Beware of “Black Swans” and “Perfect Storms:” The Principle of Plenitude and Office-Based Anesthesia

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A paradigm shift in the training, practice, and study of office-based anesthesia is necessary for our specialty. Practice improvement plans are required to prevent low-probability–high-consequence anesthesia mishaps in our offices. A scarcity of statistical data exists regarding the true risk of office-based anesthesia in oral and maxillofacial surgery. Effective proactive risk management mandates accurate data to correctly outline the problem before solutions can be implemented. Only by learning from our mistakes, will we be able to reduce errors and improve patient safety: “The only real mistake is the one from which we learn nothing”—John Powell.

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To paraphrase Aristotle, “everything will be realized.” The *Plenitude Principle* is a derivation of this concept noted by the historian Arthur Lovejoy (1873 to 1962), who stated that if something can happen, it eventually will happen. Natural and man-made disasters occur that are of low probability, but of high consequence to the human race. The field of risk analysis studies human and natural disasters such as the Challenger space shuttle explosion, the Fukishima tsunami and reactor disaster, and, of course, the September 11, 2001 terrorist attacks against America. Industry, government, and healthcare use risk management to mitigate against inherent risks in modern society. However, most often, we have labeled risks after the fact. Anesthesia mortality and serious morbidity occurs in our specialty. Recent cases involving office-based anesthesia (OBA), in young healthy individuals, have appeared on several national news outlets. This deserves open discussion.

Risk analysis uses 2 metaphors to describe the unthinkable or the extremely unlikely event. The 2 metaphors are the “Black Swans” and the “Perfect Storms.” These 2 metaphors represent 2 types of uncertainties, epistemic and aleatory.[1] Black Swans involve epistemic uncertainty, which is a lack of fundamental knowledge. Perfect Storms are aleatory uncertainties, which are the randomness of rare, but known, events, occurring in conjunction. If these 2 uncertainties are combined into a single probability measure, it is termed “Bayesian Probability.”[1]

Many times in healthcare, the existing statistics (data) will be insufficient to support existing risk management. Often, the sample size (denominator) will be too small or not accurately enough known to develop the true risk (incidence) of an adverse event. Our oral and maxillofacial surgery (OMS) office practice is unique in that the anesthesia risk has been far greater than the surgical risk to the patient. A single prospective cohort study has been published in the Journal. In the study by Perrott et al,[2] the evaluation of 34,191 patients undergoing OBA was undertaken. Approximately 2% of the patients in their study who had received deep sedation (DS) or general anesthesia (GA) (72% of the total number of patients had received DS or GA) were American Society of Anesthesiologists (ASA) class III or above, suggesting appropriate patient selection for OBA by our specialty. The “n” number in the study by Perrott et al[2] was very commendable. However, cohort studies traditionally have not been good for studying rare diseases or events because of the large sample size needed. The Bayesian method is meant to provide a continual data stream so that inferences can be updated each time new data become available.[1]

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The Black Swans

"Black Swans" is a term coined by Nassim Taleb, the author of the 2007 book, *The Black Swan: The Impact of the Highly Improbable.*[3] The author's message was that quantitative assessments of risks, based on statistics, are useless, because they are likely to miss rare events. Black Swans are often tragic, but possibly preventable, if a proactive risk system had been in place. A classic Black Swan event is September 11, 2001. When the American intelligence system failed to prevent 9/11, it was called a "failure of imagination" by the 9/11 commission.

Black Swans are seldom from direct human errors. Most "accidents" are caused by several errors in the same chain of events. Every practitioner who uses OBA has a potential Black Swan lurking; this could be an OBA-related patient death or a grave morbidity. The surrounding media attention produces a "social amplification of risk." This creates significant public anxieties that might not be justified.[1]

To identify and provide risk management for Black Swans in our profession, we must proactively monitor adverse anesthesia signals, precursors, and "near misses" in real-time with a continuous data stream. These data will improve our fundamental knowledge and reduce epistemic uncertainty. I believe the "near misses" we should be documenting are mostly adverse upper airway events.

In 1985, the American Society of Anesthesiologists developed a closed-claims database to track morbidity and mortality in their profession. The program is the "Closed Claims Project" (ASA-CCP). The ASA-CCP data have shown that for 20 years, not surprisingly, respiratory events have been most often responsible for death or brain damage.[4] Data are collected from closed malpractice insurance claim files submitted by ASA-member anesthesiologists. A problem remains; closed claims do not necessarily reflect the true occurrence of events. This type of database does not have information on the total numbers of anesthetics delivered; thus, no denominator is available. The field of OMS requires its own database. Improving our fundamental knowledge with a real-time continuous data stream open for scholarly activity and research would help reduce epistemic uncertainty.

