Anaesthesia for dentistry

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History of dental anaesthesia

The first general anaesthetic administered for a dental extraction is credited to Connecticut dentist Horace Wells. Having observed at a travelling show that laughing gas induced anaesthesia, Wells began experimenting with the gas himself. On the 11th December, 1844, he underwent extraction of one of his own wisdom teeth by a colleague whilst under the influence of nitrous oxide. The following year he attempted to demonstrate this technique in Harvard. Unfortunately, his patient cried out during the operation and Wells was laughed out of the lecture theatre. However, on December 30, 1846, a pupil of Wells, William Morton, exploited the properties of ether to facilitate dental extraction, and this agent was subsequently demonstrated successfully to the public in Massachusetts the following month. The concept of general anaesthesia as a means of performing painless dental work was thus born. This development facilitated the expansion of the dental profession, enabling increasing emphasis on restorative and conservative work, where previously there had been little to offer to sufferers but simple extraction.

Around the turn of the century, local anaesthesia was introduced. It remained an experimental technique until the introduction of lidocaine in the 1940s. Despite having a safe and effective local anaesthetic, there remained an ongoing demand for general anaesthesia based, at least in part, on cultural expectation.

Over the course of the 1970s and 1980s there were increasing concerns raised over the level of safety associated with dental anaesthesia. Every year there were a number of deaths, often in healthy children undergoing simple procedures. The reasons were multifactorial, including the fact that anaesthesia was often administered under conditions with substandard monitoring, assistance, and resuscitation equipment. Patients were often poorly prepared and dental remuneration was such that it encouraged a high throughput of patients. A working party led by Professor David Poswillo recommended in 1990 for the safe provision of general anaesthesia in dentistry outside hospital. The key recommendations were:

(i) avoid general anaesthesia where possible;
(ii) the same standards of personnel, monitoring and equipment should apply whether anaesthesia is administered in a hospital or in a dental surgery; and
(iii) dental surgeries should be inspected and registered.

Unfortunately many of the recommendations were not uniformly taken up. Despite an initial fall in the number of anaesthetics administered, this was followed by an increase both in anaesthetics (Fig. 1) and deaths.2 In the late 1990s, after a number of high profile deaths and a successful manslaughter prosecution, the General Dental Council and the Royal College of Anaesthetists issued further guidance.3 4 It was highlighted that general anaesthesia was often used inappropriately as a method of anxiety control, in situations where local anaesthesia with or without sedation might be appropriate. It was recommended that general anaesthesia should only be administered where no alternative existed such as the following:

(i) situations in which it would be impossible to achieve adequate local anaesthesia and so complete treatment without pain;
(ii) patients who, because of problems related to age/maturity or physical/learning disability, are unlikely to allow safe completion of treatment; and
(iii) patients in whom long-term dental phobia will be induced or prolonged.

Recommendations were also made that administration of dental anaesthesia should only be carried out by:

(i) anaesthetists on the specialist register of the General Medical Council;
(ii) trainees working under supervision in programmes accredited by the Royal College of Anaesthetists; or
(iii) non-consultant career grade doctors working under the responsibility of a named consultant anaesthetist.

Key points

The first general anaesthetics administered were for dental extractions.

General anaesthesia for dentistry is not without risk and should not be undertaken as a first-line means of anxiety control.

Consideration should always be given to the possibility of local anaesthetic techniques with or without conscious sedation.

Patients requiring general anaesthesia for dental work are frequently children or individuals with learning difficulties.

The standards of general anaesthesia for dentistry should be the same as those in any other setting.

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Both the anaesthetist and dentist must work with their own dedicated trained assistant and patients must be recovered with appropriate monitoring and recovery staff. Wider training of both anaesthetists and dentists in alternative techniques of pain and anxiety control must take place.

A marked reduction in the provision of general anaesthesia followed. In 2000, the Department of Health encouraged moves towards centralization of services to the hospital setting where immediate access to critical care facilities would be available. From December 31, 2001, general anaesthesia could no longer be administered in the dental surgery in this country.

