International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Anaesthetic Mortality: A Clinical And Medico-Legal Scenario

Dr. Rakesh Kumar[1], Dr. Awdhesh Kumar[2]

[1]MD(Anesthesiology),Department of Anesthesiology Mayo Institute of medical science Gadia, Barabanki, Uttar Pradesh, India

[2]M.D Forensic medicine (Resident 3rd Year), Department of Forensic Medicine and Toxicology Institute of Medical Sciences, Banaras Hindu University, Varanasi, India

Abstract: ***The death that occurs inside the operation theater often evoked considerable distress to the relatives of the patient and the subsequent misgivings on the team of doctors that performed the surgery. Anesthetic death is defined as death occurring within 24 hours of administration of anesthesia due to causes related to anesthesia. However, death may occur even afterwards due to its complications. The American Society of Anesthesiologists (ASA) has devised a classification system to grade the preoperative condition of the patient. The state of general anesthesia of necessity deprives the patient of the majority of his protective reflexes. In India, if the patient dies when a surgical procedure performed under anesthesia, often the anesthetist is unfairly accused of causing the death. The examination should be done into consideration by the pathologist when investigating an anesthetic death. There are no diagnostic findings at autopsy in most instances of anesthesia related deaths because there are no path gnomic pathological changes found in deaths caused neither by anoxia nor in acute cardiovascular collapse unless there is some underlying cause, such as a myocardial infarction. The analyses help in detecting and estimating the quantity of the drug given, estimating overdose of premedication of anesthetic agent. Morbidity and mortality during anesthesia has been markedly reduced due to better understanding of human physiology and pathology of disease processes.***

Keywords: Anesthetic Mortality, Pre-anesthetic checkup, Post-anesthetic checkup, Medical Negligence

1. Introduction

Anesthesia is from the Greek and means 'loss of sensation'. Anesthesia allows invasive and painful procedures to be performed with little distress to the patient. There are three main types of anesthesia: **General anesthesia**: the patient is sedated, using either intravenous medications or gaseous substances, and occasionally muscles paralyzed, requiring control of breathing by mechanical ventilation. **Regional anesthesia**: this can be described as **central** where anesthetic drugs are administered directly in or around the spinal cord, blocking the nerves of the spinal cord (eg, epidural or spinal anesthesia). The main benefit of this method is that ventilation is not needed (provided the block is not too high). Regional anesthesia can also be **peripheral** - for example:

Plexus blocks e.g. brachial plexus; Nerve blocks e.g. femoral. Intravenous block whilst preventing venous flow out of the region is known as Bier's block. **Local anesthesia**: the anesthetic is applied to one site, usually topically or subcutaneously **[1, 2].**

The death that occur inside the operation theater often evoked considerable distress to the relatives of the patient and the subsequent misgivings on the team of doctors that performed the surgery, as a rule, surgery and most of the medical procedure are teamwork comprising of surgeons, anesthesiologists, other specialist and nursing staff. Further anaesthetizing a patient and maintaining his vital parameters is still laden with too many imponderables. However, it cannot be overlooked that the surgical team is in better position to explain the events that occurred inside an operation theatre when the patient is unconscious or under anesthesia and the entry into the operation theater is barred to the relatives of the patient. In particular, it should be realized that the doctors and the theater staff alone know what has happened to the patient inside the operation theater when he is under anesthesia, which amounts to the superior knowledge of the medical team. The above rationale often puts the burden of explaining all the events that led to the death of the patient to the relatives of the patient and to the court of law when litigation arises on the anesthesiologists and the surgeons.

Anesthetic death is defined as death occurring within 24 hours of administration of anesthesia due to causes related to anesthesia. However, death may occur even afterwards due to its complications. **[3].** Anesthetic deaths are very rare. Only 1 in 10,000 persons die totally as a result of anesthetic **[4].** In a survey conducted by Lunn and Mushin estimated the mortality directly related to anesthesia to be 1 in 166 (0.6%) **[5].** The risk and complication of anesthesia contributes only 08% of total deaths of which overdose, maladministration, bad choice of anesthetic agent & equipment failure are the important reason behind such casualties **[6]** .

2. Anesthetic Risk and Cassification

The American Society of Anesthesiologists (ASA) has devised a classification system to grade the preoperative condition of the patient **[7, 8]:-**
ASA1: A normal healthy individual e.g. fit man with inguinal hernia.
ASA2: Those with a serious disease but have no limitation of their activities (the condition may be pre-existing or the result of the condition requiring surgery), e.g. mild angina, mild hypertension, chronic bronchitis.
ASA3: Those with a serious disease causing some limitation of their activities, e.g. moderate angina, previous myocardial infarction (heart attack), severe chronic bronchitis.

