

July-December 2019

Volume 28

Issue 2

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853



JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW

Official Publication of Medicolegal Association of Maharashtra

Editor-in-chief

Dr Ravindra Deokar

Associate Editors

Dr Sadanand Bhise

Dr Sachin Patil

**MULTISPECIALITY, MULTIDISCIPLINARY, NATIONAL
PEER REVIEWED, OPEN ACCESS, MLAM (SOCIETY) JOURNAL**

Editorial Office Address

Department of Forensic Medicine, Third Floor, Library Building, Seth G S Medical College & KEM Hospital, Parel, Mumbai-400 012
Email id: mlameditor@gmail.com Phone: 022-24107620 Mobile No. +91-9423016325



Original Research Article

Deaths Associated with Anaesthetic Procedures: An Autopsy Based Study

Vora DH^a, Khubchandani HT^{b*}, Shah KA^c

^a Assistant Professor, ^b Associate Professor, ^c Professor and Head
Department of Forensic Medicine, B.J. Medical College, Ahmedabad. Gujrat, India.

Article Info

Key words

Anaesthetic Death,
Medical Negligence,
Medicolegal Autopsy.

Abstract

The performance of a surgical operation and the administration of an anesthetic are never without risk to the life of a patient. In all such cases a careful and complete medico-legal autopsy should be undertaken. Present work is aimed to study the clinical and autopsy findings in anesthetic deaths and any discrepancy between them. Out of total 61 cases of death due to alleged medical negligence, 17 cases (29 %) of anesthetic death were studied in detail. Anesthesia was second most commonly involved branch in alleged medical negligence cases after obstetric & Gynaecology cases, (n=21, 33 %). In the present study, eight cases (47 %) were due to general anesthesia and nine cases (53 %) were due to spinal anesthesia. In cases of death associated with general anesthesia, respiratory failure leading to hypoxia was responsible in five cases while in three cases, acute cardiovascular failure leading to hypotension, bradycardia and cardiac arrest was responsible for death. In cases of death due to spinal anesthesia, sudden cardiac arrest was responsible in five cases, hypotension in three cases and bradycardia followed by pulmonary oedema in one case. In anesthetic deaths, morphological findings are minimal or even absent so, full clinical information and expert advice of an anesthetist are essential.

1. Introduction

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. In terms of Indian law, such deaths need to be notified to the law enforcement authorities. Hence, any death which is reported under this section is regarded as a death due to unnatural

unnatural causes, to be followed by an inquest. The attending clinicians are not allowed to issue a death certificate in these cases and the case must be referred for medico-legal autopsy.¹ Any autopsy on an anesthetic-related death must be a cooperative process with the anesthetist.

How to cite this article: Vora DH, Khubchandani HT, Shah KA, Deaths Associated with Anaesthetic Procedures: An Autopsy Based Study. J For Med Sci Law 2019;28(2):11-18

***Corresponding author:** Dr. Harish T. Khubchandani, Associate Professor, Department of Forensic Medicine, B.J. Medical College, Civil Hospital, Asarwa, Ahmedabad. Pin-380016. Email: drharishforensic@gmail.com (M): 9106913810

Not only are the objective findings in true anesthetic deaths meager or absent, but the autopsy surgeon's training and experience of the complex techniques of modern anesthesia is insufficient for him to appreciate, analyze, and criticize constructively without the expert knowledge of the anesthetist.²

Survey conducted by Lunn and Mushin for the association of anesthetists in 1982 indicated that, although 1 in every 166 patients died within 6 days of a surgical operation, only one in 10000 die solely as a consequence of the anesthetic. Anesthesia contributed to but not totally caused the death of 1 in every 1700 patients, many of these deaths being potentially avoidable. Autopsy reports alone are of limited value in explaining deaths associated with anesthesia.³

Anesthetic death is one of the most stressful events as experienced by anesthetists who may vary from person to person or even from case to case. For some it may be the emotional trauma and for others it may be the impact on their professional functioning.⁴

