


Anaesthesia-related Risk Factors in Unwell Patients or Trauma Patients and Anaesthetic Drug Selection: Cats and Dogs

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Abstract

Safe anaesthesia requires careful monitoring and good knowledge of the effects of various anaesthetic drugs on different organ systems. The safest approach in the anaesthesia of critical patients is to select drugs whose effects are easily reversible and to take great care with the dosage. Deaths occurring in the perioperative period are generally caused due to pre-existing diseases, anaesthetic drugs, surgical interventions, or a combination of these factors. Prolonged surgical interventions, hypothermia, fluid loss, and excessive fluid intake are also factors that increase patient deaths. When anaesthetizing an unwell patient, individual requirements are evaluated. There-

fore, it is not possible to present a single overall anaesthesia protocol applicable to all patients. There is a series of principles for the administration of anaesthesia to high-risk patients. This review discusses anaesthesia administrations required for both diagnostic and surgical interventions in trauma patients and unwell patients. The risk factors and the various complications that may be encountered by clinicians while performing sedation and anaesthesia in such patients and their treatment methods have been explained in detail.

Keywords: Anesthesia, cat, dog, risk factors, trauma

Introduction

General anaesthesia is the state of total unconsciousness produced by a controlled and reversible suppression of the central nervous system using drugs with an anaesthetic effect. Muscle relaxation, loss of reflexes and loss of pain sensation also occurs in general anaesthesia. Clinicians performing anaesthesia are usually anxious about anaesthesia-related complications and, in particular, losing a patient. However, patient loss due to anaesthesia occurs much less than the loss of a patient caused by other reasons.

In this review, anaesthesia administrations required both for diagnostic and surgical interventions in trauma patients and unwell patients have been discussed. Risk factors and various

complications that may be encountered by clinicians performing sedation and anaesthesia in such patients and their treatment methods have been explained in detail.

Key points for guidance in anaesthesia administration

1. Safe anaesthesia requires careful monitoring and good knowledge of the effects of various anaesthetic drugs on different organ systems.
2. Anticipating and preparing for probable complications is helpful in achieving successful results.
3. Analgesic treatment in critical patients must be approached on an individual basis, since responses to analgesic drugs may be very different.

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4. The safest approach in the anaesthesia of critical patients is to select drugs whose effects are easily reversible and to take great care with the dosage (Rozanski and Rush, 2007).

Targets for the anaesthesia of unwell and trauma patients

The first goal when performing anaesthesia in unwell and trauma patients must be to optimize tissue perfusion and enable sufficient oxygenation of the vital organs in particular, while achieving analgesia, muscle relaxation and unconsciousness in the patient. The final aim of the treatment, rather than the measured parameters returning to normal, is to provide maximum physiological function (Carroll and Martin, 2007).

Values that are considered normal for healthy patients undergoing anaesthesia produce higher rates of mortality in unwell patients. In humans subjected to trauma, for the chance of post-operative survival, a 110-120% higher blood volume and 50% higher cardiac findings are required. These values are necessary for tissue repair and to meet increased metabolic requirements in trauma and post-surgical patients (Carroll and Martin, 2007).

Determination of the patient's risk status according to the American Society of Anesthesiologists (ASA) classification

The ASA classification is an assessment system useful for identifying the pre-operative risk status of patients and determining a suitable anaesthetic approach and monitoring methods. It is used to classify patients depending on fatal complications arising from general anaesthesia (Redondo et al., 2007; Rozanski and Rush, 2007). According to this method;

Category 1: Normal healthy patients. General anaesthesia poses a minimal risk.

Category 2: Patients with mild systemic disease (localized infection and treated heart disease).

Category 3: Patients with severe systemic disease (fever, anaemia, mild hypovolemia).

Category 4: Patients with life-threatening severe systemic disease (heart failure, septic shock). Patients not expected to survive without intervention.

Category 5: Patients with life-threatening disease (shock, severe trauma and end stages of fatal infections). Patients not expected to survive for more than 24 h regardless of intervention.

According to ASA criteria, patients in categories 3, 4 and 5 have higher anaesthesia-related death rates (Bille et al., 2012; Brodbelt et al., 2006; Itami et al., 2017). Patient fatalities occur due to problems during anaesthesia in ASA 1 and 2, whereas in ASA 3, 4 and 5, these generate from the poor condition of the patient (Hosgood and Scholl, 2002; Redondo et al., 2007).

