1 Anesthetic complications—how bad things happen

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The delivery of anesthesia in any setting is not without risk. The environment is complex, uncertain, and ever-changing. Human performance of this potentially hazardous task can be unpredictable and imperfect, especially in times of urgency, intensity, and time pressure. Risk and human error cannot be eliminated, but can be reduced and managed by eliminating a culture of blame and punishment and replacing it with a culture of vigilance and cooperation to expose and remediate system weaknesses, which, in combination, often lead to error and injury.

The concept is straightforward. Most patients do not enjoy going to the dentist. Although patients understand that pain can be eliminated with local anesthesia, fear and anxiety still fuel avoidance of necessary care. Dentistry has responded to these issues by providing options for various levels of sedation, analgesia, or general anesthesia in the dental office. Usually, all goes well. Patients are satisfied; necessary dental work gets done. Sometimes, however, things do not go well.

Complications (adverse events, sentinel events) are defined as unplanned, unexpected, unintended, and undesirable patient outcomes: death, physical/psychological injury, or any unexpected variation in a process or outcome that demands notice. *Errors* are deviations from accuracy or correctness, usually, caused by a fault (mistake) for example, carelessness, misjudgment, or forgetfulness. Most errors have no obvious effect on patients, yet most (82%) preventable complications in the past involved human error (Cooper et al., 1978).

Errors are categorized according to persons or systems (Reason, 2000). Person approach refers to individual human error: forgetfulness, inattention, lapses (temporary failure of memory), preoccupation, violation (conscious deviation from a rule), loss of situational awareness, and fixation errors. Human errors lead to specific technical, judgmental, or monitoring mistakes, examples of which are given in Table 1.1. System approach refers to practice conditions: staff training, equipment, schedule density, health history gathering, policies, procedures, checklists, and so on. Latent errors can lay dormant in practices for years, only to be exposed during a triggering event, which then leads to an adverse outcome in a susceptible patient.

Although it is tempting to blame a complication on a single human error (e.g., the practitioner gave the wrong drug and the patient died), seldom is this the case. Most complications are now known to be due to an unfortunate temporal alignment of a *series of errors*, which results in injury. These errors can arise from multiple sources, which include *latent errors* (overbooking, failure to update medical histories, failure to check equipment, lack of training, poor communication), *psychological precursors* (fear of lawsuit, embarrassment), *system defects* (staff not trained in emergency protocols, failure to use checklists, failure to update medical emergency drugs), *triggering factors* (loss of airway, unintended drug overdose, hypotension, etc.), *atypical conditions* (key staff member absent), and *outright unsafe acts* (lack of knowledge, errors of the moment, ignoring a monitor, failure to address a problem, wrong drug given, etc.)

Scope of errors

Unfortunately, errors are a normal part of human behavior, and their causes are not obscure. Habit intrusion, stress, anger, fatigue, boredom, fear, time urgency, illness, and haste increase the odds of faulty performance.

The extent of errors documented to have contributed to anesthetic complications is great. All six major areas of anesthetic practice are implicated: inadequate pre-anesthetic evaluation, faulty patient selection, poor anesthetic management, inadequate monitoring, hurried recovery, and faulty recognition and inappropriate management of complications. Specific examples of errors are noted in Table 1.2.

The human condition

Homo sapiens is the only species that understands the concept of risk; however, habituation blunts this worry. The sense of having control over risk feeds the illusion of preparedness and prompts feelings of denial – "it won't happen (to me)"; or "if it happens to me, it won't be that bad".

Once the error cascade begins, numerous opportunities arise to stop its progression. Many times, however, these opportunities are ignored. Impending doom, coupled with the high stakes environment and time urgency, overwhelms and short circuits the human mind, which makes the most conservative (not necessarily correct) decision more attractive, ultimately leading to situational paralysis. Individuals with increased "cognitive horsepower" tend to be more susceptible to this shortfall, as worry about legal recourse, shame, and personal doom overpower rational thoughts and interfere with concentration on the task at hand (Bielock, 2010; Figure 1.1). Management of these "necessary fallibilities" is possible with repeated

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Table 1.1 Triggering events.

