

An algorithm to support anaesthetic decision making

Rachel Rogers and Alistair Hellewell*

*Correspondence email: Alistair.Hellewell@rdefn.nhs.uk

INTRODUCTION

On entering anaesthesia novice anaesthetic trainees can be bewildered by the apparent complexity of the specialty. For each patient, you must choose the most appropriate anaesthetic technique after considering patient factors, surgical factors and anaesthetic factors.

The overall goal of training is that you arm yourself with the knowledge and skills to be able to tailor your anaesthetic technique to suit a particular patient having a particular operation, by a particular surgeon. Different senior anaesthetists show some variety in the anaesthetic pathway that they would choose to use and this can lead to confusion for a new trainee.

We present an algorithm that allows the novice trainee to conceptualise the process in a simple, logical and sequential way. We believe it clarifies the apparent complexity of these decisions and allows novice anaesthetists to reach safe and sensible conclusions.

There is undoubtedly a large amount of knowledge that underpins the decisions within the algorithm but we believe it will act as a skeleton on which to hang this knowledge as it is acquired.

Over the 10 years that I (SAH) have used this algorithm as a teaching aid for anaesthesia and critical care trainees, it has received positive feedback suggesting that it helps to clarify certain aspects of anaesthesia in the early stages of training. It is worth pointing out that this algorithm is a framework and neither it nor this article can provide a complete answer for every clinical situation encountered.

The algorithm asks a number of key questions.

DOES THIS PATIENT REQUIRE AN ANAESTHETIC?

To a new trainee, it may feel that once a patient's name is written on the emergency surgery list, there is little that can be done to alter the course of events. As anaesthetists we have a very important overview of the emergency list as we see all the cases, covering different surgical specialties. This gives us a 'moderating role' in the cases listed for theatre and just because a case is listed for theatres does not mean an operation is necessarily in the patient's best interest.

No

Consider why you feel the anaesthetic is not required and qualify your decision, by considering how you would categorise it:

- **No, never**
- **No, not now**
- **No, not by me**
- **No, not here**

The decision that a patient *never* needs this operation should follow a dialogue between several groups or individuals including the surgeons, the anaesthetist, the patient and their family. This decision could be made based on palliation for a terminal disease process, or because the benefits of a proposed operation are outweighed by the risks of the anaesthetic and surgery.

Not now applies to those patients who require either further investigation or optimisation before an operation could be performed safely. This is especially relevant in emergency surgical patients where a period of fluid resuscitation and monitoring (including invasive monitoring) may facilitate safer anaesthesia and surgery.

Not by me describes cases that go beyond your level of competence, experience and confidence as an anaesthetist. You should request senior input that may range from discussion and reassurance to 'hands-on' support in theatre.

No not here applies to specific cases, such as DC cardioversion, endoscopy or radiological procedures especially if the patient presents a particular anaesthetic or physiological risk. They should be moved to a place of safety and familiarity for the anaesthetist.

Yes

If, after thorough assessment of the patient and liaison with their treating team, you feel the procedure and therefore the anaesthetic intervention is indicated, the algorithm can be used to support this process.

Summary

As a new trainee in anaesthesia one of the most important skills to acquire is anaesthetic decision making, in particular choosing the most suitable anaesthetic for a particular patient. We propose an algorithm that allows the novice trainee to conceptualise the process in a simple, logical and sequential way. Using this algorithm, we discuss certain key principles which will help guide these decisions.

Rachel Rogers
Core Trainee in Anaesthesia

S Alistair Hellewell
Consultant Anaesthetist
Royal Devon and Exeter NHS
Foundation Trust
Barrack Road
Exeter EX2 5DW
UK

Anaesthetists have a number of techniques they can use to facilitate operative conditions for each patient's operation. They fall into three broad categories and may be used in isolation or in combination;

- Sedation
- General anaesthesia
- Regional anaesthesia

WOULD LOCAL, REGIONAL OR GENERAL ANAESTHESIA BEST SUIT THIS PATIENT?

There are several factors that determine whether a local, regional or general anaesthetic technique is most appropriate. Examples of surgical, patient and anaesthesia factors are shown in Table 1.

Surgical factors

Clearly the type of operation being planned has a major bearing on the type of anaesthetic that will be most suitable. The location of the operative site is particularly relevant. For example, a distal operation such as an in-growing toe nail removal could be performed under a range of different techniques as shown in Figure 2.

