23 Anaesthesia and pain relief

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Chronic pain

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Chronic pain is defined as pain that persists or recurs for more than 3 months. In chronic pain syndromes, pain can be the sole or a leading complaint and requires special treatment and care. This could be ‘chronic primary pain’, which may be conceived of as a disease in its own right, for example in condi tions such as fibromyalgia or non-specific low-back pain. In six other subgroups, pain is secondary to an underlying disease: chronic cancer-related pain, chronic neuropa thic pain, chronic secondary visceral pain, chronic post-traumatic and postsurgi cal pain, chronic secondary headache and orofacial pain and chronic secondary musculoskeletal pain. These conditions are summarised as ‘chronic secondary pain’, in which pain may at least initially be conceived as a symptom. In sur gical practice, patients with chronic pain may present for treatment of the cause (e.g. pancreatitis, malignancy) or concomitant benign pathology . Almost 50 years ago, using gate theor y , Melzeck and Wall proposed pain to be not only subjec tive but also a multidimensional experience that incorporates sensory/discriminative, motivational/a ff ect and cognitive aspects. Recent guidance from the International Association for the Study of Pain highlights tha t the multidimensional aspect is one of the key components, hence the treatment of chronic pain involves a multidisciplinary multimodal approach. Mechanistically , chronic pain may be classified into: /uni25CF Nociceptive pain , which may result from musculoskel etal disorders or cancer activating cutaneous nociceptors (pain receptors). Prolonged ischaemic or inflammatory processes result in sensitisation of peripheral nociceptor and altered activity in the central nervous system, leading to exaggerated responses in the dorsal horn of the spinal cord. The widened area of hyperalgesia and increased sen sitivity (allodynia) have been attributed to increased trans mission in the central nervous system. the peripheral or central nerves (excluding the ‘physiolog - ical’ pain due to noxious stimulation of the nerve termi - nals). It is classically of a ‘burning’, ‘shooting’ or ‘stabbing’ type and may be associated with allodynia, numbness and diminished thermal sensation. It is poorly responsive to - opioids. Examples include trigeminal neuralgia, posther - petic neuropathy and diabetic neuropathy . - Chronic pain

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General anaesthesia is commonly described as the triad of unconsciousness, analgesia and muscle relaxation. Summary box 23.2 The general anaesthetic triad /uni25CF /uni25CF /uni25CF Induction of general anaesthesia is most frequently done by intravenous agents. Propofol has replaced thiopentone as the most widely used induction agent and can be used for main tenance of anaesthesia. Other infrequently used intravenous agents include etomidate and ketamine. Newer agents based on a benzodiazepine receptor agonist, etomidate derivatives and fospropofol are still in the experimental stage . Inhalational induction using agents such as non-pungent sevoflurane is useful in children, needle-phobic adults and those in whom a di ffi cult airway is anticipated. These patients will have a higher risk of de veloping airway obstruction. Figure 23.1 shows a commonly used anaesthetic machine. Summary box 23.3 Key features of commonly used intravenous anaesthetic agents /uni25CF /uni25CF /uni25CF /uni25CF Rapid sequence induction (RSI) using a predeter mined dose of intravenous anaesthetic agent together with a rapidly acting muscle relaxant is used in those with a high risk of regurgitation in order to secure the airway quickly . Com monly needed in emergency surgery , it is also a technique of - choice in any non-emergency surgery in a patient with delayed emptying of the stomach. T otal intravenous anaesthesia (TIV A) is becoming popular following the introduction of propofol and the ultra - short-acting opioid remifentanil. The lack of cumulative e ff ect, better haemodynamic stability , excellent recovery profile and concerns over environmental e ff ects of inhalational agents hav e made TIV A an attractive choice. TIV A is routinely used in neurosurgery , airway laser surgery , during cardiopulmonary bypass and for day case anaesthesia. Summary box 23.4 Special terms in anaesthesia /uni25CF /uni25CF Maintenance of anaesthesia can be done using a contin - uous infusion of intravenous agent (propofol) or an inhaled - vapour such as isoflurane, sevoflurane or desflurane. The use of nitrous oxide is declining, despite its analgesic and weak anaesthetic properties, because of concerns over - postoperative nausea and vomiting. It also incr eases the size