In law, as in medicine, error and negligence are not synonymous. To establish liability in a medical malpractice action, a plaintiff must prove three elements. The duty inherent in the doctor-patient relationship must have been established. A breach of duty defined by failure to exercise the required standard of care must have occurred. The breach of duty must be shown to be the proximate (underlying) cause of injury or death to a reasonable degree of medical certainty, that is, that the injury or death could have been avoided except for the breach of duty.⁵

Outcome of a malpractice case may depend on the quality of the autopsy, specifically on the awareness of the autopsy surgeon of clinical issues, particularly those that are of potential medico-legal interest, and the thoroughness of the autopsy dissection with respect to those issues. Many studies have documented that major discrepancies are common between diagnosis entered on death certificate and autopsy diagnosis.⁶

The surge of technology and the hyper-specialization in every field of medicine imply that each malpractice claim gives rise to a scientific challenge, requiring specific expertise in the analysis and evaluation of the clinical case in question. The role of legal medicine has become increasingly

specific, essential and ineluctable in the judicial setting in order to prevent and avoid erroneous interpretations and hasty scientific verdicts.⁷

The present study was designed to compare the clinical findings with the findings of a medico-legal autopsy in cases of anesthetic deaths.

2. Aims & Objectives:

- i. To study the clinical and autopsy findings in deaths associated with general anesthesia.
- ii. To study the clinical and autopsy findings in deaths associated with spinal anesthesia.
- iii. To study any discrepancies in clinical and autopsy findings of anesthetic deaths.

3. Material & Methods:

In this retrospective study, total 61 cases of death due to alleged medical negligence brought to the Forensic Medicine Department, B.J. Medical College, Ahmedabad between the January 2014 and December 2018 were studied. Out of these 61 cases, total seventeen cases of anesthetic deaths were selected for comparison between clinical and autopsy findings especially regarding the cause of death. All autopsies were performed within 24 hours of death as a part of medico-legal investigation of death as per section 174 of the Cr.P.C. For detection of the autopsy findings, post-mortem reports, reports of histo-pathological examination, chemical analysis and other ancillary investigations were studied. Clinical findings and cause of death (primary diagnosis) indicated by the clinician in-charge of the patient were abstracted from the patient's hospital records, anesthetic notes, operative notes, etc. Clinical and autopsy findings then compared and conclusions were drawn.

4. Results:

Out of total 61 cases of death due to alleged medical negligence, 17 cases (29 %) were of anesthetic death as shown in [table no. 1](#). Anesthesia was second most commonly involved branch in alleged medical negligence cases after Obst. & Gynec cases, (n=21, 33 %).

In the present study, eight cases (47 %) were due to general anesthesia and nine cases (53 %) were due to spinal anesthesia. In cases of death associated with general anesthesia, respiratory failure leading to hypoxia was responsible in five

cases while in three cases, acute cardio-vascular failure leading to hypotension, bradycardia and cardiac arrest was responsible for death. In cases of death due to spinal anesthesia, sudden cardiac arrest was responsible in five cases, hypotension in three cases and bradycardia followed by pulmonary edema in one case.

Table-1: Distribution of anesthetic deaths according to type of anesthesia and Primary Disease:

Type of Anesthesia	Primary condition	No. of cases	Total
General Anesthesia	Spinal Tumor (D11-Schwannoma)	1	8 (47%)
	Spinal space reduction L5-S1	1	
	Congenital coloboma	1	
	Uterine fibroid	2	
	Umbilical Hernia	1	
	Congenital Polydactyli & Syndactyli	1	
Spinal Anesthesia	LSCS	3	9 (53%)
	Ortho- Tibia Fracture	1	
	Ortho- Femur Fracture (ST or IT)	5	
Total			17 (100%)

Out of total 8 cases of death due to general anesthesia, 3 were belonging to neurosurgery and spine surgery, 2 of general surgery, 2 of gynecology, and 1 case of ophthalmology. Out of 9 cases of death due to spinal anesthesia, 6 cases were belonging to orthopedics. Out of these 6 cases, 5 were of sub-trochanteric or intra-trochanteric fracture of femur bone and in 1 case tibia was fractured. Three cases of spinal anesthetic deaths occurred during LSCS operation. Out of total eight cases of death associated with General Anesthesia, in four cases (50 %) autopsy has revealed undiagnosed preexisting disease. Out of total nine cases of death associated with Spinal Anesthesia, in only two cases (22 %) autopsy has revealed undiagnosed preexisting disease.

