



Forensic Sciences & Anesthesia: Dilemmas & Challenges

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ABSTRACT

The confluence of forensic science and anesthesia is emerging as evidence of anesthesia abuse has been reported in past years. An attempt has been made to showcase the problems with anesthesia such as anesthesia abuse, safety guidelines related to the use of anesthesia, anesthesia-related morbidities/mortalities, and associated risks. The need for forensic science intervention plays a pivotal role in dealing with such types of dilemmas and challenges. Furthermore, this paper also focuses on the measures related to forensic anesthesia and the reduction of negligence-related risks in perioperative events and in distinguishing perioperative and anesthetic deaths.

Keywords: forensic anesthesia, mortalities, perioperative, negligence, abuse

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INTRODUCTION

Forensic anesthesiology is a specialized branch of forensic medicine that investigates and analyses anesthesia-related incidents and deaths. This field involves the examination of medical records, testimonies, and other relevant evidence to determine the causes and contributing factors of anesthesia-related incidents. Anesthetic drugs are generally used in different healthcare settings to induce patients into a sedative and painless state to perform surgical operations. Moreover, these drugs are also used for hypnosis, analgesia, and muscle relaxation.

Lot many cases have been reported for negligence but more than 70% of them remain unsolved. The challenge has to be overcome by following the prerequisites for anesthetic care. Anesthetic care is segregated into three stages i.e. preoperative, operative, and postoperative stage. All these stages are entwined together to ensure proper anesthetic management of the patient. Starting with the pre-operative stage is essential to ensure the perioperative safety of the patients. By helping to plan, stratify, and optimize the treatment plans for patients undergoing surgical operations. The evaluation of a patient in the preoperative stage is known as preoperative anesthetic assessment. The preoperative anesthetic assessment includes details such as the patient's medical history, physical condition, and relevant test results before undergoing surgery or a medical procedure that requires anesthesia. The physical preoperative examination is focused on the airway and respiratory system, cardiovascular systems, and central nervous system along with vital monitoring. This assessment helps determine the most suitable anesthesia plan and management approach for the individual patient, for example, if a patient is on psychotropic medication or long-term cardiac medication requires consideration before making an anesthesia plan. Taking into account factors such as overall health, medical conditions, medications, allergies, and potential risks associated with anesthesia. It aims to ensure patient safety, optimize anesthesia delivery, and minimize complications during and after the procedure.

The operative phase involves monitoring the body's processes, managing the important organ system, and treating any intraoperative emergencies, physician anesthesiologists must employ cutting-edge technology per minimum monitoring standards (MMS). These vital processes include the patient's heart rate and rhythm, respiration, blood pressure, body temperature, fluid balance, and electrolyte levels. The healthcare provider also keeps track of all the patient's vital processes [4]. The operative phase includes monitoring

of anesthesia dosage, during the operative phase, most causalities are reported due to inadequate oxygenation and ventilation [5].

Eventually, the postoperative anesthesia care unit (PACU), involves transferring information such as the patient's medical history, intraoperative events, and postoperative strategy from the anesthesiologist to a registered nurse of PACU [6]. It provides an environment for more continuous monitoring of oxygen saturation, blood pressure, and arterial blood investigation. Moreover, it allows to ensure proper airway and pain management postoperatively [7]. This short communication enumerates the mortalities/morbidities and associated risks related to Forensic Anesthesiology during the sequence of events in pre/operative/post-operative stages.

