Learning objectives

- To be able to define general anaesthesia.
- To be able to discuss general anaesthesia in terms of its component parts, i.e. the triad of general anaesthesia.
- To be able to define balanced anaesthesia.

Definitions

Anaesthesia literally means ‘lack of sensation/feeling’ (from an meaning ‘without’ and aesthelia pertaining to ‘feeling’). Therefore, general anaesthesia means global/total lack of sensations, whereas local anaesthesia relates to lack of sensation in a localised part of the body.

General anaesthesia can be defined as a state of unconsciousness produced by a process of controlled, reversible, intoxication of the central nervous system (CNS), whereby the patient neither perceives nor recalls noxious (or other) stimuli.

General anaesthesia is, however, often referred to as the state of the patient when the three criteria in the triad of general anaesthesia have been met.

The triad of general anaesthesia

1. Unconsciousness: no perception (or memory) of any sensory, or indeed motor, event.
2. Suppressed reflexes: autonomic (e.g. haemodynamic, respiratory and thermoregulatory) and somatic (e.g. proprioceptive reflexes such as the righting reflex). Suppression of autonomic reflexes can be a nuisance (see Chapter 18 on Monitoring), whereas suppression of somatic reflexes can be useful, for example it can provide a degree of muscular weakness/’relaxation’.
3. Analgesia (or, more correctly in an unconscious patient, antinociception): can also be thought of as suppressed responses/reflexes to nociceptive sensory inputs.

We could potentially produce all three components in a patient following administration of a single ‘anaesthetic’ drug. If, however, that drug did not have very good analgesic properties, then we might need to administer it in large doses to produce sufficiently ‘deep’ unconsciousness to reduce the responses to noxious stimuli. The problem is that such deep anaesthesia is often associated with extreme depression of the central nervous system and homeostatic reflexes. Alternatively, therefore, we can produce the above three components separately by administering drugs that more specifically provide each component. This latter approach is theoretically advantageous because, by ‘titrating to specific effect’, we can often use relatively small doses of each individual drug thereby minimising both each individual drug’s, and the overall, side effects. This ‘polypharmacy’ approach, meaning using several different drugs, is often referred to as balanced anaesthesia.

Balanced anaesthesia

The use of a number of different drugs to produce a state of general anaesthesia, which fulfils our criteria of unconsciousness, muscle relaxation and analgesia.

In this context, we must also consider the whole of the perioperative period, this includes:

- Drugs administered before the induction of anaesthesia (premedication).
- Drugs administered for the induction of anaesthesia.
- Drugs administered for the maintenance of anaesthesia.
- Drugs administered in the recovery phase.

The depth of general anaesthesia

Some texts refer to the stages and planes of anaesthesia that try to mark the progression of the continuum between consciousness and death. When ether was used as the sole anaesthetic agent, these stages and planes could be fairly well defined. Table 1.1 describes their features for the dog. However, the features of these
Table 1.1 Stages of ether anaesthesia in the dog.

<table>
<thead>
<tr>
<th>Stage of anaesthesia</th>
<th>Depression of CNS</th>
<th>MM colour</th>
<th>Pupil size</th>
<th>Eyeball activity</th>
<th>Breathing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I: stage of voluntary movement/excitement</td>
<td>?Sensory cortex</td>
<td>N / flushed</td>
<td>Small</td>
<td>Voluntary</td>
<td>Rapid/irregular</td>
</tr>
<tr>
<td>Stage II: stage of involuntary movement/excitement ‘delirium’</td>
<td>Motor cortex</td>
<td>Decerebrate rigidity</td>
<td>Flushed</td>
<td>Dilated</td>
<td>Increased</td>
</tr>
<tr>
<td>Stage III (light surgical): plane 1</td>
<td>Midbrain</td>
<td>Flushed / N</td>
<td>Smaller</td>
<td>Increased</td>
<td>Slow/regular</td>
</tr>
<tr>
<td>Stage III (moderate surgical): plane 2</td>
<td>Spinal cord</td>
<td>N</td>
<td>Miotic</td>
<td>Fixed, ventral rotation</td>
<td>Slow/regular</td>
</tr>
<tr>
<td>Stage III (deep surgical): plane 3</td>
<td>Spinal cord</td>
<td>N / pale</td>
<td>Miotic</td>
<td>Vental rotation</td>
<td>Large abdominal component</td>
</tr>
<tr>
<td>Stage III (excessive surgical): plane 4</td>
<td>Spinal cord</td>
<td>Pale</td>
<td>Bigger</td>
<td>Ventral rotation</td>
<td>Abdominal/shallow</td>
</tr>
<tr>
<td>Stage IV: paralysis (death follows respiratory and subsequent cardiac arrest)</td>
<td>Medulla</td>
<td>Pale/cyanotic</td>
<td>Mydriatic</td>
<td>Central</td>
<td>None/agonal gasps</td>
</tr>
</tbody>
</table>