5. Discussion:

Anesthetic deaths may be divided in to two broad categories^{2, 8, 9} namely:

1. Deaths which occur during the administration of an anesthetic but which are not due to the anesthetic.

2. Deaths which are the direct result of the administration of an anesthetic.

Group-1 includes following categories:

- Death due to primary injury or disease which necessitated the operation and administration of an anesthetic.
- Deaths due to diseases other than those for which the operation was undertaken, but which were diagnosed before the operation was commenced
- Deaths due to diseases other than those for which the operation was undertaken, but which was not diagnosed before the operation was commenced

In a case of this nature, it has to be determined whether the condition could reasonably have been diagnosed by a proper preoperative clinical examination.

There are several diseases of a potential serious nature, e.g. coronary artery atherosclerosis, which may be clinically latent and which may not be detectable even after most careful routine clinical examination. The failure to make a preoperative diagnosis of such a condition does not necessarily imply that the practitioner in attendance was negligent.

- Surgical deaths i.e. accidental incision of a large blood vessel or aneurysm is the direct responsibility of the surgeon.

Out of total eight cases of death associated with General Anesthesia, in four cases (50 %) autopsy has revealed undiagnosed preexisting disease. In one case severe atherosclerosis of coronary arteries was present while in another case severe atherosclerosis of coronary arteries with left ventricular hypertrophy was found in autopsy. While in two cases severe chronic lung disease was found in autopsy. These unrelated diseases were not diagnosed or suspected in preoperative and pre-anesthetic evaluation. (See [the table-2](#))

Case-1: severe atherosclerosis of left anterior descending coronary artery with left ventricular hypertrophy. Another incidental finding was cavernous hemangioma of liver.

Table-2: Clinical Diagnosis and Autopsy Diagnosis in deaths associated with G.A.

Case No.	Clinical Diagnosis	Autopsy Diagnosis	Undiagnosed preexisting condition

			revealed in autopsy
1	Male, 48 yrs, G.A. (Propofol & Scolin) for D11 Schwannoma, Hypoxia followed by cardiac arrest occurred within 5-10 minutes of G.A. before starting the surgery.	40-50 % narrowing of LAD coronary artery with atherosclerosis , Left ventricular hypertrophy, tongue and lip bite due to convulsions, signs of difficult intubation. <i>No any signs of hypoxia found in the autopsy.</i>	1. Coronary atherosclerosis . 2. Left ventricular hypertrophy. 3. Multiple small cavernous hemangiomas in liver.
2	Male, 12 yrs, surgery for congenital coloboma under G.A., vomiting occurred after recovery	Aspiration of gastric contents in to bronchial tree, brain and lungs are congested and edematous.	Nil
3	Female, 40 yrs, lap. Hysterectomy under G.A., immediately after surgery developed negative pressure pulmonary edema (NPPE) , hypoxia, pink frothy fluid from ET tube.	Both lungs are congested, edematous, and found severely adherent to chest wall. Centri-lobular hemorrhagic necrosis of liver suggestive of circulatory failure. <i>No any signs of hypoxia found in the autopsy.</i>	Chronic pulmonary disease.
4	Female, 38 yrs, Hysteroscopic and laparoscopic removal of multiple fibroid uterus under G.A. After 30 min. developed bradycardia, hypotension and pulmonary edema, died on next day.	Pulmonary edema, about half liter reddish fluid in abdomen, suggestive of cardiac failure. <i>No any findings of hypotension, and cardiac arrest found in the autopsy.</i>	Nil
5	Male, 75 yrs, surgery for umbilical hernia, G.A., died on first post op. day, known case of Hypertension, heart block and hypothyroidism .	Left ventricular myocardial infarction, both coronary arteries were showing severe atherosclerosis . Pulmonary edema. Acute tubular necrosis of kidneys.	Coronary atherosclerosis .
6	Female, 15 yrs, Cranio-Vertebral junction abnormality with neurodeficit. C2, C3, C4 laminectomy under G.A., died on same day.	Negative Autopsy	Nil
7	Female, 57 yrs, known case of asthma, spine surgery of space reduction between L5-S1 under G.A., developed hypoxia due to bronchospasm, and convulsion, followed by cardiac arrest. Died before surgery started.	Pulmonary edema. <i>No any signs of hypoxia were found in autopsy.</i>	Nil
8	Two & half yrs old male child, surgery for polydactyli and syndactyli of four limbs under G.A., hypotension and cardiac arrest after surgery, died on same day.	100 ml reddish fluid in pleural cavity, 300 straw color fluid in peritoneal cavity suggestive of circulatory failure, lungs are edematous	Histopathology shows chronic interstitial inflammation of both lungs