RISKS ASSOCIATED WITH ANESTHESIA:

Anaesthesia is nevertheless dangerous, especially when performing certain operations like managing the airway during general anesthesia, controlling hemorrhage before and after surgery, and managing circulatory problems brought on by regional anesthesia. As per the classification given by the American Society of Anesthesiologists (ASA). Patients in the ASA I and II classes are the safest candidates for anesthesia because they are more likely to have adequate pulmonary and cardiovascular reserves to resist general anesthesia and profound sedation. For ASA III patients, heavy sedation and general anesthesia should be used with care. To further lower the chance of harmful cardiovascular and pulmonary problems, the anesthetic strategy may need to be significantly modified [10]. Anesthesia has the potential to cause fatal consequences. Certain procedures such as the insertion of central venous catheters (CVCs), the use of infusion pumps, and the delivery of medicine, among other extra activities, all lead to an increase in morbidity. Adverse outcomes might happen not just during the operation itself, but also as a result of the anaesthetist's pre- and post-operative interventions. Inadequate preoperative treatment due to poor patient assessment or ineffective preoperative management has been proven to be a significant contributing factor in 38-42% of fatalities. Human failures have been found in 51-77% of anesthesia-related fatalities. The majority of cases include a lack of expertise or competence, which has been shown in 89% of fatalities involving human errors, and, less commonly, mistakes in judgment or analysis, which have been seen in 11% of these deaths [11]. Several possible hazards associated with anesthesia include Allergic reactions, cardiovascular complications, Respiratory issues, Aspiration, Nerve damage, Anesthesia errors, organ damage, etc. Along with such hazards, medico-legal concerns also arise which include:

- **Insufficient Information and consent:**

If there is no valid consent, the procedures done with the utmost care and standards can also be considered as respect issues. The consent should clearly define all the treatment-related information such as the nature of the disease, the success rate of the procedure, cost, and available options for treatment. The patient must have well-informed consent. The patient's native tongue should be utilized to explain it, and an interpreter may be engaged if necessary. To ensure that the patient has comprehended everything, extra care must be given if he has any communication issues (deaf, dumb, or blind). The repercussions of insufficient information and consent not only create serious menace of negligence but also lead to societal violence. Forensic experts play a vital role in funding the facts for such social stigma to percolate the apprehension of the act and the responsibility of medical practitioners.

- **Malpractices :**

When an anesthesiologist fails to perform his duty as per standards or if negligence is incurred from his end, it is considered malpractice. These malpractices can include inaccurate and insufficient pre-operative assessment, poor post-operative monitoring, poor selection and implementation of anesthetic procedures, etc. [2].

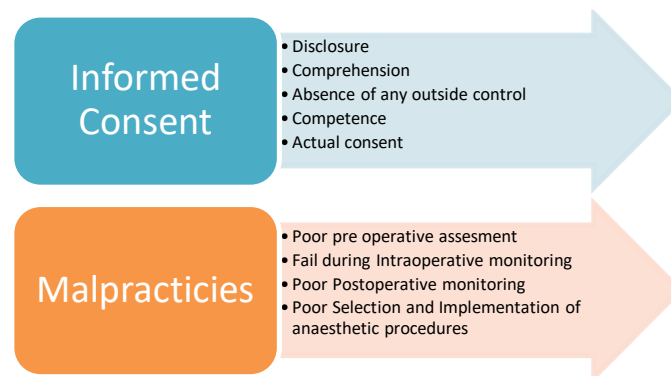


Figure 1 Medicolegal concern

Forensic professionals are deputed for examination of malpractice cases where the negligence of medical practitioners or paramedical staff is being reported. The root cause for such acts could be

1. Carelessness
2. Competence Challenge
3. Lack of Information
4. Lack of Treatment

Anesthetic Abuse:

Substance abuse is taking the lives of many people. This section of the review discusses anesthetic-related abuse. Consumption of anesthetic abuse without the appropriate medical tools and supervision is extremely harmful. It is reported that various controlled substances used for anesthesia are readily accessible and available such as opioid groups, the most commonly encountered designer drug fentanyl, and sufentanil. Moreover, among all the anesthesia drugs it has been found that propofol is highly abused following meperidine, morphine, opiates, and benzodiazepines [12].