Anaesthesia-related mortality risk

The risk of death due to anaesthesia is much lower than the mortality risk arising from a disease or surgical intervention.

However, since anaesthesia is achieved via the controlled administration of drugs with toxic properties to the patient, it bears risks such as organ dysfunction, delayed recovery and death (Alef et al., 2008; Evans and Wilson, 2007; Jones, 2001).

Anaesthesia-related mortality rates are higher in Veterinary Faculty hospitals. Playing a role in this are the facts that patients brought to the Veterinary Faculty have multiple problems and diagnostic and surgical interventions are more complicated (Brodbelt, 2009).

Two main factors are influential in patient deaths. Firstly, the physical condition of the patient, and secondly the knowledge, experience and skill of the practitioner. Close monitoring of the patient is important for timely detection of possible risks and necessary intervention (Brodbelt et al., 2008; DeLay, 2016; Evans and Wilson, 2007; Jones, 2001).

The Anaesthesia-related mortality risk is 0.05-0.1% in healthy dogs, 0.24% in healthy cats and 1.33% in ill dogs and cats. The risk of death is higher in cats than in dogs. Also the mortality risk in rabbits and other exotic animal species is higher in comparison to cats and dogs (Bille et al., 2012; Brodbelt, 2009; Brodbelt, 2010; Itami et al., 2017).

The Anaesthesia-related death rate in humans is 0.02-0.05%. The main reason for human mortality rates being lower than animals is the excess of animal species in veterinary anaesthesia. Also, in human anaesthesia, clinical staff receive a high level of training and there is more anaesthesia equipment, monitoring and intensive care facilities (Biboulet et al., 2001; Brodbelt, 2009).

In recent years, factors such as an improvement in veterinary equipment, safer medication and better monitoring in line with technological developments, have significantly reduced anaesthesia-related mortality risk (Brodbelt, 2009; Brodbelt, 2010; DeLay, 2016).

In order to minimize the risk of anaesthesia-related death, prior to anaesthetising the patient it is important to determine a high heart rate, high total leucocyte count, low PCV, low glucose concentrations and levels of inflammatory mediators such as c-reactive protein. Stabilizing the patient before anaesthesia helps to reduce anaesthesia-related death risk (Bille et al., 2012; Brodbelt et al., 2007; Itami et al., 2017; Perkowski, 2000).

Patients at high risk from anaesthesia and operative intervention

In small animal practice (particularly in elderly cats with hyperthyroidism) all trauma patients with lung injuries, patients with life-threatening conditions such as haemothorax, pneumothorax and pulmonary haemorrhage, acute head trauma and severe intra-abdominal haemorrhage, carry a high risk with respect to anaesthesia and surgical intervention. Also, newborns, patients with portosystemic shunt occlusion and cardi-

ac, intracranial or intraocular surgery patients are considered to be cases requiring extreme caution (Evans and Wilson, 2007; Evans and Wilson, 2011).

Anaesthesia-related death

Anaesthesia-related death is described as any death occurring in the period starting from anaesthesia induction up to the time when the patient has regained consciousness or returned to its pre-operation status (Brodbelt, 2009).

Peri-operative deaths occurring in the first 48 h including completion of the anaesthetic procedure are deaths related to anaesthesia and sedation. Inoperable surgical patients, patients in the ASA 3, 4, 5 categories and cases with a pre-existing medical condition are not included in anaesthesia deaths (Brodbelt, 2009).

Research has revealed that among anaesthesia-related deaths, 0.1% occur at premedication, 6-8% during induction, 30-46% during maintenance and 47-60% in the post-operative period and the first 48 h. The first 3 post-operative h are important (Brodbelt et al., 2006; Brodbelt et al., 2008; Itami et al., 2017).

Reasons for death

Deaths occurring in the peri-operative period are usually caused by pre-existing diseases, anaesthetic drugs, surgical interventions or a combination of these factors. Deaths due to physiological causes may be multifactorial. Multiple organ or system failure leads to the loss of the patient (Brodbelt, 2009; Brodbelt, 2010).

The majority of patient losses observed in the post-operative period occur as a result of cardiovascular and respiratory system complications. Gastrointestinal, neurological, liver and kidney problems are also among the reasons for death (Brodbelt, 2010; Hosgood and Scholl, 2002).