Case-3: lungs were found severely adherent to the chest wall could not be removed whole during autopsy.

Case-5: severe atherosclerosis of left anterior descending coronary artery with left ventricular myocardial infarction.

Case-8: chronic interstitial inflammation of lungs found in histo-pathological examination.

Out of total nine cases of death associated with Spinal Anesthesia, in only two cases (22 %) autopsy has revealed undiagnosed preexisting disease. In one case left ventricular hypertrophy and chronic pyelonephritis were present while in another case moderate atherosclerosis of right coronary artery with about 30 % narrowing of its lumen was found in autopsy.

Case-14: left ventricular hypertrophy and chronic pyelonephritis. After giving spinal anesthesia patient developed sudden bradycardia and frothing due to pulmonary edema.

Case-15: 30 % narrowing of right coronary artery with moderate atherosclerosis. Patient developed chest pain and died after 20 min of spinal anesthesia.

So, in four cases (out of nine) of general anesthesia and in two cases (out of eight) of spinal anesthesia, the new information (pre-existing undiagnosed disease) provided by the medico-legal autopsy. This could have influenced the treatment decisions in some cases.

Group-2 includes deaths which are the direct result of the administration of an anesthetic.

In all recent studies of anesthesia related mortality, problems pertaining to the respiratory system were the single largest cause of death.

Out of eight cases of deaths associated with general anesthesia, five cases were due to respiratory failure. Causes of respiratory failure in these cases are complications of endotracheal intubation due to difficult intubation in one case, aspiration of gastric contents in one case, negative pressure pulmonary edema in one case, and in one case severe bronchospasm occurs in known case of asthmatic bronchitis after G.A. but before beginning the surgery. In one case exact cause of respiratory failure could not be detected.

One of the commonest causes of anesthesia-related mishaps is complications related to the endotracheal intubation. In case no.1 of our study (**Table-2**), signs of difficult intubation in the form of injuries to the mouth and laryngo-pharynx as well as hemorrhage in the neck musculature were seen.

In a study of 50 individuals who had endotracheal intubation prior to reaching an emergency room, in an unsuccessful attempt at resuscitation, 37 (74 %) had injuries of the airway following intubation.⁹

General anesthetics can also produce asthma-like attacks that are not apparent in unconscious patients.⁹ Bronchiolar spasm may contribute to airway obstruction and may be due to many factors including pre-existing asthma, hypersensitivity to drugs, aspiration of gastric contents and fluid overload. In case no.7 (**Table-2**), due to pre-existing asthma, bronchiolar spasm occurred after general anesthesia caused hypoxia and convulsions before starting the surgery.

In case no.2 (**Table-2**), airway obstruction and hypoxia were occurred due to aspiration of stomach contents due to vomiting. Vomiting occurred after completion of the surgery and apparent recovery from the anesthesia.

Ventilatory effort may be impaired during anesthesia either as a result of depression of the respiratory center, or through muscular weakness. Almost all anesthetic agents are respiratory depressants, and overdosage will result in inadequate ventilation. Inadequate Ventilatory support following the use of neuromuscular blocking drugs has been cited as a frequent cause of death due to anesthesia, and effect of these drugs is potentiated by volatile anesthetic agents.⁸ More common is the tendency to give multiple medications during induction and maintenance of general anesthesia or deep sedation, with resultant synergistic action of these drugs.¹⁰ In case no.8 this poly-pharmacy effect of CNS depressants may have caused the hypoxia.