Propofol is a potent drug with high addiction potential and high mortality rates as well. The survey results of 126 academic anesthesiology programs observed 10 cases of propofol abuse among 10,000 anesthesia providers, with a mortality rate of 28–45% [13]. Moreover, the following are the risk factors specific to anesthetic abuse among anesthesiologists: (1) Daily dealing with opiates and sedative drugs; (2) Availability of drugs; (3) Very little quantity is required, so it is easy to divert from leftover ampules [14]. Opioids have been the primary choice of drug for critical pain management, despite having high abuse potential and numerous side effects. In earlier times, the inclination was more toward opioids for pain management which resulted in increased abuse-related cases, and increased drug dependence. Among these effects, respiratory problems are the most peculiar, with opioid-induced respiratory depression (ORD) being a major contributor to brain damage and even death. Guidelines for the prescription of opioids for both acute and chronic pain have undergone a considerable adjustment as a result of the surge in fatalities linked to prescription drug addiction [10]. Various pain management strategies are in practice such as an Enhanced recovery pathway and multimodal respiratory approach which uses opioids as the last choice instead of putting it as the first choice compared to earlier used approaches. The current approach uses acetaminophen first followed by lidocaine magnesium, ketamine, and then finally opioids [15]. Forensic Investigation uses blood, plasma, serum, viscera, tissues, urine, breast milk, hair, and exhaled breath in cases of exposure to anesthetic drugs. The methods that are most widely acknowledged and utilized are gas chromatography (GC), high-performance liquid chromatography (HPLC), and liquid chromatography- Mass Spectrophotometry (LC-MS/MS), eventually giving a positive result in all the cases [16]. The suggested sources of abuse are generally the residues of ampules, fake or bogus prescriptions, etc. Many of these cases are solved internally without any forensic investigation [17]. Such cases require timely interventions and strict action against the anesthesiologist to avoid medicolegal consequences.

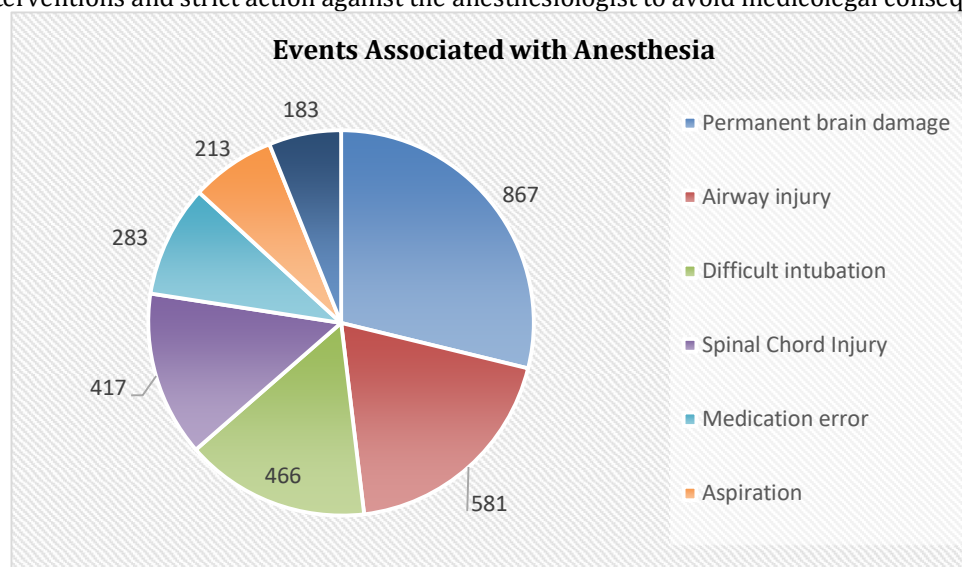


Figure 2 Sentinel events associated with anesthesia

Anesthesia-Related Morbidity & Mortality:

The American Society of Anesthesiologists (ASA) Closed Claims Project was formed in 1984 to enhance patient safety and minimize anesthetic harm in response to rapidly growing professional liability insurance costs during the early 1980s. The ASA Closed Claims Project intended to identify significant anesthesia loss regions and analyze injury trends to develop preventive techniques, consequently lowering patient injuries

and related malpractice claims. Over the years, claims for acute and chronic pain treatment rose while claims for surgical anesthesia steeped down. Chronic pain care accounted for 18% of claims in the 2000s, acute pain management 9%, and obstetric anesthesia 8%. The close claims data can be used to analyze "Sentinel Events" associated with anesthesia from a total number of 3010 sentinel events given in Figure 2. [18].