ASA4: Those with a serious disease that limits their activities and is already a threat to life, e.g. severe angina at rest, acute myocarditis, chronic bronchitis with respiratory failure, perforated peptic ulcer.
ASA5: Moribund patient with little chance of survival, submitted to surgery as a last resort, e.g. ruptured aortic aneurysm, severe trauma, massive pulmonary embolism, severe peritonitis due to perforated colon.
Class 1 - 3 requires full medico-legal investigation. Class 4 and 5, where death is anticipated, there is less need for full investigation. ASA Rating and mortality rate in % class 1 - 0.1, 2-0.2, 3- 1.8, 4- 7.8, 5- 9.4 respectively.
The ASA scheme is the most comprehensive system, but it does not embrace all aspects of anesthetic risk, as there is no allowances for inclusion of many criteria such as age, smoking history, obesity pregnancy difficulty in intubation or risk of asymptomatic patient who may have sever coronary artery disease. It also disregards the inherent risk of a particular operation.

3. Causes of Anaesthetic Deaths: [8, 9, 2]

Deaths which are the direct result of the administration of anesthesia; the state of general anesthesia of necessity deprives the patient of the majority of his protective reflexes:

1) **Death due to respiratory failure**: Respiratory failure usually occurs during or after the anesthesia or surgical procedure due to overdose of premedication drugs (Barbiturates, Benzodiazepines, morphine etc.) or anesthetic agents, administration of opiates during postoperative period, laryngospasm or bronchospasm of varying reasons.
2) **Airway obstruction**: Loss of protective reflexes as a result of anesthesia frequently leads to obstruction of the upper airway by the soft tissues of the mouth and pharynx.
3) **Pnumothorax:** Rupture of the lung may result from the application of excessive pressure to the airway, but may also occur at normal ventilator pressure if there is a pre-existing weakness in the lung. Positive pressure ventilation will rapidly convert a simple pnumothorax into a tension pneumothorax with life threatening consequences.
4) **Aspiration of gastric content:** Aspiration was considered the primary or secondary damaging event in 3.5% of all claims **[10],** of these events, 67% occurred during induction, and 11% of these claims showed documented cricoid pressure. Of the aspiration claims, 60% were associated with an outcome of death or brain damage compared with 43% of nonaspiration claims. Nevertheless, Cheney **[10]** concluded, “aspiration of gastric contents is not a major liability hazard for the anesthesiologist.” These data also reflect practice before the widespread use of the laryngeal mask airway.
5) **Respiratory depression**: Almost all anesthetic agents are respiratory depressants, and overdose will result in inadequate ventilation, particularly in debilitated patients and those at the extremes of age.
6) **Deaths due to Equipment Failure**: Malfunction of apparatus, kinked pipes, cross tubes, explosion etc.
7) **Due to cardiovascular failure**: Cardiac arrest is the commonest, occurs due to oxygen depletion or carbon dioxide accumulation due to fault or failure in technique. Most of cardiac arrest occur under relative light anesthesia and therefore tend to occur at either the start of operation or at the end of surgical procedure. Asphyxia of myocardium, overdose of anesthetic agents and reflex vagal stimulation are the three most common patho-physiological events by which cardiac arrest become supervenes.
8) **Hypovolaemia:** Unrecognized or inadequately managed hypovolemia is the commonest cause of anesthesia related death attributable to the cardiovascular system.
9) **Cardiac arrhymia:** Fatal cardiac arrhythmias may result from a variety of factors such as pre-existing disease, abnormal reactions to drugs, unskillful anesthesia, surgical stimulating, or a combination of these.
10) **Diminished myocardial contractility**: Myocardial performance may be impaired by metabolic disorder, electrolytic imbalances, hypoxia, hypothermia, drug and acute myocardial ischemia.
11) **Complication of regional anesthesia [2, 7]**:
    - Pain - 25% of patients still experience pain despite spinal anesthesia.
    - Postdural headache from cerebrospinal fluid (CSF) leak.
    - Hypotension and bradycardia through blockade of the sympathetic nervous system.
    - Limb damage from sensory and motor block.
    - Epidural or intrathecal bleed.
    - Respiratory failure if block is 'too high'.
    - Direct nerve damage.
    - Hypothermia.
    - Damage to the spinal cord - may be transient or permanent.
    - Spinal infection.
    - Aseptic meningitis.
    - Haematoma of the spinal cord - enhanced by use of LMWH pre-operatively.
    - Anaphylaxis.
    - Anesthetic intoxication **[11]**
    - Urinary retention.
    - Spinal cord infarction.