Problems of dental anaesthesia

The problems of dental anaesthesia relate both to the patient population, and the nature of the surgery.

Patient factors

Patients are frequently children with all the attendant problems of paediatric anaesthesia. Children may have adenotonsillar hypertrophy and also have a tendency to develop frequent respiratory tract infections with an associated increased risk of airway problems under general anaesthesia.

Individuals with learning difficulties may often present for dental work under general anaesthesia owing to poor dental hygiene. These patients may be uncooperative and communication may be challenging. Individuals from institutions are at higher risk of hepatitis B. Other medical conditions and physical abnormalities may co-exist, such as epilepsy, reflux, and cardiac anomalies.

Patients are frequently highly anxious and needle phobic. There may be high levels of autonomic activity with increased propensity to arrhythmias and vasovagal responses. Gastric emptying may also potentially be delayed.

Finally, patients are frequently treated as day cases with all the associated problems of ambulatory anaesthesia.

Surgical factors

These can be summarized as follows: (i) the airway must be shared by the anaesthetist and dentist; and (ii) the airway may become soiled with blood and debris.

Stimulation of the trigeminal nerve during dental work may be implicated in the increased incidence of arrhythmias seen in these patients. This tendency may be exacerbated by any degree of hypoxia or hypercarbia owing to airway obstruction, and in the presence of certain volatile agents, in particular halothane.

Local anaesthesia

This is generally performed by the operating dentist. Local anaesthetic solutions with or without vasoressors are used to perform various infiltrative techniques and nerve blocks (Fig. 2). These may be combined, where appropriate, with conscious sedation or topical anaesthesia.

The commonly used local anaesthetic solutions are:

**Lidocaine 2% plain**

Used for blocks and infiltrations; however, effectiveness of analgesia is limited and of brief duration. Maximum adult safe dose is $4 \times 2.2$ ml cartridges or $3 \text{ mg kg}^{-1}$. The addition of 1:80 000 epinephrine prolongs effectiveness to over 90 min and increases maximum adult safe dose to $10 \times 2.2$ ml cartridges or $7 \text{ mg kg}^{-1}$.

**Prilocaine 3% with felypressin 0.03 IU ml$^{-1}$**

Used for blocks and infiltrations, effective analgesia over 90 min, predisposes to methaemoglobininaemia, avoid in pregnancy. Maximum adult safe dose $9 \times 2.2$ ml cartridges or $6 \text{ mg kg}^{-1}$.

**Articaine 4% with epinephrine (1:100 000)**

Currently recommended for infiltration only. It has rapid onset (<2 min) with exceptional ability to penetrate dense mandibular
cortical bone. It is ideal where blocks are contraindicated. Maximum safe adult dose 7 mg kg\(^{-1}\).

**Bupivacaine 0.25–0.5% plain**

Used for blocks and infiltrations where up to 8 h of anaesthesia is required. Maximum safe dose 2 mg kg\(^{-1}\).

**Conscious sedation**

Conscious sedation is defined as a technique in which the use of a drug or drugs produces a state of depression of the central nervous system enabling treatment to be carried out, but during which *verbal contact with the patient is maintained*. The patient must retain their protective airway reflexes, and be able to respond to and understand verbal communication. The drugs and techniques used must therefore carry a margin of safety wide enough to make loss of consciousness unlikely.\(^6\)

Alongside the move away from general anaesthesia in dentistry, there has been increasing emphasis in the training of dental practitioners in the safe provision of conscious sedation. All members of the dental team providing sedation must have received theoretical, practical and clinical training before undertaking independent practice. They must also be trained to deal with sedation-related complications, including cardio-respiratory arrest. Patients should be carefully selected and medically pre-assessed, and consent must be obtained.

The principal methods currently in use are inhalation, intravenous and oral although other methods are occasionally used.

**Inhalation sedation**

A titrated mixture of up to 70% nitrous oxide may be administered. Clinical monitoring of patient colour, respiration and pulse is sufficient, and adult patients need not be accompanied home afterwards. This is the technique of choice in children felt to be candidates for sedation.