Anesthetic morbidity, encompassing complications except for death during the perioperative phase, is categorized into minor (moderate distress without prolonged hospitalization), intermediate (serious distress or extended stay without lasting effects), and major (permanent disability). Cardiac arrests and coma, linked to patient safety, are commonly used indicators. Their prevalence is 0.8-3.3/10,000 for cardiac arrests and 0.15-0.9/10,000 for brain injuries. Other complications include paraplegia (0.6-0.9/100,000), peripheral nerve neuropathy (3%), and ulnar neuropathy (0.5%). Incidents with intermediate or low morbidity are notably high. Minor events, like hoarseness after intubation, occur in 14-50% of patients. Dental injuries requiring further treatment happen in 0.1 % of cases. Drug administration errors occur in 0.1%, equipment issues in 0.23% during general and 0.05% during regional anesthesia. Postoperative nausea and vomiting (PONV) are common (10-79%) based on risk factors. [11]

Anesthesia-related mortality refers to patient deaths occurring under or following the care of an anesthetist. Anesthesia-related deaths can be anesthesia-attributable (solely responsible) or anesthesia-contributory (partially responsible) in nature. The perioperative mortality reflects the level of anesthetic care and quality of surgery [19]. Moreover, anesthetic deaths are usually misinterpreted as perioperative deaths. The main contributing causes to anesthesia-related death during the past 20 years have been cardiovascular consequences brought on by the administration of anesthetic medicines, together with insufficient blood management during bleeding, anemia, and followed by airway management failure [22].

Anesthesia and Forensics A Flamboyant Challenge:

Assuring patient safety, upholding medical standards, and offering precise analysis in situations involving anesthesia-related events, complications, anesthesia-related abuse, anesthesia-related morbidities and mortalities or legal issues are the goals of forensic principles in anesthesiology. The forensic approach is inculcated to reduce and keep track of anesthesia-related cases so that the negligence can be proved in a court of law. As discussed, anesthetic drugs can be a source of abuse and thus, require proper record and log maintenance adhering to the guidelines established for ensuring anesthetic care. A post-mortem assessment is of utmost necessity in cases where a patient dies owing to medical negligence made by the negligent practitioner may be held accountable. Forensic experts should exercise extreme caution during post-mortem examination since it is one of the most challenging examinations and even has reporting issues. For this, a multidisciplinary examination should also may be used to conduct an accurate examination [21]. In cases of anesthetic death, the examination criteria include the patient's medical history, cause of Surgery, pre-anesthetic treatment, anesthetic drugs, the sign of any burn or explosion, a sign of blood transfusion reaction, resuscitative measures, equipment used, Autopsy, and Toxicological examination for quantitative and qualitative examination of anesthetic drug [22].

CONCLUSION

Forensic anesthesiology is gaining importance to provide justice and analysis of deaths due to medical negligence which may incurred at pre/peri or post-operative procedures. In a nutshell, it is found that numerous factors result in anesthesia-related abuse/ morbidities/ mortalities. The reasons and causes for the same could be possible as follows:

1. Anaesthetic complication due to poor pre-anesthetic assessment
2. Overdose of anesthetic drug
3. Adverse effects of the drug
4. Poor implementation of the safety management system
5. Lack of coordination between surgeons, anesthetists, and nurses.
6. Human mistakes related to a lack of experience or competence result in patient care that deviates from what is advised.
7. Improper post-operative care

The culmination of forensic professionals to find the facts in anesthesiology-related risks is an important branch which was earlier under shed and how gaining boom in investigation and lead repercussion whether pernicious or favourable. Hence this review is just a summary portraying the importance of forensic science and anesthesia.

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