The other factors, listed in Table 1, will influence you in deciding which of these modalities would be most suitable for your patient. For example, if the patient is an anxious young child, you are unlikely to put them through the distress of having the procedure performed under local anaesthetic. Conversely, if they are an adult with major comorbidities, there would be strong indications to choose this option and opting for one of the less invasive techniques would offset the impact of this comorbidity. Similarly, an epidural carries a risk of complications which would generally outweigh the benefits for this minor procedure.

Duration of surgery

A very short minor operation would not demand the long term block afforded by an epidural. Conversely, an operation lasting several hours will not be possible under local anaesthetic. It is not recommended practice to plan to change from one technique to another mid-

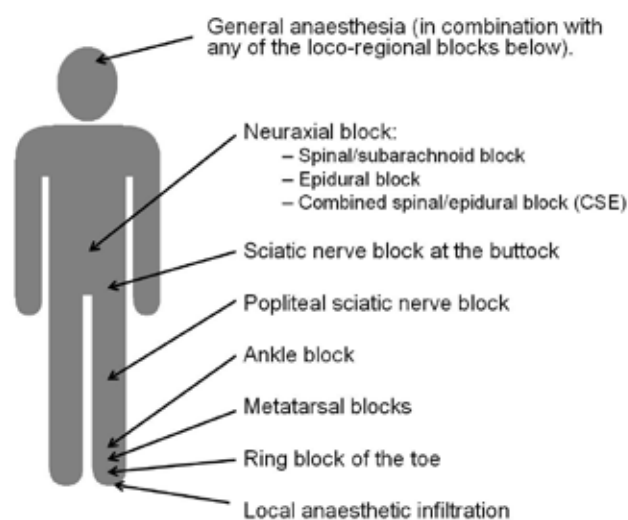


Figure 2. The options for providing loco-regional anaesthesia for an operation on the big toe, which may be used alone or in combination with general anaesthesia

procedure (for example proceeding under local or regional block, knowing that the procedure will outlast the block and planning to convert to general anaesthesia when indicated).

Anticipated postoperative course

You must consider and plan for postoperative analgesia - for procedures with significant postoperative pain a long acting method such as a block or epidural may be beneficial. Bear in mind that the attitude of the surgeon and the ward team is important. After total knee arthroplasty many surgeons now plan for their patients to be mobilised on the first postoperative day. For this reason, epidurals and long-lasting nerve blocks are used less in favour of subarachnoid block, often using an opioid additive. In addition, many procedures are now planned as day case surgery; a patient is more likely to be mobile and ready for discharge home more quickly after a general anaesthetic (GA), compared to a spinal or epidural block. Similarly,

Table 1. Examples of the surgical, patient and anaesthetic factors to consider when planning a patient's anaesthetic

Surgical factors	Patient factors	Anaesthesia factors
Type and site of surgery	Age	Anticipated difficult intubation
Duration of surgery	Comorbidities	Equipment available
Anticipated postoperative course (day-case or in-patient)	Obesity	Family history (e.g. malignant hyperpyrexia)
Requirement for muscle relaxation	Anatomical considerations	Fasting status, oesophageal reflux etc
'Shared airway' between anaesthetist and surgeon	Patient's preference	Anaesthetist's preference or experience
Likelihood of major blood loss		
Surgeon's preference		

for those at risk of postoperative nausea and vomiting, avoidance of GA or, if unavoidable, using a total intravenous anaesthetic technique that avoids use of anaesthetic agents, would be most appropriate.

Patient factors

Age has a large influence on anaesthetic choice, examples being young children and the comorbidities associated with old age. In the elderly, maintenance of cardiovascular stability during anaesthesia is a priority and the relative cardiovascular risks and benefits of general versus neuraxial anaesthesia must be considered.

Other patient factors which may influence the type of anaesthesia include the body habitus and anatomy of the patient – for example a spinal may be extremely difficult to perform in patients with obesity or arthritic fusion of the spine.

Patient choice is of increasing importance, given that our patients are now generally better informed and have opinions about the available techniques. Prior experience of one technique or other will influence a patient's attitude to experiencing the same technique again. Ultimately, however, the anaesthetist should decide on the most appropriate anaesthetic pathway and explain this to the patient.

For patients with comorbidities that put them at significant risk from general or regional anaesthesia, the necessity of the surgery should be considered. You may try to dissuade a patient with unstable angina from undergoing a cosmetic procedure, but may accept the risks if the same patient presents again needing a bowel resection for colonic carcinoma.