Disorders of circulatory homeostasis form the second largest group of anesthetic related deaths. Unrecognized or inadequately managed hypovolemia is the commonest cause of anesthesia related death attributable to the cardiovascular system. Where death has occurred from such hypovolemia, autopsy is frequently unhelpful in establishing the cause. Over-enthusiastic fluid therapy may also contribute to anesthesia related mortality from pulmonary edema or cardiac failure. Fatal cardiac arrhythmias during anesthesia may result from a number of factors, such as pre-existing disease, abnormal reactions to drugs, unskillful

anesthesia, surgical stimulation, or a combination of these.⁸

In three cases of general anesthetic deaths (refer table no. 3), cardio-vascular failure was the cause of death. In two cases bradycardia and hypotension occurred first followed by cardiac arrest and cardiogenic pulmonary edema. In these cases preoperative hypovolemia and intra-operative blood loss which may remain unrecognized or inadequate provision could not be ruled out. In such cases cardio-vascular failure due to cardiac arrhythmia could also not be ruled out. In one case myocardial infarction due to coronary atherosclerosis was found to be a cause of death.

Table-3: Distribution of General Anesthetic cases according to cause of death

Cause of death in G.A.	No. of Cases
Respiratory Failure leading to Hypoxia	5
Cardio-vascular failure leading to hypotension, bradycardia and cardiac arrest	3

Out of nine cases of deaths associated with spinal anesthesia (refer table no. 4), in five cases sudden cardiac arrest developed during spinal anesthesia. In all these five cases, immediate CPR was given due to which cardiac activity was restarted. In all these cases patient developed of permanent vegetative state due to Hypoxic Ischemic Encephalopathy. Out of these five cases of sudden cardiac arrest during spinal anesthesia, in two cases DVT followed by the pulmonary thrombo-embolism was found during autopsy at about three days and eight weeks after surgery respectively. In two cases, septicemia and DIC were found in autopsy at about 3 weeks and 4 weeks after surgery. In one case patient died on fourth post-operative day with pulmonary edema. No any specific cause of death was found in autopsy.

Table-4: Clinical Diagnosis and Autopsy Diagnosis in deaths under Spinal Anesthesia

Case No.	Clinical Diagnosis	Autopsy Diagnosis	Undiagnosed preexisting condition revealed in Autopsy
9	Female, 25 yrs, LSCS under S.A., sudden	Congestion of organs,	Nil

	cardiac arrest, revived after CPR, Hypoxic Ischemic Encephalopathy, DIC, ARF, Septicemia, died after 22 days	hemorrhages in abdominal wall due to DIC	
10	Male, 60 yrs, Road Traffic Accident, proximal tibia fracture on rt. Side, plating under S.A., just before closure developed sudden cardiac arrest, revived after CPR, severe diffuse encephalopathy, died about 2 months after surgery	DVT in both legs with pulmonary thromboembolism, red hemorrhagic spots on both kidney surfaces, septicemia	Nil
11	Female, 70 yrs, RTA, left femur IT fracture, nail removal done after 7 months under S.A., cardiac arrest, CPR, developed hypoxic ischemic encephalopathy, died after one month	septicemia	Nil
12	Male, 21 yr, RTA, left femur fracture mid shaft, plating under S.A. & Epidural catheterization, developed severe hypotension, died on second day	Congestion of organs, Negative autopsy	Nil
13	Male, 35 yr, RTA, left Femur ST fracture, bradycardia followed by sudden cardiac arrest, revived after CPR, died on third day	DVT in left femoral vein, brain and both lungs severely edematous, pulmonary thrombo-embolism	Nil
14	Male, 46 yr, RTA, left femur IT fracture, nailing done, after 24 days removal done under S.A., sudden bradycardia, frothing, died on same day	Both lungs are congested & edematous, left ventricular hypertrophy found, coronaries are patent	1. Left ventricular hypertrophy 2. Chronic pyelonephritis on

			histopathology
15	Male, 75 yr, RTA, left femur IT fracture, nailing under S.A., developed chest pain, hypotension died on same day	Only 30 % block in right coronary artery, lungs are congested and edematous. No exact cause of death could be ascertained	Moderate atherosclerosis of right coronary artery
16	Female, 23 yrs, LSCS under S.A., developed sudden cardiac arrest, unconscious, CPR given, developed hypoxic ischemic encephalopathy, died on 4 th post operative day.	Edema over face, hands, feet, legs, and back. 500 ml reddish fluid in peritoneal cavity s/o cardiac failure, pulmonary edema.	Nil
17	Female, 35 yrs, full term pregnancy, twins, LSCS, hypotension, death during operation.	Negative Autopsy	Nil