Amnesia: loss of awareness Analgesia: pain relief Muscle relaxation Propofol (di-isopropyl phenol) : smooth induction, better haemodynamic stability, blunting of autonomic re /f_l exes and ability to use as a continuous infusion Thiopentone (barbiturate) : rapid induction, myocardial depression. A reduced metabolic rate and lowering of intracranial pressure is useful in neurosurgical patients but the drop in blood pressure can have detrimental effects Etomidate (steroid derivative) : good haemodynamic stability, brief duration of action, but concern over adrenocortical depression Ketamine (phencyclidine derivative) : preservation of blood pressure and respiratory re /f_l exes together with excellent analgesia makes it an ideal choice for /f_i eld anaesthesia. Emergence delirium is associated with administration of ketamine Figure 23.1 Anaesthetic machine. RSI is a technique that allows the airway to be rapidly secured. It is used when there is a high risk of regurgitation that may lead to pulmonary aspiration TIVA is becoming increasingly popular

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KEY PRINCIPLES OF ANAESTHESIA

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Optimum patient care is dependent on a collaborative approach by the anaesthetic and surgical teams. The importance of multidisciplinary collaboration has been clearly demonstrated by national audits such as the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) and the Confi dential Enquiry into Maternal Deaths in the UK. These audits have led to changes in clinical and non-clinical practice to improve morbidity and mortality . The use of a safety checklist in operating theatres in the form of the Wor ld Health Organization's (WHO) 'WHO Anaesthesia ; the name was suggested by Oliver Wendell-Homes, first appeared in Bailey's William Thomas Gren Morton , 1819–1868, dentist who practised in Boston, MA, USA. Horace Wells , 1815–1848, Harvard, CT , USA, dentist who pioneered the use of nitrous oxide anaesthesia to prevent pain during dental procedures. Sir James Y oung Simpson , 1811–1870, Professor of Midwifery , Edinburgh, UK. John Snow , 1813–1858, general practitioner, London, UK, was one of the pioneers of anaesthesia. Humphrey Davy , 1800, suggested that nitrous oxide inhalation might be used to relieve the pain of surgical operations and named it 'laughing gas'. Henry Edmund Gaskin Boyle , in 1917, got his gas-oxygen machine, which became the first 'Boyle apparatus'. The first examination for a Diploma in Anaesthesia was held in London in 1935. The First Chair in Anaesthesia : Ralph Waters, Wisconsin, USA, in 1933 and RR Macintosh in Oxford, UK, in 1937. During the First World War Sir Ivan Magill and Stanley Rowbotham bation. Sir Magill is also remembered for his laryngoscope, Magill attachment and laryngeal forceps. Surgical Safety Checklist' has shown a reduction in the inci - dence of perioperative untoward events. - The role of the modern anaesthetist has evolved from just - being responsible for the patient in the operating suite into a 'perioperative physician' who optimises the patient for surger y , assesses and minimises risk, cares for the patient during the operation and then manages both pain and homeostasis in the postoperative period. Summary box 23.1 Ground rules for anaesthesia /uni25CF /uni25CF /uni25CF /uni25CF -

Local and regional anaesthesia techniques • The management of chronic pain and pain from malignant • disease Safe surgery is achieved by close teamwork between the surgeon and the anaesthetist Safety checklists ensure that things are not forgotten Risk assessments allow the best strategy to be chosen Anaesthetists are extending their care into the pre- and postoperative phases

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Local anaesthetic drugs (Table 23.2) may be used to provide anaesthesia and analgesia, as a sole agent or as adjuncts to general anaesthesia. Available techniques include topical anaesthesia, local infiltration, regional nerve blocks and central neuraxial blocks (spinal and epidural anaesthesia). Local anaesthesia techniques can lead to complications that may be local, such as infection or haematoma, or systemic, as a result of overdose or accidental intravascular injection.

TABLE 23.2 The common local anaesthetic drugs. Name Maximum dose Comments Early onset, short Lidocaine 3 /uni00A0 mg/kg (7 /uni00A0 mg/kg acting, good sensory with adrenaline block [epinephrine]) Bupivacaine 2 /uni00A0 mg/kg Long lasting, more cardiotoxic, must never be used intravenously Prilocaine 6 /uni00A0 mg/kg (9 /uni00A0 mg/kg Least systemic with adrenaline) toxicity, causes methaemoglobinaemia Ropivacaine 3–4 /uni00A0 mg/kg Less cardiotoxic, greater sensory–motor separation Levobupivacaine 2 /uni00A0 mg/kg Isomer of bupivacaine with fewer cardiotoxic properties

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Learning objectives

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To gain an understanding of: Techniques of anaesthesia and airway maintenance • Methods of providing pain relief • Learning objectives

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Management of the airway during anaesthesia