For non-urgent surgery it is essential that all treatable comorbidities are optimised. This will usually involve review by their general practitioner or sometimes referral to a specialist physician. The most commonly encountered comorbid conditions are respiratory, cardiac and endocrine diseases. Cessation of smoking should be strongly advised. For some patients, surgical correction of other conditions may make future anaesthesia and surgery far less risky; examples are angioplasty and stenting for critical coronary artery disease and carotid endarterectomy for carotid stenosis.

A proportion of patients will require repeat investigations for known conditions or new investigations for previously undiagnosed comorbidities. For example, patients diagnosed with bronchial carcinoma commonly have obstructive airways disease and respiratory function tests are useful to make the diagnosis, assess the severity of the disease and also to gauge the response to a trial of steroids.

Anaesthetic factors

Airway and breathing

If you have concerns about difficult intubation, this may sway your decision in favour of a local or regional anaesthetic technique. It is, however, still important to have a plan in case general anaesthesia is subsequently required, for example following a high neuraxial block or anaphylaxis following local anaesthesia.

Regional anaesthesia

The anaesthetist's preference and experience is important, but where a particular block would be best, it is advisable to seek assistance from a

colleague if you are not personally proficient in that technique, rather than persisting with a less suited type of anaesthetic. An example of this situation is to perform mastectomy in an awake patient under paravertebral block, where GA would be hazardous due to severe respiratory disease. Time constraints of theatre lists can be significant and may require logistical arrangements in order to allow a block adequate time to work before surgery commences.

Risks of regional anaesthesia

Some patients have conditions that relatively or absolutely preclude regional or neuraxial anaesthesia. For example, spinal anaesthesia is hazardous in patients with severe aortic stenosis, and neuraxial blocks create a risk of spinal canal haematoma in patients taking combined antiplatelet drugs.

In addition there is a list of potential adverse effects of these procedures, including nerve damage, haemorrhage, infection and local anaesthetic toxicity. Informed consent, summarizing these risks, should be sought prior to a regional technique.

PLANNING A GENERAL ANAESTHETIC

If you have decided that general anaesthesia best suits your patient for the planned procedure, then there are further decisions which must be made.

1. Mode of induction
2. Airway management plan
3. Mode of ventilation.

Mode of induction of anaesthesia

There are 4 options here:

Rapid sequence induction (RSI)

- The patient has a significant risk of aspiration of stomach contents into the respiratory tract, due to either a full stomach or a high regurgitation risk (hiatus hernia, pregnancy).

Standard intravenous induction

- For patients who are starved with low risk of reflux.

Inhalational induction

- Usually for children where obtaining IV access is not possible or too distressing.
- For adults with needle phobia.
- Useful for emergency anaesthesia where the airway is compromised by swelling due to infection (e.g. epiglottitis).

Awake fiberoptic intubation (AFI) - see article on page 27

- Where airway difficulties are anticipated or known.
- This ensures that the airway is secured before spontaneous ventilation is abolished.

Airway maintenance

The options for airway maintenance are heavily influenced by the decisions made concerning spontaneous breathing or ventilation.

- **Facemask**
+/- oropharyngeal or nasopharyngeal airway.
- **Laryngeal Mask Airway (LMA)**
Use of the LMA is not widespread in poorly resourced centres, as it is difficult to use effectively without propofol, which obtunds laryngeal reflexes and allows LMA insertion very effectively.
- **Variant of the classic LMA - Proseal™ or LMA supreme™**
These devices include an oesophageal port so regurgitation will be quickly visible and can be managed accordingly. They also have an altered cuff profile that allows a better seal around the laryngeal opening, allowing more effective IPPV and lowering the threshold for using an LMA in overweight patients.
- **Endotracheal tube (ETT)**
The gold standard for airway control, the ETT may be inserted orally or nasally and may be cuffed or uncuffed.

There are certain pairings from the above options which work particularly well together and these will form your most frequently used anaesthetic combinations. The first of these is the spontaneously breathing LMA anaesthetic and the second is the ventilated intubated anaesthetic, indicated in the shaded portions of Table 2.