The main cardiovascular reasons include, a weakened pumping ability of the heart and vascular collapse leading to insufficient blood supply to vital organs. Cardiac arrest occurs as a result of cardiac arrhythmias due to increased catecholamines in the circulation, myocardial hypoxia, specific anaesthetic drugs, pathological conditions present in the patient, interventional procedures such as vagal traction or eye enucleation and myocardial depression due to high-dose anaesthetic drug administration (Brodbelt, 2009; Jones, 2001).

Hypovolaemia and circulation failure are also among the main reasons for cardiovascular collapse (Brodbelt, 2009; Muir et al., 2007).

Anaesthesia deaths originating in the respiratory system usually arise from unsuitable endotracheal intubation, upper respiratory tract trauma and insufficient ventilation. The principle cause of respiratory complications, seen in brachycephalic

patients in particular, is respiratory obstruction. As well as the small size of the feline respiratory tract, cats are also more vulnerable to trauma, spasm and oedema formation compared to dogs. In this species, the death rate due to endotracheal intubation is as high as the death rates of a respiratory and cardiovascular origin. Therefore, extreme caution must be observed during endotracheal intubation in cats (Brodbelt, 2010; Jones, 2001).

Other causes of patient loss in the peri-operative period include; post-operative renal insufficiency, iliac thrombosis, regurgitation, aspiration of gastric content, anaphylactic reactions, failure to regain consciousness and other unknown reasons (Brodbelt, 2009; Muir et al., 2007).

In cats, the most important risk factors for anaesthesia-related deaths are; general poor health, advanced age, endotracheal intubation and insufficient monitoring (Brodbelt, 2010; Jones, 2001).

Determining the risk factors leading to anaesthesia-related deaths will reduce the rate of death. In pediatric, elderly, unwell and trauma patients, sterilization procedures, Terriers, Spaniels and brachycephalic breeds, the death rate is usually high (Brodbelt, 2009; Brodbelt, 2010; Muir et al., 2007).

Prolonged surgical interventions, hypothermia, fluid loss or excessive fluid intake are also factors increasing patient deaths (Devey, 2013; Hosgood and Scholl, 2002; Muir et al., 2007).

Possible complications in trauma patients and unwell patients

During the first few days, tissue breakdown without direct relation to trauma, suppression of the immune system and complications due to metabolic disorders may be observed in trauma patients and unwell patients. Complications may be either septic or aseptic, or originating from both (Carroll and Martin, 2007; Rozanski and Rush, 2007).

Cardiopulmonary collapse and arrest may develop in trauma patients and unwell patients. Acute circulatory failure is caused by severe myocardial ischaemia, arrhythmias with poor prognosis, hypoxaemia due to pulmonary or respiratory tract injury, haemorrhagic shock and acid-base and electrolyte disorders. In such patients, cardiopulmonary resuscitation is commenced immediately and the sympathetic system is stimulated. Insufficient resuscitation, anaesthesia and major trauma such as surgery usually result in death (Campbell, 2005; Carroll and Martin, 2007; Jones, 2001).

Planning for possible complications

Firstly, possible complications are identified and treatment is planned. Necessary devices for monitoring the patient, drugs and other equipment are prepared in an easily accessible position (Dyson, 2008; Rozanski and Rush, 2007).

When the patient is presented to the emergency department; the airway, respiration, circulation and neurological condition is assessed initially. Parameters including respiratory rate and motion, heart rate and rhythm, blood pressure and pulse quality, capillary refill time, central nervous system functions and pain are regularly checked to monitor patient condition and prognosis (Carroll and Martin, 2007; Devey, 2013; Pachtinger, 2013).

In anaesthetized patients, access to respiratory and intravenous routes is obligatory. In the presence of cardiovascular depression, oxygen support is provided to maintain tissue oxygenation. In the event of the patient requiring assisted ventilation, endotracheal intubation is performed. Intravenous access is essential to administer emergency medication and fluid therapy. Furthermore, it is beneficial to place multiple intravenous catheters in most of the patients at risk. This procedure will make it easier to administer serum, blood, injectable analgesic and anaesthetic drugs to the patient (Quandt, 2013; Rozanski and Rush, 2007).

In order to reduce pain and stress in trauma patients, in the first instance endogenous encephalins, endorphins and other amino peptides are released producing a moderate level of sedation and analgesia. Therefore, anaesthetic drugs are used at lower doses in these patients (Carroll and Martin, 2007).