The Perfect Storms

The term "Perfect Storm" comes from the 1997 book by Sabastian Junger that was made into a successful Hollywood movie in 2000. I believe we might have our own "Perfect Storm" brewing that relates to the safety of elective OBA. We must be cognizant that anesthesia risks will be increasing in the future, because our society is aging and includes larger numbers of patients with untreated or poorly treated chronic disease. Continuing education courses specifically addressing anesthesia and chronic disease interactions would be advantageous. In addition, we have been using the same anesthetic agents for the past 30 years, which produce respiratory depression and impair protective reflexes. Instead of fitting the patient to the drug, we should be fitting the drug to the patient. We should partner with the pharmaceutical industry and researchers to develop safer agents for OBA use.

The SimMan (Laerdol, Wappingers Falls, NY) mannequin should be available in all of our US dental schools. Our OMS residents, community OMS practitioners, and dental students should be trained to provide the technical skills necessary for upper airway management and other office emergencies.

Recently, I was fortunate to be able to audit and participate in a "Maintenance of Certification in Anesthesia" course (MOCA, American Board of Anesthesiology [ABA], Raleigh, NC) with 6 medical anesthesiologists. Simulation is a major part of the recertification process to maintain ABA board certification in anesthesiology. I was immediately struck that even experienced, board-certified anesthesiologists can underperform in high-stress, simulated cardiac arrest situations. The first arrest simulation of the day was videotaped and studied by the participants, the MOCA course director, and myself. Hyperventilation is very deleterious in low-flow arrest states. The course director gently pointed out to the 6 participants that the SimMan was being ventilated at a rate of 44 breaths/minute with the bag valve mask.

In OBA, adverse respiratory events (causing hypoxemia) will almost always precede cardiac events. It is unlikely for the respiratory event to arise from a primary cardiac event because our office patients will be mostly ASA class I or II (96% of the patients in the study by Perrott et al[2] were ASA class I or II). In a recent report that was "anesthesia-centric," Moitra et al[5] documented that ventricular fibrillation (VF) rarely occurs in the perioperative setting. Approximately 14% of cardiac arrests associated with anesthesia have been due to VF. However, 45% of the cardiac arrests due to anesthesia have been bradycardia or asystole, neither of which is amenable to defibrillation. VF is a common community dysrhythmia, but is not common in the perioperative setting. Hypoxemia-related bradyasystolic arrest with hypercarbia due to an unpredictable difficult airway is a more common scenario in operating room deaths related to anesthesia. "Anesthesia-centric" advanced cardiovascular life support (ACLS) has emphasized that in a perioperative setting, pulseless electrical activity due to the Hs and Ts (hypovolemia, hypoxia, hydrogen, hyper- or hypokalemia, hypoglycemia, hypothermia, tablets or toxins, cardiac tamponade, tension pneumothorax, thrombosis [myocardial infarction, pulmonary embolism], tachycardia, trauma [hypovolemia from blood loss]) is more common and presents with nonshockable rhythms.[5] We should tailor our ACLS protocols to be "OMS-centric," concentrating on the early recognition and treatment of hypoxemia, instead of the "community-centric" ACLS protocols recommended by the American Heart Association. To best monitor ventilation in OBA, we should be using capnography and precordial monitoring together.

In conclusion, risk analysis involves being proactive and acknowledging the "Perfect Storms" and "Black Swans" in OBA. Retrospective, quantitative statistical measures cannot predict low-probability–high-consequence events. The adverse respiratory or other "near misses" occurring with OBA in the OMS office setting should be documented in real-time to improve our knowledge base and reduce epistemic uncertainty. Aleatory uncertainty can be reduced by regular high-fidelity simulation training sessions. Practice improvement plans would be valuable for OBA in OMS (Table 1). These "smart plans" should be specific, timely, measurable, and relevant to each OMS practice. Only 1 tragic patient event can negatively affect all of us. Elective OBA is the lifeblood of our specialty; I would not want to see this privilege jeopardized by a "failure of imagination."

> To be ignorant of one's ignorance is the malady of the ignorant. —Amos Bronson Alcott

Table 1. PRACTICE IMPROVEMENT PLANS FOR ORAL AND MAXILLOFACIAL SURGERY

Emphasize the OBA "team" concept
Database of "near misses"
Daily checklists
Written protocols
Regular emergency drills
Strict patient selection regarding upper airway anatomy (eg, Mallampati/Friedman tongue position)
Minimize the use of opioids
End-tidal capnography and precordial stethoscope monitoring of ventilation
Continuing education on anesthesia and chronic disease interactions
Regular high-fidelity simulation training
"OMS-centric" ACLS protocols for hypoxemia
Supraglottic airway training
Nontechnical skills for the OBA team

Abbreviations: ACLS, advanced cardiovascular life support; OBA, office-based anesthesia; OMS, oral and maxillofacial surgery.

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