**I.V. sedation**

This is commonly achieved with a titrated benzodiazepine, although a patient- or target-controlled infusion of propofol has gained some popularity over recent years. Clinical monitoring must be supplemented by pulse oximetry and blood pressure readings. Facilities must be available to administer oxygen or ventilation if needed. Patients must be recovered appropriately and be accompanied by a responsible adult.

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**Fig. 2** Types of local anaesthesia.
Oral sedation
Temazepam and midazolam are useful. Monitoring and recovery requirements are as for i.v. sedation.

General anaesthesia
General anaesthesia should now only be performed in the hospital setting and requires a trained anaesthetist with a dedicated assistant. It is required for three main groups of patients:
(i) simple dental extractions or exodontia, previously known as "dental chair anaesthesia". These are mostly performed in children aged 4–10 yr, or in those with learning difficulties;
(ii) day-case anaesthesia for extraction of permanent molars or minor oral surgery work; or
(iii) in-patient anaesthesia for more complex or extensive dental work.

Conduct of general anaesthesia
Assessment
Patients must be assessed in the usual manner, particularly regarding their medical, social and surgical suitability for day-case anaesthesia. Given the risks of general anaesthesia, the possibility of performing the procedure under local anaesthesia with or without sedation should always be considered. The risks of general anaesthesia should be explained to the patient, and consent obtained.

Premedication
Premedication is rarely required, although the highly anxious individual, or uncooperative child may benefit from a short-acting benzodiazepine. EMLA or Ametop cream to facilitate i.v. cannulation in children is useful.

Monitoring
Minimum monitoring standards must be met. This includes capnography in cases where endotracheal intubation is employed. A full range of resuscitation equipment must be available, and all equipment should be of a standard equal to that used for the administration of anaesthesia in any other setting.

Induction
Inhalational, i.v. and intramuscular inductions all have their place. Inhalational induction is associated with an increased incidence of arrhythmias, particularly with halothane. Sevoflurane is preferable, owing to the speed of onset and offset. It also causes fewer arrhythmias and may be a safer option. A full face mask is usually required for an inhalational induction, but may subsequently be exchanged for a nasal mask or other airway maintenance device as described below. However, an i.v. induction using propofol is the technique of choice at present in day-case anaesthesia.

In extraction of wisdom teeth, or more extensive dental work, the patient may require endotracheal intubation. This may be facilitated by means of a non-depolarizing neuromuscular blocking agent of appropriate duration of action. The use of the depolarizing neuromuscular blocking agent succinylcholine is perhaps best avoided in this population of predominantly ambulatory patients because of muscle pains. Neuromuscular blocking agents may be avoided entirely either by intubating the patient whilst breathing spontaneously in a deep plane of anaesthesia, or by administering a high dose of alfentanil (up to 30 μg kg⁻¹). Maintenance of a deep plane of anaesthesia throughout the procedure will then be necessary to facilitate tolerance of the endotracheal tube, with resultant respiratory depression and hypercarbia.

Airway
For simple exodontia, the airway has traditionally been maintained by means of a nasal mask. More recently, the laryngeal mask has become the airway of choice as it provides a more definitive airway. However, both types of airway may easily be lost without the close cooperation and vigilance of the dentist and the anaesthetist. The laryngeal mask may need to be moved during surgery and is continually at risk of being dislodged. The two principal nasal masks in use are the Goldman and the McKesson. The airway is maintained by supporting the mandible with the fingers and preventing the tongue from falling back, whilst the patient is allowed to breathe spontaneously via the nasal mask. The nasal mask is held in position by the anaesthetist’s thumbs. A pack is placed by the dentist at the back of the pharynx to prevent the patient from breathing through the mouth, and to collect any blood or debris from reaching the larynx. A gag or bite-block is then positioned on the side opposite the extractions to open the mouth. Downward pressure by the dentist during extraction of mandibular teeth has the potential for airway obstruction. This can be partially prevented if the dentist uses the non-extracting hand to pull up on the patient’s mandible. A nasopharyngeal airway may be a useful adjunct to this technique particularly in the child with large adenoids or tonsils, which may obstruct their airway soon after induction.