Approach to general anaesthesia in critical patients

When anaesthetizing critical patients, individual requirements are assessed. Therefore, it is not possible to present a single overall anaesthesia protocol applicable to all patients. There is a series of principles for anaesthesia administration in high-risk patients (Rozanski and Rush, 2007). These are;

Stabilization of the patient

Prior to anaesthesia, the patient is stabilized as much as possible. Most anaesthetic drugs suppress the cardiovascular and respiratory systems. This, in turn, reduces perfusion and oxygenation of organs such as the liver, kidneys, heart and brain. It leads to the development of many side effects arising from anaesthesia (Bednarski et al., 2011; Rozanski and Rush, 2007).

In healthy patients with no heart or respiratory problem, the cardiovascular depression caused by anaesthesia does not produce significant complications. However, prior to anaesthesia if oxygen transport is decreased (heart disease, anaemia, pulmonary disease or electrolyte disorders) or if there are circulation disturbances due to organ failure (kidney failure or traumatic brain damage) the depressant effects of anaesthetic drugs will cause a drop in tissue oxygenation (Rozanski and Rush, 2007).

In order to stabilize the patient before anaesthesia, intravenous fluid therapy, blood infusion, establishment of electrolyte balance and correction of lung functions by treating pleural effusion and pneumothorax must be achieved. Also, reducing

intracranial pressure, warming hypothermic patients, treating hypoglycaemia and fluid therapy to lower azotaemia in patients with kidney failure are among the necessary steps (Quandt, 2013; Rozanski and Rush, 2007).

Drug selection for heart and respiratory functions

Drugs with a minimal effect on heart and respiratory functions must be selected. In order to develop pre-anaesthesia tissue perfusion, anaesthetic drugs that cause myocardial, vascular and respiratory depression should be avoided. The drugs of choice should be those best maintaining cardiovascular and respiratory functions such as opioids (morphine, fentanyl), benzodiazepines (midazolam, diazepam), ketamine and etomidate (Demirkan et al., 2002; Mathews and Dyson, 2005; Rozanski and Rush, 2007).

Propofol, thiopental and inhalation anaesthetics such as isoflurane and sevoflurane decrease cardiac contractility and cause vasodilatation and hypoventilation (Mathews and Dyson, 2005; Rozanski and Rush, 2007).

Reversal of drug effects

While opioids, benzodiazepines and ketamine have minimal side effects, in cases with severe cardiovascular, respiratory or neurologic depression, these drugs may cause patient instability or prolonged sedation (Armitage-Cahn et al., 2007; Rozanski and Rush, 2007).

The effects of opioids may be reversed using an antagonist such as naloxone. The effects of benzodiazepines are antagonized using flumazenil. Since the plasma half-life of naloxone and flumazenil is short, it can be repeated as required. These drugs must always be administered slowly. If naloxone is administered rapidly at a higher dose than necessary, it causes cardiovascular side effects. Diluting antagonist drugs in saline at a rate of 1:10 enables easy slow intravenous administration of a small dose of the drug (Quandt, 2013; Rozanski and Rush, 2007).

Drug doses and route of administration

In most patients in a critical condition, sensitivity to anaesthetic drugs increases. In these patients, a larger amount of the blood is directed towards the brain in order to keep the patient alive. Therefore, a much greater amount of medication reaches the brain. Especially in patients where the blood-brain barrier is disrupted, anaesthetic drugs reach the central neurons more rapidly and cause depression in the central nervous system (Rozanski and Rush, 2007).

In patients with hypoproteinaemia, binding of the anaesthetic drug to proteins decreases and the free active part of the drug increases. The required drug dose is also reduced in these patients. However, it is difficult to pre-estimate the lower dose amount. Therefore, "effective" drug administration is advised (Rozanski and Rush, 2007).

In effective drug administration, the drugs are given in a controlled and slow manner via the intravenous route, continuing the injection until the desired sedation or level of anaesthesia has been achieved. In subcutaneous or intramuscular anaesthetic drug administration however, the full calculated dose is given to the patient. This may lead to an unintentional high dose administration of the drug to the patient (Bednarski et al., 2011; Rozanski and Rush, 2007).

