



DELAYED RECOVERY FROM GENERAL ANAESTHESIA: AN OBSERVATIONAL STUDY

Anesthesiology

Dr Harshita Lal	3 rd yr postgraduate Resident Department of Anaesthesiology, critical care, Pain and Palliative Medicine, GMC Haldwani (Nainital)
Dr D.C Punera	Associate professor Respiratory Medicine Department, GMC Haldwani (Nainital)
Dr Urmila Palaria*	Professor, Department of anaesthesiology, critical care, Pain and Palliative Medicine, GMC Haldwani (Nainital) * Corresponding Author

ABSTRACT

Delayed awakening from general anaesthesia (GA) is one of the biggest challenges faced by an anaesthesiologist. We can define recovery from GA as the state of consciousness of an individual when he is easily arousable and is aware of his surroundings and identity. All patients who underwent different surgeries under GA in our institution during the study period and showed delayed recovery from GA based on the Aldrete score were included in the study. Of the 3058 patients who were given GA in 18 months, 52 had delayed recovery and were analysed in the study. Extremes of age, type of surgery, type of drug, metabolic causes such as respiratory acidosis, comorbidities such as diabetes, and deranged kidney function test may affect the time of recovery from anaesthesia.

KEYWORDS

GA, Aldrete score, delayed recovery

INTRODUCTION

Amnesia, analgesia, and muscle relaxation are the three components of general anaesthesia (GA). Amnesia is defined as the reversible loss of memory. Postoperatively, the patient should be easily arousable, maintaining the airway and adequate ventilation, and with adequate analgesia.⁽¹⁾ Recovery from GA can be defined as a state of consciousness of an individual when the patient can be easily arousable and is aware of his surroundings and identity.^(2,3) The patient is aroused when all anaesthetic agents are eliminated from the brain. Although delayed recovery from GA is not uncommon, recognising the cause of delayed recovery and initiating treatment is crucial, because delayed treatment can lead to increased morbidity and mortality. Therefore, delayed recovery from anaesthesia remains a cause of concern for both the anaesthesiologist and surgeon.

The etiology of delayed recovery from GA is multifactorial; certain metabolic factors, electrolyte imbalances, and several comorbidities affect recovery. Complete physiological recovery occurs after 40 min in 40% patients. In only 11% patients, complete functional recovery in all aspects occurs by the third postoperative day.⁽²⁾ Patients should be shifted from the operating room only when they have adequate ventilation and oxygenation, a patent airway, and stable haemodynamic parameters. Adequate recovery time and a high alertness to rare side effects have become more crucial due to the increasing popularity of day-care surgery.

Higher incidence of early postoperative respiratory complications is noted when the patient returns unresponsive to the recovery room irrespective of age or the American Society of Anaesthesiologists (ASA) category. Patients cannot be considered as fully recovered until they have returned to their preoperative physiological state.⁽²⁾

PHASES OF RECOVERY FROM GA :

1. IMMEDIATE RECOVERY FROM GA

This stage of recovery includes recovery of consciousness, protective airway reflexes, and motor activity and generally lasts for a short period. An outpatient can be considered fit for discharge with a responsible attendant.

2. INTERMEDIATE RECOVERY FROM GA

During this stage of recovery, the patient recovers his power of coordination and the feeling of dizziness fades. This stage generally lasts for 1 h after a short anaesthetic. An outpatient can be considered fit for discharge with a responsible attendant.

3. LONG-TERM RECOVERY FROM GA

This phase of recovery includes complete recovery of coordination and higher intellectual function and may last for hours or even days.^{(4),(5)}

MONITORING RECOVERY FROM GA:

The Glasgow Coma Scale is used to assess the prognosis after head

trauma and can also be used to assess the level of consciousness after GA. A score of >12 is an indication of recovery and return of consciousness in most patients and a score of <8 indicates coma. The Aldrete score is now being used to assess recovery from anaesthesia. The maximum Aldrete score is 10; a score of 9 is required for discharge from the postanaesthetic care unit.⁽⁶⁾

MATERIAL AND METHODS

The present observational prospective was conducted in Dr. Susheela Tiwari Government Hospital, Haldwani, a tertiary care teaching hospital, over a period of 18 months to evaluate the causes of delayed recovery from GA. The study was approved by the hospital ethics committee.

The patient's age, sex, general preoperative condition, pre-existing comorbidities, ASA physical classification, and surgery indication were determined. Furthermore, duration of both the anaesthesia and surgery were recorded. Patients with mental disability, hearing impairment, and language problem, and those receiving anaesthesia other than GA were excluded from the study.