For extraction of wisdom teeth or other more extensive dental procedures, the patient is generally intubated. The nasal route is preferred as this creates more room for the operating surgeon to work. However, where a relative or absolute contraindication to nasal intubation exists, or in the smaller child, oral intubation may be used. The tube may then be moved around to facilitate access to all four quadrants of the mouth as necessary. A pharyngeal pack is usually inserted. As with simple dental extraction, the laryngeal mask is increasingly being used in this type of surgery.

Maintenance
Maintenance may be either inhalational or i.v.. Inhalational maintenance is usually achieved by the administration of a volatile agent in a mixture of either nitrous oxide or air in oxygen. As with inhalational induction, the incidence of arrhythmias is
highest with the use of halothane, and may be as high as 32% (enflurane 10%, isoflurane 14%). Arrhythmias are increased in the presence of hypoxia or hypercarbia and associated with airway obstruction. The nature of arrhythmia also differs between agents with a higher incidence of ventricular arrhythmias seen with halothane, as compared with the more benign supraventricular arrhythmias seen with isoflurane. In spite of these issues, halothane remained the agent of choice for many years owing to the more irritant nature of the other agents available and the associated higher incidence of coughing, salivation and laryngospasm. Sevoflurane has been shown to be significantly less arrhythmogenic than halothane and is also non-irritant, and has now superseded halothane as the agent of choice in the UK. Target-controlled infusions of propofol may also be used.

Patient positioning
Historically, patients were anaesthetized and operated on in the sitting position. This position was favoured as it was felt to facilitate surgical access and lessen the risk of aspiration of blood and debris from the oropharynx. These benefits need to be balanced against the risk of venous pooling or unrecognized vasovagal syncope causing a reduction in venous return and hypotension, with the potential for cerebral hypoperfusion and hypoxia. The sitting position is therefore now unusual and patients are anaesthetized supine with or without a slight head-up tilt. A pharyngeal pack will still help to prevent debris and secretions from reaching the posterior oropharynx and being aspirated in this position.

Recovery
Pharyngeal packs should be removed and the pharynx cleared of secretions and debris by suction. Swabs may have been placed by the surgeon across the sockets of the extracted teeth to absorb any ongoing bleeding. The patient should be turned into the lateral position, possibly with a degree of head-down tilt to encourage the drainage of any blood or secretions away from the larynx. Neuromuscular blocking agents should be antagonized as appropriate, oxygen 100% administered and any anaesthetic agents discontinued. Extubation or removal of a laryngeal mask where indicated may be performed either with the patient in a deep plane of anaesthesia, or with the patient in a very light plane. The former technique carries an increased risk of aspiration of blood and secretions into the larynx.

The patient must be recovered in appropriate facilities by qualified staff as with any other general anaesthetic. They must remain in hospital until the usual criteria for discharge as a day-case are fulfilled. Pain, nausea and vomiting must be controlled, and there should be no continued bleeding. The patient must be accompanied home by a responsible adult with clear instructions as to what to do should any postoperative complications arise.

Analgesia
For simple extractions a single dose of paracetamol may be sufficient. However, the pain experienced will increase with the number of teeth removed, and with the degree of difficulty experienced by the dentist in extraction. For more extensive work, dexamethasone and a non-steroidal (e.g. diclofenac) help to reduce pain and swelling. Local anaesthetic may be infiltrated into the sockets by the surgeon, or a block performed if work is limited to one or two quadrants. Short-acting opioids such as fentanyl or alfentanil are often used intraoperatively for the more painful procedures; however, longer-acting opioids such as morphine are best avoided in the day-case patient. If pain control cannot be achieved by means of simple analgesics, this may be an indication for postoperative admission to hospital.

References

See multiple choice questions 54–57.