Monitoring the cardiovascular and respiratory systems

Heart rate, respiratory rate and blood pressure must be monitored in anaesthetized and unwell patients. These parameters give information about the patient's cardiac output, plasma volume and respiratory functions. In addition, a pulse oximeter shows the decreases in arterial oxygenation, while capnometry displays the changes in arterial CO₂ pressure. Measuring body temperature is important for the timely detection of the adverse effects of hypothermia on the cardiorespiratory system (Pachtinger, 2013; Rozanski and Rush, 2007).

While ECG monitoring detects arrhythmias and electrolyte balance disorders; pulse quality, mucosa colour and blood pressure provide important data for the assessment of cardiac output. Urinary catheterization is required to evaluate kidney function, while central venous catheterization is essential for central venous pressure, blood gases and electrolyte analysis (Haskins, 2007; Pachtinger, 2013; Perkowski, 2000; Rozanski and Rush, 2007).

In ASA 3, 4, 5 category patients, heart rate and cardiac arrest incidence is extremely high. In these patients, fever, pain, hypoxia, hypercapnia and heart failure increase the heart rate. Hypovolaemia, peripheral vasodilatation or a decrease in myocardial contractility, on the other hand, produces hypotension and bradycardia. This increases the risk of anaesthesia. In such patients, fluid input and positive inotropic support must be provided to continue sufficient tissue perfusion (Jones, 2001; Redondo et al., 2007).

General anaesthesia increases the formation of atelectasis in peripheral lung areas, thus decreasing ventilation and causing hypoxaemia. Hypoxaemia, in turn, leads to various arrhythmias and disruption of the body's acid-base balance. Giving a high input of oxygen to patients with normal lung structure prevents the development of hypoxaemia (Guzel et al., 2013a; Itami et al., 2017).

Since patients in the high-risk category are generally inclined towards hypoventilation, mechanical ventilation is advised for these patients. However, mechanical ventilation increases intrathoracic pressure and obstructs venous return (Redondo et al., 2007). In their study carried out in patients in the ASA 1 and 2 categories, Guzel et al. (2013a) reported that there was no statistical difference between heart rate and blood gas parameters in dogs with spontaneous respiration and those given mechanical ventilation.

The oxygen saturation of haemoglobin (SpO₂) values in high-risk group patients are significantly less than patients in the ASA1 category. The main reason for hypercapnia developing during anaesthesia is the suppression of the respiratory centre due to anaesthetic drugs. In the case of end tidal CO₂ (EtCO₂) values being higher than 60 mmHg, the patient must be given either manual or mechanical respiratory support (Pachtinger, 2013; Redondo et al., 2007).

In order to minimize anaesthesia related deaths, during the anaesthesia period it is extremely important to closely monitor the patient, observe oxygen saturation using a pulse oximeter and determine CO₂ levels with the use of capnography (Brodbeck, 2009; Brodbelt, 2010; Quandt, 2013).

Anaesthesia in trauma patients and unwell patients

In unwell or trauma patients it is important to provide sedation, anaesthesia and pain control for diagnostic or therapeutic surgical interventions. All anaesthetic drugs have potential cardiopulmonary suppressing properties. Therefore, in emergency patients, a balanced anaesthesia technique is used to perform safe general anaesthesia. With this method, the amount of anaesthetic drug required is reduced (Bednarski, 2011; Campbell, 2005).

An experienced anesthetist is able to determine 140 different anaesthesia protocols suitable for the condition of the patient. For this purpose, the anesthetist prepares and administers appropriate combinations of drugs including atropine, acepromazine, medetomidine, xylazine, ketamine, propofol, thiopental, halothane, isoflurane, sevoflurane, opioids and non-steroidal anti-inflammatory drugs (NSAIDs) (Redondo et al., 2007).

Drugs used for premedication

This is the administration of a single or multiple drugs (anticholinergic, tranquilizer, sedative) via different routes (subcutaneous, intramuscular, intravenous) in order to prepare the patient's metabolism prior to general anaesthesia (Bednarski, 2011; Koc and Saritas, 2004).

Anticholinergic drugs are used to control possible excessive secretions in the patient and the cardiopulmonary effects of the vagal tone. However, since anticholinergics such as atropine or glycopyrrolate increase heart rate and myocardial oxygen consumption and lead to arrhythmias, these drugs are not routinely used in unwell patients (Bednarski, 2011; Carroll and Martin, 2007; Guzel and Perk, 2002).