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Loss of muscle tone as a result of general anaesthesia means that the patient can no longer keep their airway open. There fore, patients need their airway to be maintained for them. The use of muscle relaxants will mean that they will also be unable to breathe for themselves and so will require artificial ventilation. Head tilt, chin lift and jaw thrust manoeuvr es along with adjuncts such as oropharyngeal airways (Figure 23.2 used to facilitate bag–mask ventilation while induction agents exert their full e ff ect. A laryngeal mask airway or endotracheal tube is then inserted, and the patient is allowed to breathe spontaneously or is ventilated during the procedure. The addition of a cu ff to the endo-tracheal tube facilitates positive pressure ventilation and protects the lungs from aspi ration of regurgitated gastric contents. Supraglottic airways /uni25CF Laryngeal mask airway (LMA) . Developed by Dr Archie Brain in the UK, the original LMA first-generation supraglottic airway . The mask with an inflatable cu ff is inserted via the mouth and produces a seal around the glottic opening, providing a very reliable means of maintaining the airway . Its placement is less irritating and less traumatic to a patient’s airway than endotracheal intubation. The technique can be easily taught to non anaesthetists and paramedics and can be used as an emergency airway management tool. Several varieties of first-generation LMAs are available, including the classic LMA and the flexible LMA. Further advancements ha led to the development of second-generation supraglottic ® devices, such as the ProSeal LMA and the i-gel (Figure 23.3). These devices usually have an in-built ‘bite block’ and oesophageal drain tube. They can be used for ventilation of the lungs at higher inflation pressures and are more suitable for patients with a higher body mass index. There are also modified versions of the LMA, including the ILMA (intubating LMA), that allow a blind technique, aiding insertion of a tracheal tube in di ffi cult conditions. Archie Brain , b. 1942, formally an anaesthetist, whose patent application for the laryngeal mask airway was granted in 1982. devices have a good safety and e ffi cacy profile and should be replacing all first-generation devices. /uni25CF Di ffi cult intubation . Endotracheal intubation is feasible in most patients, but in a certain proportion of patients it may be di ffi cult or impossible. However, if it is compounded by an inability to ventilate and therefore maintain oxygenation of the patient by bag–mask, the consequence can be catastrophic hypoxia. Many devices - have been developed to aid intubation if di ffi culty is ® ® ® anticipated (e.g. McGrath blade, Airtraq , C-MAC video laryngoscope) (Figures 23.4 and 23.5); similarly , protocols have been created by specialised societies to deal) are - ® is a - ve ®

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Monitoring and care during anaesthesia

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A minimum basic monitoring of cardiovascular parameters is required during surgery . This includes: /uni25CF vascular /uni25CF electrocardiogram (ECG); /uni25CF blood pressure; /uni25CF adequacy of ventilation: /uni25CF inspired oxygen concentration; /uni25CF oxygen saturation by pulse oximetry; /uni25CF end-tidal carbon dioxide concentration. Monitors of temperature, ventilation parameters and delivery of anaesthetic agents are also routinely used, while measurement of urine output and central venous pressure are recommended for major surgery . Friedrich Trendelenburg , 1844–1924, successively Professor of Surgery at Rostock (1875–1882), Bonn (1822–1895) and Leipzig (1895–1911), Germany . The Trendelenburg position was first described in 1885. /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF Summary box 23.7 - Intermittent positive-pressure ventilation /uni25CF /uni25CF ed - /uni25CF -

Disadvantages Muscle pain, hyperkalaemia, prolonged apnoea and life-threatening malignant hyperthermia Dependent on hepatic metabolism and renal clearance; hence, caution if hepatic and renal impairment Histamine release and allergic reactions Allergic reactions Excreted unchanged via bile and urine Volume controlled, which ensures adequate gas entry but risks high-pressure damage Pressure controlled, which avoids high-pressure damage but risks inadequate ventilation PEEP reduces alveolar collapse and reduces vascular shunting so improving perfusion

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Muscle relaxation and artificial ventilation

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Pharmacological blockade of neuromuscular transmission by neuromuscular blocking agents provides relaxation of muscles, allowing easy surgical access. However, the patient will need artificial ventilation. Neuromuscular blocking agents are broadly classified into depolarising and non-depolarising groups according to their mode of action (Table 23.1). Suxamethonium is the most commonly used depolarising agent. It binds to the nicotinic acetylcholine receptors, result - ing in opening of the cation channel, leading to depolarisation and rapid relaxation of muscles. Despite its adv erse e ff ects such as hyperkalaemia, muscle pain, anaphylaxis and potentially life-threatening malignant hyperthermia, suxamethonium is still widely used because of its quick onset and short duration of action. These properties are useful when rapid endotracheal intubation is necessary to protect the patient’s airway or when short duration surgery is performed. Non-depolarising muscle relaxants act by competitive blockade of postsynaptic receptors at the neuromuscular junction. They provide longer, pr edictable activity but require careful monitoring, appropriate timing and reversal of their action by agents such as neostigmine and sugammadex at the end of the procedure. A peripheral nerve stimulator is rou - tinely used to monitor the depth of neuromuscular block and also to confirm satisfactory recovery of muscle power prior to te the extubation. With the incr easing availability and evidence of the use of sugammadex, the non-depolarising muscle relax - ant rocuronium is an alternative to suxamethonium in the ‘rapid-sequence’ induction as it allows reversal of its actions with sugammadex in a rapid manner. /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF

