

References

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2. Milan, S.A., Wu, L.S. & Sosa, J.A. *Curr Surg Rep* 2014. 2: 37. https://doi.org/10.1007/s40137-013-0037-7

Related chapters in Open Access Atlas

- **Thyroidectomy** https://vula.uct.ac.za/access/content/group/ba5fb1bd-be95-48e5-81be-586fbaeba29d/Thyroidectomy.pdf
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How to cite this chapter

Fagan JJ, Konny A, Torr G. (2014). Thyroidectomy under local and regional (cervical plexus block) anaesthesia https://vula.uct.ac.za/access/content/group/ba5fb1bd-be95-48e5-81be-586fbaeba29d/Thyroidectomy%20under%20local%20and%20regional%20anaesthesia.pdf

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