Tranquilisation is described as the behavioural changes in the relaxed patient where the patient is aware of the surrounding events. Sedation is a state of drowsiness with cloudy consciousness as a result of central nervous system suppression. During tranquilisation and sedation, the patient is indifferent to events around it, however, it responds to painful stimuli. Both groups of drugs are used to alleviate the patient's sense of fear, make pre-oxygenation easier and minimize sympathoadrenal stimuli (Guzel, 2003; Thurmon and Short, 2007).

There is no perfect way to sedate a patient. The safest sedative drugs for emergency patients are those that can be titrated, have reversible effects and no suppressive effect on the cardiopulmonary system (Campbell, 2005).

Phenothiazines and α_2 agonists (xylazine, medetomidine, dexmedetomidine) produce hypotension by significantly suppressing the cardiovascular system. Therefore, these drugs are unsuitable for the sedation of patients that are either unstable or hypotensive (Armitage-Cahn et al., 2007; Campbell, 2005; Demirkan et al., 2002). In unwell patients (ASA 3, 4 and 5), medetomidine increases the anaesthesia-related mortality risk (Brodgelt et al., 2006; Brodgelt et al., 2007).

Due to its lower cardiopulmonary depressing effect compared to other drugs, acepromazine reduces anaesthesia-related mortality risk. At the same time, it exhibits a protective effect against rhythm disorder by increasing the arrhythmia threshold produced by catecholamines (Brodgelt et al., 2006; Brodgelt, 2010). Despite this, since acepromazine can cause thrombocyte dysfunction and sequestration of erythrocytes in the spleen, it is not used in patients with anaemia or bleeding (Campbell, 2005).

Neuroleptanalgesia achieved with the combination of benzodiazepine (diazepam or midazolam) and opioid (morphine or fentanyl) is one of the most reliable sedative combinations for the anaesthesia of emergency patients (Guzel, 2003; Guzel et al., 2013b; Liao et al., 2017). Both drug groups are reversible. The clinical doses in use have scarcely any depressive effect on cardiovascular and respiratory functions. In patients with cardiovascular or central nervous system problems, or for interventions such as radiography or thoracocentesis, satisfactory sedation can be achieved with this combination (Guzel, 2003; Liao et al., 2017; Mathews and Dyson, 2005).

Neuroleptanalgesia produces excellent premedication prior to anaesthesia. As well as being beneficial in decreasing the dose of the main anaesthetic drug required for anaesthesia, it also produces pre-emptive analgesia for surgery or other painful interventions (Guzel, 2003; Liao et al., 2017). This combination has several contraindications. In patients with central nervous system depression, opioids may cause hypoventilation. This leads to an increase in intracranial pressure. Therefore, such patients must be closely monitored regarding respiratory functions (Rozanski and Rush, 2007).

Intravenous morphine and meperidine administration in dogs causes dose-related histamine secretion and causes severe hypotension. Slow intravenous injection of these drugs is acceptable on condition that blood pressure is monitored (Carroll and Martin, 2007; Mathews and Dyson, 2005). Morphine causes mydriasis, excitation and aggressive behaviour in cats. Oxymorphone, hydromorphone or fentanyl does not lead to histamine secretion. Also, its use in critical patients has been proven to be safe (Campbell, 2005; Mathews and Dyson, 2005).

Drugs used for anaesthesia induction

Patients exposed to trauma are usually in a state of acidaemia and hypoproteinemia. Therefore, the need for the induction drug is greatly reduced (Carroll and Martin, 2007). Propofol, thiopental, etomidate and ketamine/benzodiazepine combination is used for anaesthesia induction. In unwell patients, the dosage to be used is significantly reduced and the drug is administered via the intravenous route. This way, overdosing is avoided (Campbell, 2005; Liao et al., 2017).

In traumatised or unwell patients, intravenous induction anaesthetics are preferred for the immediate control of airways. Mask induction is not recommended with volatile anaesthetics. In mask procedures, it is difficult to follow the depth of anaesthesia and the amount of anaesthetic drug needed is higher. This leads to cardiovascular depression (Bednarski et al., 2011; Carroll and Martin, 2007).