12) **Adverse drug reaction**: Hypersensitivity or adverse effects of anesthetic agents causing cardiac arrthymia or cardiac arrest or respiratory failure due to mayo-neuronal blockage and rarely by hepatic necrosis and malignant hyperthermia as in cases of halothane administration.
13) **Death due to other factors;** Disease or injury for which anesthesia and operation is being done, surgical mishappening (unintentional cutting or tearing of large blood vessels), postoperative events (phelebothombosis, pulmonary embolism, aspiration), physical condition of patient (old age or diabetes or hypertension), inadequate communication between staff and unforeseeable conditions e.g. haemoglobinopathies (sickle cell anemia), occult coronary artery disease, transfusion hepatitis, and AIDS. This all leads to cardiac arrest or asphyxia due to respiratory failure.

4. Liability of an Aneasthetist and Medico-Legal Aspects Related To Anaesthetic Deaths [2, 7]:

In India, if the patient dies when a surgical procedure performed under anesthesia, often the anesthetist is unfairly accused of causing the death. When death occurs during a surgical procedure performed under anesthesia, the surgeon or anesthetists should at once report the matter to police for holding an inquest. As per Sec.39 CrPC all deaths occurring in due course of surgery and anesthesia should be treated as unnatural deaths and should be reported to the police. Failing of which the doctor can be punished under Section 202 IPC for intentional omission to give information of offence to police by the person who is bound to inform. During the trial, the presiding judicial officer is likely to consider the following question:

1. Doctor's duty in Anesthetic Practices: Anesthetists must attend the patient a day before surgery, do Pre-anesthetic check-up and investigate the patient for any alarming situations if required. Before consent, anesthetist must explain the procedure of anesthesia, type and nature of anesthetic agent, its side effects, complications and risks involved in the procedure clearly to the patient in local language, so that he can understand the nature and consequences of giving consent.

2. **Informed Consent**: Before administration of anesthesia, the anesthetist must take the consent in writing from the patient or his legal guardian or parents if he or she is unconscious or below 18 years of age. It is the ultimate right of the patient to accept or refuse the medication. Nothing should be decided against the patient's will.

3. Reasonable Degree of Skill: It is the duty of the anesthetist to attend the patient, assess him and optimize the patient with necessary investigations and treatment. He must apply reasonable degree of skill and care in the selection of anesthetic agent and the procedure. It is the duty of the hospital management to provide adequate and trained hands. They must provide all necessary latest functioning equipment. Trainee should be regularly supervised by the seniors. Anesthetic must adhere to standard practice and follow the protocols of the institution.

Any act or omission by anesthetist causing bodily injury, disease or death of the patient is negligence for which he/she can be sued in the civil court or in consumer forum for compensation or can be punished under Sec. 304-A IPC in criminal court. Negligence against an anesthetist can be proved when injury has occurred only from anesthetic procedures due to deviation from the standard protocol. The burden of proving that the anesthesiologist was negligent falls on the complainant. Court allows both parties to prove their case by means of producing evidence. This may include records, books, journals or expert witnesses. But when the negligence is gross and obvious to even a lay man, it comes under the doctrine of res ipsa loquitor, for example, when pre-anesthetic evaluation is not done before giving anesthesia, unexplained cardiac arrest during anesthesia leading to death is negligence. Where an explosion occurred during the course of administering anesthetic to the patient when the technique had been frequently been used without any mishap **[12].** Here the burden of proof does not lie on the plaintiff but defendant physician has to prove that the accident did not occur due to his negligence **[13].**

In a case patient developed complication like meningitis after spinal anesthesia, court found that anesthetic agent was not contaminated and the staff had taken the usual precautions to disinfect themselves before the operation, acquitted anesthetist and passed sentence against hospital for some fault in sterilization procedure **[14].**

4. Precaution and Defense: Anesthetist should update his professional knowledge all the time, keep full and accurate records of his patients. He must check the instruments prior to use do the sensitivity test for a drug known to cause anaphylactic reactions and do not leave patient till recovered from effect of anesthesia. When an anesthetist is sued for negligence, he can defend himself by proving that he has applied reasonable degree of skill and care during anesthetic procedures. A doctor is not negligent if he is acting in accordance with a practice accepted as proper by responsible body of medical men skilled in that art even though other doctors adapt a different practice". This is known as Bolam's Law **[15].** The damage to the patient may also occur due to error in judgment, therapeutic misadventure, medical mal-occurrence, unforeseeable harm or when a new disease appears but doctor is not liable as long as he applied a reasonable standard of skill and care.