Although this table highlights that the majority of anaesthetics fit into the two main categories, there is considerable scope for tailoring your anaesthetic to meet the particular requirements for each patient. In the early part of an anaesthetist's career it is advisable to stick to simple techniques. Part of becoming a more senior anaesthetist is that you develop the ability to refine your technique depending on patient and surgical factors. For example, most would intubate and ventilate a patient for a laparoscopic sterilisation, however, if working on a weekly basis for a surgeon who completes the procedure in 10 minutes, it is reasonable to use a ventilated LMA anaesthetic for slim, fit patients.

Mode of ventilation

Spontaneous breathing or controlled ventilation

The decision to employ spontaneous ventilation (SV) or intermittent positive pressure ventilation (IPPV) is closely linked to your choice of airway (see above).

CASE EXAMPLE

The following is a fairly complex example, with multiple pathologies and factors to consider and weigh against each other. The conclusion is hopefully a pragmatic solution but any of the techniques suggested

Table 2. Broad classification of general anaesthesia techniques

	SV	IPPV
Face mask/ LMA	A common combination	Most supraglottic airway devices work very well with paralysis and ventilation. Many studies comparing these devices assess them under these conditions.
ETT	<ul style="list-style-type: none"> • Some degree of muscle relaxation is generally used (but not essential) to facilitate tracheal intubation. • With deep anaesthesia ETT is tolerated. • Popular where long-acting neuromuscular blockers are not available. 	Commonly used for the indications in Table 3.

Table 3. Examples of factors to consider when deciding if a GA should be spontaneously breathing or ventilated

Factors	Spontaneously breathing		IPPV	
Surgical	ENT	Surgeon wishes to assess vocal cord function under GA	Muscle relaxation required	Laparotomy, large paraumbilical hernia repair, reduction of dislocated THR)
	Avoidance or neuromuscular block	Localisation of facial nerve during parotidectomy	Ventilatory support required	One lung anaesthesia for thoracic surgery
			CO ₂ control	Neurosurgery
Patient	Obesity	Limits the duration of SV (hypoxia more likely)	Full stomach, reflux disease	Endotracheal tube required (and so usually IPPV)
	Respiratory disease	If peripheral surgery, SR may be better tolerated for short procedures	Respiratory disease	Copious secretions may require suction of secretions (bronchiectasis)
Anaesthetic	Anticipated difficult intubation	Rheumatoid arthritis affecting cervical spine		

may be successful depending on the anaesthetist's experience and skills, the surgical technique and duration, and the desires and beliefs of the patient.

A 66-year-old woman has a gangrenous foot and lower leg and she requires an above knee amputation. She has rheumatoid arthritis and severe COPD with saturations of 88% on air. Her exercise tolerance is 10-20 yards and respiratory function tests have shown her FEV₁ (forced expiratory volume in one second) to be 0.7 litres (37% of her predicted value). She required ventilation for 3 days after general anaesthesia for a hernia repair 2 years ago. Two coronary stents were inserted 4 months ago for unstable angina.

She has an ejection systolic murmur and an echocardiogram has confirmed moderately severe aortic stenosis (gradient of 77mmHg) and a hypertrophied ventricle with good systolic function. She took clopidogrel and aspirin until 4 days ago. Your job is to give her an anaesthetic.

DISCUSSION

It is sensible and useful to discuss cases such as these with a colleague and even to share the responsibility of the anaesthetic with a second anaesthetist.

This is not a case for a trainee surgeon. The case should be completed as quickly as possible by a senior surgeon.

Does she need an anaesthetic?

She has a condition that will worsen without surgical attention and she will become less fit as sepsis develops. The surgeons have opted for an amputation as definitive surgery and so we should do our utmost to facilitate this.

General or regional anaesthesia?

In this case there are factors in favour of both a general or regional technique. The factors that push us away from embarking on a general anaesthetic are:

1. *Severe COPD.* Her respiratory disease is severe based on her functional ability and the respiratory function tests. Her FEV₁ is such that her cough may be poor postoperatively - there is no absolute figure that predicts this but a reading less than 40% of the predicted value for height and weight is a risk factor for postoperative complications.¹ Of note she needed a period of ventilation after previous minor surgery and this is likely to be the case again.
2. *Rheumatoid arthritis.* She may have cervical spine disease (atlanto-axial subluxation) and there is a risk that laryngoscopy may cause cervical cord damage.

The factors that are against regional anaesthesia are:

1. *Moderately severe aortic stenosis.* The vasodilatation resulting from a single-shot subarachnoid block is likely to cause profound hypotension in patients with significant aortic stenosis. The loss of afterload caused by sympathetic blockade will impair diastolic

coronary blood flow. In addition her hypertrophied left ventricle is more at risk of ischaemia during periods of hypotension.