N = normal
Changes tabled above refer specifically to those observed during ether anaesthesia in the dog.
Surgical stimulation may alter haemodynamic and respiratory variables via autonomic reflexes which persist into stage III, planes 2–3.

Table 1.2 Summary of effects of general anaesthesia.

CNS depression
- Loss of consciousness
- Damping of reflexes
  - Cardiovascular → Hypotension
  - Respiratory → Hypoventilation
  - Thermoregulatory → Hypothermia
  - Postural → Reduced muscle tone
- Central modulation of nociception (hopefully providing analgesia/antinociception)

CVS depression
- Reflex (e.g. baroreflex) suppression (centrally and peripherally)
- Changes in autonomic balance
- Changes in vasomotor tone (drug effects, centrally and peripherally)
- Myocardial depression
  - Direct (drugs)
  - Indirect (e.g. hypoxaemia, hypercapnia [acidosis])

Respiratory depression
- Reflex suppression (↓ventilatory response to ↑PCO₂, ↓pH and ↓PO₂)
- Reduced respiratory muscle activity (↓ sighing and yawning)
- Alveolar collapse/small airway closure (atelectasis)
- Reduced functional residual capacity
- Ventilation/perfusion mismatch → Hypoventilation (hypercapnia/hypoxaemia)
stages/planes of canine ether anaesthesia do not necessarily apply when we do not want to use ether, when we need to consider species other than dogs, when we prefer to practice ‘polypharmacy’ to achieve the desired state/depth of general anaesthesia and when we add surgical stimulation to the anaesthetised patient, because depth of anaesthesia is not only related to the ‘dose’ of drug/s administered, but is also dependent upon the degree of stimulation (usually surgery) at the time. Nevertheless, consideration of anaesthetic depth does make us think about patient monitoring.

Table 1.1 is included purely for interest, but it is important to note that during the induction of anaesthesia, stage II (involuntary excitement/movement) may be witnessed; and during recovery from anaesthesia, all the stages are traversed in the reverse order, such that emergence excitement (stage II) may be observed.

**Important stages of anaesthesia**

- **Pre-operative assessment**: patient stabilisation; provision of analgesia.
- **Premedication**: anxiolyis/sedation and initiation of analgesia provision if not already provided.
- **Induction** of anaesthesia.
- **Maintenance** of anaesthesia: continuation of analgesia/antinociception provision.
- **Recovery** from anaesthesia (sometimes referred to as ‘reanimation’): aftercare; continuation of analgesia provision.

**Conclusions**

The effects of general anaesthesia are summarised in Table 1.2. Our main objective is to maintain tissue perfusion, with delivery of oxygen and removal of waste products. If this fails, we can expect increased patient morbidity and mortality. There are no safe anaesthetics; there are only safe anaesthetists.

**Further reading**


Schupp M & Hanning C (2003) Physiology of Sleep. British Journal of Anaesthesia: CEPD Reviews 3 (3), 69–74. (Distinguishes sleep from general anaesthesia; useful information on effects of sleep deprivation for the anaesthetist.)


**Self-test section**

1. Define ‘general anaesthesia’.
2. What do you understand by the phrase ‘balanced anaesthesia’?