Advantages Suxamethonium Quickest onset, very short duration, spontaneous recovery Ideal for rapid intubation and for short procedures Vecuronium Long acting Minimal cardiovascular effect and less allergic reaction Atracurium Intermediate acting Non-enzymatic Hofmann degradation Suitable in renal and hepatic failure Rocuronium Rapid onset, intermediate action Suitable for rapid intubation Rapid reversal possible using sugammadex

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Figure 23.9 Dual-lead spinal cord stimulator in the epidural space.

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Principles of chronic pain management

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Non-pharmacological treatment This involves a multidisciplinary approach targeting the biopsychosocial model of health (Figure 23.8). Early assess - ment and engagement with physiotherapy and exercise are key contributors in successful management. Psychological inter - ventions such as counselling, cognitive behaviour therapy and mindfulness are recognised strategies for pain control. ‘Pain management prog rammes’ lay out a logical structure for this. - Pharmacological treatment Drugs in chronic non-malignant pain Paracetamol and NSAIDs are the mainstays of musculoskel - etal pain treatment. The tricyclic antidepressant drugs and anticonvulsant agents are often useful for the pain of nerve injury , although side e ff ects can prove troublesome and reduce compliance. Both pregabalin and gabapentin r educe sponta - neous neuronal activity by their action on the α δ subunit of the 2 calcium channel. They are now routinely used for managing - neuropathic chronic pain. In more severe and debilitating non-malignant chronic pain, opioid analgesic drugs are used in slow release oral preparations (morphine and oxycodone) and transcutaneous patches (fentanyl and buprenorphine). - - - s - -

Physical Genetic health vulnerabilities Biological Disability Drug Temperament effects IQ Mental Peers Social skills health Social Psychological Family relationships Coping skills School Trauma Family circumstances Self-esteem Figure 23.8 Biopsychosocial model of health.

Commonly used terms in chronic pain Tapentadol, with its dual action on the opioid and noradren aline (norepinephrine) selective reuptake inhibition pathway , may provide relief in patients with both a neuropathic and nociceptive element to their pain. Combinations of drugs often prove useful to achie ve the optimum of e ffi cacy with minimal side e ff ects. Treatment of pain dependent on sympathetic nervous system activity Even minor trauma and surgery (often of a limb) can provoke excessive sympathetic adrenergic activity , inducing vasocon striction and abnormal nociceptive transmission. This can lead to chronic burning pain, allodynia, trophic changes and resultant disuse. Management includes antineuropathic pain medications - (pregabalin, gabapentin, amitriptyline) as part of m ultimodal analgesia with a multidisciplinary pain management approach. This includes considerab le input from psychological services and targeted physiotherapy . Interventional treatment may include local anaesthetic injection of the stellate ganglion for upper limb symptoms. Percutaneous chemical lumbar sympa - thectomy with local anaesthetic is used for relief of rest pain in advanced ischaemic disease of the legs. Interventional pain management for chronic pain - Local anaesthetic and steroid injections can be e ff ective around an inflamed nerve and they reduce the cycle of constant pain transmission with consequent muscle spasm. Transforaminal

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Regional anaesthesia

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Regional anaesthesia involves central neuraxial or peripheral nerve or plexus blocks using local anaesthetic drugs. It has a clear advantage when general anaesthesia carries a higher risk of morbidity and mortality , such as in patients with debilitating respiratory and cardiovascular disease and obstetric cases. It also provides excellent pain relief in the postoperative period, reducing the need for analgesics such as opioids. As with general anaesthesia, venous access should be established and vital parameters should be monitored during regional anaesthesia. Localising nerves using anatomical landmarks and eliciting paraesthesia alone carries a high risk of nerve damage and intravascular injection and has a lower success rate. The use of nerve stimulators to localise nerves impro ves the success rate and reduces risks. Ultrasound-guided regional anaesthesia allows the visualisation of nerves and the spread of local anaes thetics, enabling the use of a smaller dose of local anaesthetic agents with improved success rates and safety . Summary box 23.8 Types of anaesthesia /uni25CF /uni25CF /uni25CF /uni25CF

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Ventilation during anaesthesia

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