Following the completion of surgery, the patients were assessed for extubation on the basis of the Aldrete discharge score.⁽⁶⁾

Patients who did not recover immediately from GA were subjected to the following investigations as per their duration of recovery from anaesthesia and were managed accordingly.

Upto 30 min: noninvasive blood pressure, electrocardiogram (ECG), oxygen saturation, capnography, temperature, peripheral nerve stimulation and urine output were monitored.

Upto 2 h: Additional monitoring with capnography, temperature, and peripheral nerve stimulation was performed. In addition, haemoglobin, haematocrit, blood glucose, serum

electrolyte (Na⁺, K⁺, Ca⁺⁺, and Mg⁺⁺) levels, blood urea level, serum creatinine levels, thyroid function, and arterial blood gas were analysed.⁽⁶⁾

More than 2 h: In addition to the above mentioned monitoring with computed tomography, magnetic resonance imaging, and other imaging techniques was performed.

RESULTS

We screened 3058 patients who were administered GA and found that 52 patients had delayed recovery. Thus, only these 52 patients were included in the study after they signed written informed consent.

The demographic features of the patients, preoperative ASA physical classification, pre-existing comorbidities, surgical indications, and duration of anaesthesia were recorded.

In the present study, 53.85% of the patients were females and 46.15% were males. The mean age of the patients was 43.42 ± 16.04 years. Majority of the patients (25.00%) were aged 31–40 years, followed by 21.15% patients who were aged 41–50 years and 17.31% patients who were aged 51–60 years. Only 5 patients were below 20 years of age.

In this study, exploratory laparotomy was performed in majority of the patients (25.00%), laparoscopic cholecystectomy was performed in 23.08% patients, and tympanoplasty in 9.62% patients (Figure 1).

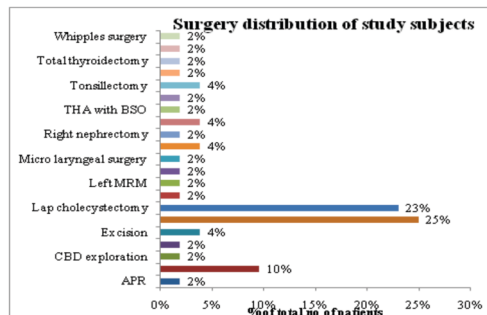


Figure 1: Distribution of various surgical procedures

Among the aetiologies for delayed recovery, respiratory acidosis was the cause of delayed recovery in most of the patients (25.00%), followed by hypokalaemia in 11.54% patients; hypoglycaemia, hypothermia, and use of muscle relaxants were the causes in 9.62% patients each (Table 1).

Table 1: Cause distribution of study subjects

Causes	Frequency	Percentage
Basal ganglia bleed	1	1.92%
Benzodiazepines	1	1.92%
Hyperglycaemia	2	3.85%
Hypernatremia	3	5.77%
Hypocalcaemia	2	3.85%
Hypoglycaemia	5	9.62%
Hypokalaemia	6	11.54%
Hypernatremia	1	1.92%
Hypothermia	5	9.62%
Inhalational agent	3	5.77%
Muscle relaxant	5	9.62%
Opioids	2	3.85%
Phenytoin	1	1.92%
Propofol	1	1.92%
Respiratory acidosis	13	25.00%
Uraemia	1	1.92%
Total	52	100.00%

The mean duration of delayed recovery in the study subjects was 5.17 ± 10.43 h. In most of the patients (42.31%), the duration of recovery was within 30 min, followed by 30 min to 1 h in 36.54% patients and >2 h in 17.31% patients (Figure 2).

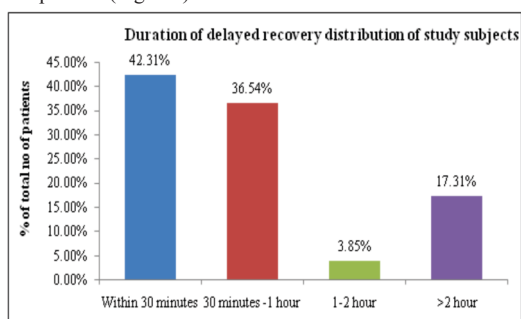


Figure 2: Duration of delayed recovery distribution of study subjects.

In the present study, comorbidities were present in 26.92% patients. Hypertension was the most common comorbidity present in 50.00% patients, followed by diabetes mellitus in 28.57% patients and hypothyroidism and obesity in 3(21.43%) patients each. Deranged kidney function test (KFT) and asthma were observed in 1 patient each.