2. *Antiplatelet therapy.* She is taking dual antiplatelet therapy. It is usually recommended that clopidogrel is stopped 7 to 10 days prior to neuraxial block.

So our options are:

1. General anaesthesia

One approach would be to recognise that she has a risk of postoperative respiratory difficulties, and plan for her to be admitted to a high-dependency area postoperatively. This will be strongly influenced by the resources available for postoperative ventilation, should the need arise.

Induction would be hazardous in view of her aortic stenosis and invasive blood pressure monitoring would be desirable. A vasopressor agent should be available and drawn-up. Where no vasopressor agent is available, ketamine is probably the induction agent of choice, although the tachycardic side effects of this drug are not ideal in aortic stenosis.

Airway management / SV or IPPV

If she tends to produce a large amount of sputum, tracheal intubation to aid suction of secretions is preferred. Her cervical spine should be managed with caution, avoiding excessive flexion or extension. If sputum is minimal a face mask or LMA anaesthetic, with spontaneous breathing should be adequate.

We should avoid large doses of opioids, so ask the surgeon to insert a wound catheter to administer local anaesthetic postoperatively.

2. Regional anaesthesia

Nerve blocks

A combination of femoral and sciatic nerve blocks may not provide sufficient cover of the surgical field to avoid general anaesthesia. Performing a lumbar plexus block in place of the femoral nerve block would improve this, but this block is more invasive and is relatively contraindicated with antiplatelet drugs such as clopidogrel.²

Neuraxial block

A single shot subarachnoid block with this degree of aortic stenosis would probably cause considerable hypotension. A spinal catheter would allow titrated administration of the subarachnoid block and consequently improved haemodynamic stability (see case series on page 45 of this edition of *Update*). Epidural anaesthesia is an option to consider, but the block may be less reliable for awake surgery than a subarachnoid block.

There is a risk of bleeding and haematoma formation with all of these regional techniques and the risk of this must be weighed against the benefits of avoiding a general anaesthetic in this patient. The patient must be monitored very carefully for symptoms and signs of spinal cord haematoma and compression postoperatively.

We decided that the risk of a bleeding complication from a neuraxial block was strongly outweighed by the anticipated difficulties of general anaesthesia. We felt that a spinal catheter technique would minimise the haemodynamic consequences of neuraxial block.

We opted to insert a spinal catheter, which was uneventful. With the patient lying with the operative leg down, three doses of 1.0ml 0.5% hyperbaric bupivacaine were administered at 15 minute intervals. A good unilateral block was achieved. Metaraminol (a vasopressor α -agonist) was available but there was no significant drop in blood pressure (invasively monitored). Above knee amputation was performed by a senior surgeon and completed in 1 hour.

We removed the catheter in the postoperative period, in order not to mask spinal cord haematoma and we infused bupivacaine via a surgically-placed wound/stump catheter for 3 days postoperatively.

The patient made an uneventful recovery.

Invasive blood pressure monitoring is desirable for a neuraxial technique in view of the degree of aortic stenosis.

CONCLUSION

The aim of ANDSA is to aid novice anaesthetic trainees to clarify and simplify some of the decision making that can appear complex on entering the speciality. We would welcome feedback and suggestions for improvement.

REFERENCES

1. Portch D, McCormick B. Pulmonary function tests and assessment for lung resection. *Update in Anaesthesia* 2009; **25**,1: 13-21. Available at: <http://update.anaesthesiologists.org/wp-content/uploads/2009/10/Pulmonary-Function-Tests-and-Lung-Resection.pdf>
2. Barker J, Telford R, Bolton T. Perioperative management of antiplatelet drugs. *Update in Anaesthesia* 2010; **26**: 5-8. Available at: <http://update.anaesthesiologists.org/wp-content/uploads/2011/03/Perioperative-management-of-antiplatelet-drugs.pdf>

IMPORTANT NOTICE

Periodically we need to check that *Update in Anaesthesia* is being posted to the correct recipients. If you wish to continue receiving the journal please send the following details to us:

Name

Institution

Postal address

Email address (if you have one)

Number of recipients wishing to receive *Update* at this address

Please send this information:

By email to: worldanaesthesia@mac.com

or by mail to: Carol Wilson
Pound Cottage
Christow
Exeter
EX6 7LX
United Kingdom