Propofol provides rapid induction and recovery. There is no accumulation in the body as a result of repeated usage. However, in the event of high dosage or fast injection, it produces apnoea and a significant degree of hypotension (Campbell, 2005; Guzel et al., 2006). In the anaesthesia induction of patients aged 10 years and older, diazepam/alfentanyl combination and propofol anaesthesia was compared and it was reported that propofol presented more stable results regarding heart and respiratory system functions and intraocular pressure (Guzel et al., 2013b). In the anaesthesia of patients in categories 4 and 5 according to ASA criteria, a propofol injection followed by isoflurane administration reduced anaesthesia-related mortality rate (Bille et al., 2014).

In central nervous system disorders, due to their properties of reducing brain activity and intracranial pressure, barbiturates such as thiopental may be used for the purpose of increasing oxygen transport to the brain, especially in patients with cerebral ischaemia. Therefore, seizure activity will be decreased and neurons protected (Armitage-Cahn et al., 2007).

Ketamine is an anaesthetic drug with indirect cardiovascular stimulating properties. In healthy patients, it increases blood pressure, heart rate and cardiac output. It is a good choice for the anaesthesia induction of patients with weak myocardial contractility, cardiogenic shock and myocardial insufficiency. In unwell or trauma patients, ketamine and diazepam may be rapidly given consecutively at low intravenous doses (Guzel and Perk, 2002; Guzel, 2003). Ketamine is not used in cats with hypertrophic cardiomyopathy or patients with head trauma or eye damage (Carroll and Martin, 2007; Rozanski and Rush, 2007).

Etomidate has no depressive effect on either cardiovascular or respiratory functions. It enables the continuity of cerebral and haemodynamic homeostasis. Therefore it is a suitable anaesthetic drug for use in unwell patients. It is combined with benzodiazepine or an opioid in order to minimize side effects such as myoclonus (muscle spasm) and vomiting. Repeated use of

etomidate in cats causes haemolysis due to propylene glycol (Armitège-Cahn et al., 2007; Guzel and Perk, 2002; Guzel, 2003; Guzel et al., 2006).

Drugs used for the maintenance of general anaesthesia

Maintenance of general anaesthesia is achieved using volatile anaesthetics such as halothane, isoflurane and sevoflurane. Isoflurane and sevoflurane are equally hypotensive. However, they do not make the myocardium susceptible to the effects of catecholamines. Halothane produces a significant level of myocardial depression and vasodilatation. These undesired effects may be reduced by maintaining low concentrations (Armitège-Cahn et al., 2007; Carroll and Martin, 2007; Thurmon and Short, 2007).

Propofol induction may be used as an alternative to volatile anaesthetics. In the case of total intravenous anaesthesia being preferred, it is beneficial to give the patients oxygen or assisted ventilation. Therefore, endotracheal intubation must be performed (Bednarski, 2011; Rozanski and Rush, 2007).

Analgesia in unwell or trauma patients

In general, opioid agonists are used as an analgesic in these patients. The analgesic effects of these drugs are strong and reversible and the incidence of side effects is low. However, use of opioid agonists in extremely unwell patients may produce an unexpected depth of sedation or cardiorespiratory depression. Therefore, each patient must be assessed individually and drug selection and dosage must be decided accordingly. Epidural administration of opioid analgesics is also useful. In this route of administration, side effects arising in systemic usage are not observed (Alef et al., 2008; Armitège-Cahn et al., 2007; Mathews and Dyson, 2005; Pekcan, 2016).

In patients with sufficient tissue perfusion, non-steroidal anti-inflammatory drugs (NSAIDs) may also be used as analgesics. If NSAIDs are used together with opioids, the opioid dose must be reduced (Alef et al., 2008; Mathews and Dyson, 2005; Pekcan, 2016).

Recovery from anaesthesia and the recuperation process of patients

During and after anaesthesia, intravenous fluid support must be given to patients. In the post-operative period, intestinal and urinary bladder functions, hypothermia, lung functions and skin integrity must be checked regularly. Eye ointment is used to protect the eyes from drying and against external effects. The environment must be quiet. Suitable social communication regarding their individual needs must be made with hospitalised patients (Armitège-Cahn et al., 2007; Brodeur et al., 2017; Quandt, 2013).

Conclusion

In unwell and trauma patients, from the moment the patient arrives at the emergency department, it is important to com-

pose a detailed situation plan and effectively use a well-prepared protocol and time resource. At the same time, the team performing the procedure should delegate roles, assess the patient as quickly as possible and commence treatment. The process will therefore begin without delay and the chance of patient survival will increase.

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