- Technical
  - Drug overdose
  - Failed airway management technique
  - Oxygen source disconnection
  - Equipment failure
- Judgmental
  - Inadequate patient history
  - Wrong drug/technique
  - Wrong airway management technique
  - Delay or failure to adequately treat abnormality
- Monitoring/vigilance
  - Failure to detect abnormality
  - Failure to accept abnormality
  - Alarm "saturation"

Table 1.2 Examples of anesthetic errors (Cooper et al., 1984).

- Loss of oxygen supply (tanks empty, not turned on, tubes disconnected)
- Drug error – wrong drug, wrong dose, syringe swap (unlabeled)
- Wrong choice of airway maintenance
- Careless, lack of vigilance haste
- Faulty information gathering and assimilation
- Lack of preparation, scenario rehearsal
- Poor communication among team members
- Unreliable intravenous access
- Unfamiliarity with drugs

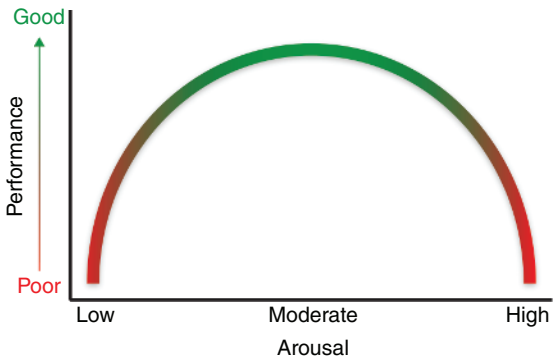

Figure 1.1 Performance decrement at extremes of arousal. Adapted from (Bielock, 2010).

practice under stress, periodic "pauses" to collect thoughts, a focus on outcome rather than mechanics, continual self-assurance of one's ability, and the use of memory guides.

Currently, there is a national focus on checklists (Gawande, 2009) as part of a cognitive safety net to provide protection against necessary fallibility by outlining the minimum necessary steps, especially important during times of adversity and complexity, when worry short-circuits the brain.

Scope of complications

The dental community provides a wide range of anesthesia: local anesthesia only, local anesthesia with nitrous oxide, enteral sedation, parenteral sedation, and anesthesia. It naturally follows that the complications associated with these techniques are also highly variable. These complications range from inability to anesthetize, failed sedation, syncope, and pressure or rhythm disorders to hypoxia and death.

It remains impossible to accumulate complete data on the nature and frequency of anesthetic errors/complications in the dental office. Errors are often managed without patient injury. Most dental anesthetics are administered in private practices (often by solo practitioners) which have sparse reporting requirements. Voluntary reporting is stifled due to fear of further inquiry and punishment. Learning from errors including changing of systems does not occur. Insurance companies also have no obligation to report closed claims, and many malpractice cases are settled and sequestered.

Table 1.3 Examples of anesthetic complications.

- Syncope
- Laryngospasm
- Bronchospasm
- Upper airway obstruction
- Allergy
- Seizure
- Tachycardia/bradycardia
- Cardiac arrhythmia
- Hypertension/hypotension
- Myocardial infarction/cardiac death
- Malignant hyperthermia
- Aspiration
- Post-anesthetic recall of intraoperative awareness

Perianesthetic complications are rare in the dental office, with most reports showing similar data. Perrott et al. (2003) reported on a prospective study of 34,391 ASA I and II patients and showed a complication rate of 1.3 per 100 cases. These included, in approximate order of decreasing frequency, vomiting, laryngospasm/bronchospasm, prolonged recovery, vascular injury, syncope, arrhythmia, seizure, and neurologic impairment. D'Eramo et al. (2008) reported similar complication rates from a survey of 169 oral and maxillofacial surgeons. Other examples of complications are noted in Table 1.3. However, a true mortality rate is not readily obtainable. The most current data from OMSNIC (the malpractice insurance company that covers approximately 80% of US oral and maxillofacial surgeons) estimates the likelihood of an office-anesthetic-related death to be 1/365,554 anesthetic cases (Estabrooks, 2011).

The prevention, diagnosis, and management of anesthetic complications are the focus of this book, and are addressed from multiple perspectives. Patient evaluation and selection, with emphasis on common comorbidities, knowledge of drug action, limitations of office-based anesthesia, monitoring, and preparation and management of adversity are addressed. Crisis resource management during error/complication evolution is not taught in dental school or residency programs. It is included here as the most important asset for complication management.

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