In three out of nine cases of deaths associated with spinal anesthesia (refer table no. 5), sudden fall in blood pressure was developed during surgery and all patients were died on same day. No any specific cause of death was found at autopsy in all three cases (Negative Autopsy). In one case, moderate atherosclerosis of right coronary artery with about 30 % narrowing of its lumen was found during autopsy as age related change.

Cause of death in S.A.	No. of Cases
Sudden Cardiac Arrest	5
Hypotension	3
Bradycardia followed by pulmonary edema	1

In one case of death associated with spinal anesthesia, during surgery, suddenly bradycardia was developed followed by pulmonary edema and frothing. No any specific cause of death was ascertained in autopsy. However, left ventricular hypertrophy with chronic pyelonephritis was found present in autopsy.

This report demonstrates the extremely high yield of early post-mortem autopsies performed in the case of operative and anesthetic deaths with

suspicion of malpractice. Autopsies frequently identified undetected complications, including surgical complications and disease processes. They could also suggest faulty or negligent practice that would otherwise go unrecognized.

This report also demonstrates that most early post mortem examinations performed on patients who died due to surgical or anesthetic causes, provide new and often unexpected information of great assistance in identifying the cause of death.

6. Conclusions:

The morphological findings in the “anesthetic deaths” are minimal or even absent so, more than in any other type of case, expert advice and full clinical information are essential.

Early Post-mortem examination on case of anesthetic death can provide new and often unexpected information of great assistance in identifying the cause of death.

In most of the cases of death associated with anesthesia, the cause of death has to be determined from a consideration of the clinical features as well as the autopsy findings.

References:

- Hosahally JS, Chandra YP, Ramkumar J. Anesthetic death: A case report. *Eur J Forensic Sci* Jul-Sep. 2015;2(3):25.
- Saukko P., Knight B., Knight's Forensic Pathology, 4th edition, CRC Press, London, 2004: 497-507.
- Lunn J., Mushin W., “Mortality associated with anesthesia”, *Anesthesia*, London: Nuffield Provincial Hospital Trust, 1982; 37: 856.
- Kumar A., Srivastva A.K., Sharma B., “Anesthetic deaths: A Medico-legal Scenario”, *J Indian Acad Forensic Med.* July-Sept 2014;36(3): 292-295.
- Bove K.V., Clare Lerry, J.D. and the autopsy committee, “Role of Autopsy in Medical Malpractice cases I- A review of 99 appeals court decisions”, *Arch Pathol Lab Med.* Sept. 2002;126:1023-1028.
- Bove K.V., Clare Lerry, J.D. and the autopsy committee, “Role of Autopsy in Medical Malpractice cases II- Controversy related to autopsy performance and reporting”, *Arch Pathol Lab Med.* Sept. 2002;126:1032-1035.
- Ferrara S. D., Baccino E., Bajanowsky T., et al, “Malpractice and medical liability. European Guidelines on Methods of Ascertainment and Criteria of Evaluation”, *Int. J. Legal Med.* 2013; 127 : 545-557.

8. Gordon I., Shapiro A.H., Berson S.D., Forensic Medicine, A Guide to Principles, 3rd ed., Churchill Livingstone, Edinburgh, 1988: 194-203.
9. Dikshit P.C., HWV Cox Medical Jurisprudence and Toxicology, 7th ed., Lexis Nexis- Butterworths, India, 2008: 571-578.
10. DiMaio V.J., DiMaio D., Forensic Pathology, 2nd ed., CRC Press, Boca Raton New York, 2001: 269.