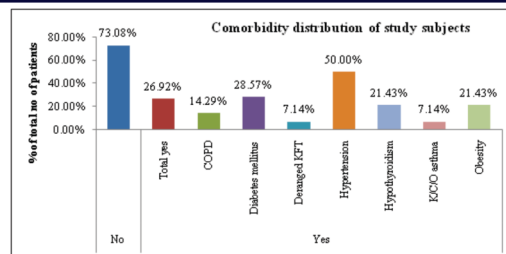


Figure 3: Co-morbidities distribution of study subjects.

DISCUSSION

Delayed arousal from anaesthesia is one of the biggest challenges faced by an anaesthesiologist. With the widespread use of fast-acting anaesthetic agents, patients generally awaken quickly in the postoperative period. However, the recovery time from GA may be affected by patient factors, anaesthetic factors, duration of surgery, and painful stimulation.⁽⁶⁾⁽⁷⁾

The principal factors responsible for delayed arousal following anaesthesia are the anaesthetic agents and medications used in the perioperative period. However, the non-pharmacological causes may also have.⁽⁷⁾

1. serious sequelae; hence, recognising them is equally important. Certain underlying metabolic disorders such as hypoglycaemia, severe hyperglycaemia, electrolyte imbalance (especially hyponatraemia), hypoxia, hypercapnia, central anticholinergic syndrome, chronic hypertension, liver disease, hypoalbuminaemia, uraemia, and severe hypothyroidism may also be responsible for delayed recovery following anaesthesia.⁽⁷⁾
2. Unexpected delayed recovery after GA may also be due to surgery-related complications such as intraoperative cerebral hypoxia, haemorrhage, embolism, or thrombosis.⁽⁷⁾

This study was conducted in the Department of Anaesthesiology and Critical Care of the Government Medical College, Haldwani over a period of 18 months to evaluate the causes of delayed recovery from GA.

In a review article, Classified the causes or risk factors for delayed recovery from anaesthesia into four categories:⁽⁷⁾

1. Patient factors such as age, sex, and systemic comorbidities.
2. Drug factors such as type of drug, dosage, administration, and interactions.
3. Surgical and anaesthetic factors such as type and duration of surgery
4. Metabolic factors such as hypoglycaemia, hyperglycaemia, hyponatraemia, hypernatraemia, hypokalaemia, hyperkalaemia, hypothermia, and respiratory acidosis

Of all the causes for delayed recovery from GA in our study, respiratory acidosis was the major cause observed in 25% patients, followed by hypokalaemia in 11.54% patients; hypoglycaemia, hypothermia, and use of muscle relaxants in 9.62% of patients each. Other reported causes were surgical bleed; drugs such as inhalational agents, benzodiazepines, muscle relaxants, opioids, phenytoin, and propofol; and metabolic factors such as hypoglycaemia, hyperglycaemia, hyponatraemia, hypernatraemia, hypocalcaemia, hypothermia, respiratory acidosis, and uraemia.

In a similar study, the age, sex, body mass index (BMI), preoperative blood urea nitrogen (BUN) level, and duration of cardiopulmonary bypass (CPB) were reported to be independent factors affecting the recovery time from GA, specifically in patients undergoing elective cardiac surgery.

Patients of the advanced age group, those with higher BUN levels, and those with longer CPB time tended to recover consciousness slowly, whereas female patients and those with higher BMI were inclined to have faster emergence.⁽⁸⁾

Another study concluded that the medications and anaesthetic agents used in the perioperative period are the most common cause of delayed recovery from GA, where the recovery depends on the tissue uptake, average concentration, and duration of exposure of the drug.⁽⁹⁾ The

occurrence of delayed recovery in otherwise healthy patients typically relates to some underlying undiagnosed condition.⁽²⁾

A response to stimulation should occur within 60–90 min following prolonged anaesthesia.⁽⁹⁾ Zelcer and Wells, found a 9.46% incidence of unresponsiveness between 15 and 90 min after GA among 443 mixed surgery patients⁽¹⁰⁾. Thus, different studies have reported different time ranges for delayed recovery depending on the various risk factors. In our study, the mean duration of delayed recovery was 5.17 ± 10.43 h. In most of the patients (42.31%), the recovery duration was within 30 min, followed by 30 min to 1 h in 36.54% patients, and >2 h in 17.31% patients.

A metaanalytical study discussed the various causes of delayed recovery from GA and concluded that such delayed recovery is often multifactorial and that the anaesthetic agent may not always be the cause⁽⁷⁾.