5. Examination of Anesthetic Death [16]

The examination should be done into consideration by the pathologist when investigating an anesthetic death.

1) **History**: The necessary inquiries should cover the period prior to hospitalization.
2) **Condition requiring surgery**: some surgical conditions are on high risk e.g. resection of the aortic aneurysm and repair.
3) **Preaneasthetic medications**: error in relation to preoperative mechanism is giving wrong medication, over medication, or no medication, which may precipitate death.
4) **Aneathetic agents**: inadvertent mixing of the anesthetic gases may cause death.
5) **Burn or explosion**: death from anesthetic explosion occurs rarely.
6) **Shock and hemorrhage**: Shock and hemorrhage should be evaluated with other finding of the case.
7) **Blood transfusion**: Blood transfusion reactions and incompatibility should be investigated.
8) **Resuscitative measure**: the measures adopted should be noted.
9) **Equipment:** with appropriate qualified individuals, all the equipment including the valves and containers should be checked to assure the correct mixing of percentages.

6. Autopsy in Deaths due to Aneasthetic Death [17]:

The findings at autopsy will vary according to the cause of death. There are no diagnostic findings at autopsy in most instances of anesthesia-related deaths because there are no path gnomic pathological changes found in deaths caused neither by anoxia nor in acute cardiovascular collapse unless there is some underlying cause, such as a myocardial infarction. While doing a post-mortem, it is difficult to evaluate the cause of death, as usually there is no evidence of sudden fall of blood pressure, cardiac irregularities or epiglottic spasm, which may have been responsible for causing sudden death.

Exterior of the body should be carefully examined looking for external, evidence of therapy, including wounds, scars, repairs, and other procedures. Occasionally, the odor of anesthetic agent may be smelt. The changes in the organs are of hypoxia. Alveolar air should be collected with a syringe by pulmonary puncture. Before chest is opened, blood should be collected under oil and both lung and brain saved and quick-frozen. In cases of spinal anesthesia, cerebro-spinal fluid (CSF) should be collected for chemical analysis. The sample of gases used for anesthesia should also be sent for chemical analysis to know whether they were proportionately mixed before use. Gas chromatography study is done to evaluate the concentration of gases present in the viscera.

When air embolism is suspected to be the cause of death, abdominal cavity should be opened first and inferior vena cava should be inspected for air bubbles. To exclude the possibility of post-mortem putrefaction gas, samples withdrawn in a syringe should be sent for chemical analysis. Similarly, culture of blood and exudates and histopahtological examination of tissue samples from heart, liver, kidney and brain should be done. Serological examination to rule out the possibility of serologic reactions due to the transfusion of wrong blood group should also be done.

When death occurs from hypovolaemia, autopsy is frequently negative in establishing the cause.

When death occurs subsequent to the administration of local anesthesia, the autopsy findings are those of hypoxia. The injection site, blood, and liver should be sent for toxicological identification of local anesthetic and its metabolic breakdown products.

The explosive nature of anesthetic gases is well known. With muscle relaxants and assisted respiration, it is not uncommon for the stomach to be filled with anesthetic agent. This is an unusual type of hazard which the autopsy surgeon should consider in post-anesthetic combustion of any type. While interpreting the toxicological report, it should be remembered that some drugs may either potentiate or alter the function of anesthetic agents.

The cause of death will usually be a complicating circumstance rather than specific over dosage with an anesthetic agent. Assignment of the exact cause of death in the operative or immediate post-operative period is one of the most difficult tasks which fall to the forensic expert. A full clinical history is necessary, together with consultation with the surgeon or other medical staff, in order to arrive at the best possible opinion as to the reason for the death. where pre-existing natural disease, especially heart disease is present, the contribution of this to the cause of death must be estimated. Similarly, respiratory insufficiency due to lung disease may be a potent factor in causing death. in aged or debilitated persons, who may be a poor risk for operation, account must be taken of the condition of their myocardiurn and lungs. In operations on persons already shocked from trauma, and evaluated.

7. Toxicological Analysis [4]

Collect sample and toxicological analysis should be done:

1) Alveolar air with a syringe by pulmonary puncture before opening the chest. One lung is removed and collected by clamping the main bronchus and retained in a nylon bag and sealed so that the headspace gas can be analyzed. Prior to postmortem examination it is important to avoid loss of gases due to exposure of the tissues to the air, it may be necessary to obtain samples of every viscera by the biopsy techniques and frozen immediately.
2) At autopsy some portion of fat from the mesentery, skeletal muscle tissue, brain, and liver, half of each kidney is retained.
3) Urine should be collected in containers with as little headspace as possible, sealed and immediately refrigerated or frozen.
4) Blood should be collected under liquid paraffin. Blood, urine and other body fluids should also be collected for bacteriological examination.
5) Residual solutions, medication containers, samples of gases used for the anesthesia and samples of the operating room air may have to be collected in occasional cases.

The analyses help in detecting and estimating the quantity of the drug given, estimating overdose of premedication of anesthetic agent.

Table: Showing the fatal concentrations of some anesthetic agents in blood are:

Sr.No.	*Anesthetic agent*	*mg %,*
1.	chloroform	40 to 60
2.	ethyl chloride	40mg.
3.	Diethyl ether	180
4.	Trichloroehylene	50
5.	Divinyl ether	50
6.	halothane	20

Finally, the pathologist should carry out retrospective evaluation of the case with appropriate discipline**.**

8. Conclusion

- Morbidity and mortality during anesthesia has been markedly reduced due to better understanding of human physiology and pathology of disease processes.
- It is expected from anesthetist to take pre- and postoperative rounds, develop good patient relationships, take valid and informed consent; keep the things which

are necessary during and after the operation; check the equipment and monitors; label all the drugs, supervise the juniors & avoid critical incident sand maintain up-to-date records.

- By the knowledge of the ASA "Standards for Basic Intra-Operative Monitoring" a decrease in the number of anesthesia-related liability claims.
- For the investigation of cause of death discussion between forensic pathologist, surgeon and anesthetist may arrive that will be the best consensus of opinion to offer the investigating authority and courts of law. The Indian Society of anesthesiologist must come out with protocols to be followed by its members in different clinical situations.
- Once this is done the courts will decide the issues of medical negligence by the fact whether the protocol was followed or not. This will also improve the patient care and the outcome.
- Improved monitoring, especially the greater use of pulse oxymetry and capnography, has undoubtedly contributed to the decrease in severe complications.
- Errors in judgment and performance occur and can have serious consequences.

References

[1] Dr. Gurvinder Rull et al; Important Complications of Anesthesia; Document ID: 1302 (v22); 2014.
[2] Pekka Saukko and Bernard knight, 3rd edition Knight's forensic pathology, pp: 480-486.
[3] SO Tudjegbe, FE Amadasun; What is anesthetic death?; Annals of biomedical science. 2010; 9(1):25-28.
[4] Reddy K S N; the Essentials of Forensic Medicine & Toxicology. 31th ed. Hyderabad: K Sugna Devi; 2012.p.352-354.
[5] JN Lunn, WW Mushin Mortality associated with anesthesia. London, Nuffield provincial hospital trust, 1982;Gordon I,HA Shapiro and SD Person Forensic medicine - A guide to principal,3rd edn, Churchill Livingstone,Edinburgh,1988,pp194.
[6] Cooper JB, Newbowenks and Kitz RJ;An analysis of major errors and equipment failures in anaesthesia management: consideration of prevention and detection; Anesthesiology 1984; 60: 34-42.
[7] K.mathiharan; Amrit K Patnaik.; Modi's medical jurisprudence and toxicology; 23rd edition; 2005; Lexis Nexis publication ; Railway injuries; pp:668-669.
[8] K. .mathiharan; Amrit K Patnaik.; Modi's medical jurisprudence and toxicology; 23rd edition; 2005; Lexis Nexis publication ; Railway injuries; pp:671-675.
[9] Gautam Biswas; review of forensic medicine & toxicology including clinical and pathological apects; 2nd edition; JAYPEE; 2012; pp:296-298.
[10] Cheney FW. Aspiration: a liability hazard for the anesthesiologist? ASA Newsl; June 2000; 64:5-6, 26.
[11] Picard J, Meek T; Complications of regional anesthesia; Anesthesia; 2010 Apr; 65 Suppl 1:105-15. doi: 10.1111/j.1365-2044.2009.06205.x.
[12] Lindsay v/s Midwestern Health Board (1993) 2 I.R. (Irish Reports) 147, 181 (Supreme Court of Ireland).
[13] Vollar v/s Portsmouth Corporation (1947) 203 L.T.J. (Law Times Journal) 264.
[14] Bolton v/s Stone (1951) A.C. (Appeal Cases-Law Reports) 850,863 per Lord Oaksey.
[15] Bolam v/s Friern hospital management committee, 1957 1WLR 582, Queen's Bench division, England.
[16] Reddy K S N.;The Essentials of Forensic Medicine & Toxicology. 31th ed. Hyderabad: K Sugna Devi; 2012.p.353-354.
[17] 17.Dr.Denesh Rao; Forensic pathology online; aesthetic deaths; investigation of deaths related to anesthetic procedure; 2013.