Elderly patients have increased sensitivity towards anaesthetic drugs, and they show a slow return of consciousness due to a progressive decline in the central nervous system function.⁽²⁾⁽⁸⁾⁽⁹⁾⁽¹¹⁾

A different mechanism is responsible for delayed recovery from GA in the paediatric population. Heat loss is greater in children due to the larger body surface area, resulting in hypothermia, slow drug metabolism, and delayed return of consciousness⁽⁷⁾.

In both male and female patients, respiratory acidosis was the main cause of delayed recovery, with recovery occurring within 30 min in both sexes. No significant association was observed between sex and cause of delayed recovery ($P = 0.355$) or sex and duration of delayed recovery ($P = 0.388$) in our study.

Buchman F conducted an age matched comparison between male and female patients and found that women recovered faster from GA than men⁽¹²⁾.

Apfelbaum et al also reported that men are 1.4 times more likely to have delayed recovery from anaesthesia than women as opposed to our study where female patients outnumbered male patients in delayed recovery. However, we did not find a specific association of sex with other causes of delayed recovery⁽¹³⁾.

The anaesthetic technique and drug selection determine the duration of unconsciousness. Recovery time increases with an increase in the duration of anaesthesia. Benzodiazepines, inhalational agents, muscle relaxants, opioids, phenytoin, and propofol were the causes of delayed recovery in our study.

Ineffective breathing may lead to increased hypercarbia, resulting in sedation and sometimes unconsciousness, which causes delayed recovery.

However, in our study, only 2 patients had chronic obstructive pulmonary disease (COPD) and 1 patient had asthma. Respiratory acidosis was the cause of delayed recovery in both the COPD patients, whereas use of muscle relaxants was the main cause of delayed recovery in the asthma patient. No significant association was observed between COPD or asthma and either cause or duration of delayed recovery ($P > 0.05$) probably due to the small sample of patients with respiratory problems in our study.

Patients fear surgery, and surgical stress causes problems in anaesthetic responses. In the present study, exploratory laparotomy was performed in majority (25%) of the patients, laparotomy cholecystectomy was performed in 23.08% patients, and tympanoplasty in 9.62% patients.

Garg R et al reported a case of delayed recovery after prolonged laparoscopic repair of a diaphragmatic hernia under GA due to metabolic acidosis caused by tissue handling and fluid replacement, hyperkalaemia, and hypocalcaemia⁽¹⁴⁾.

In the present study, comorbidities were present in 26.92% patients. Hypertension was the most common comorbidity present in 50% patients, followed by diabetes mellitus in 28.57% patients and hypothyroidism and obesity in 3 (21.43%) patients each. Deranged KFT and asthma were observed in 1 patient each.

In our study, 2 of the 4 diabetic patients and a patient with deranged KFT presented with delayed recovery from GA due to hyperglycaemia, exhibiting a significant association between hyperglycaemia and delayed recovery ($P < 0.05$). Hyperglycaemia as a significant metabolic cause of delayed recovery in diabetics has been reported in various studies.⁽⁹⁾⁽¹⁵⁾

Hypothyroidism, which was seen in 3 patients in our study, is another important common comorbidity. The delayed recovery was due to hypocalcaemia, opioid use, and respiratory acidosis, and it showed no significant association with metabolic causes or duration of delayed recovery ($P > 0.05$). A study reported a 41-year-old woman with unexplained hypothermia leading to delayed recovery from anaesthesia⁽¹⁶⁾.

The most common comorbidity in our study patients was hypertension. However, hypertension and other systemic comorbidities such as asthma and obesity showed no association with the metabolic causes of delayed recovery. None of the systemic comorbidities showed an association with the duration of delayed recovery ($P > 0.05$).

CONCLUSION

The findings of this article provide valuable information on patient care to anaesthesiologists so that they can adjust their anaesthetic management based on patient condition. However, other factors such as sex, hypertension, hypothyroidism, and COPD showed no significant association with the causes and duration of delayed recovery in our study, which may be due to a small sample size and the observational nature of our study. Thus, future long-term comparative studies with a large sample size are recommended to determine the cause–effect relationship for delayed recovery from anaesthesia.

REFERENCES

- (1) Sarangi S. Delayed Awakening From Anaesthesia. The Internet Journal of anesthesiology. 2009; 19(1).
- (2) Frost EA. Differential diagnosis of delayed awakening from general anesthesia: A review. Middle East J Anaesthesiol 2014; 22: 537-48.
- (3) Sinclair R, Faleiro RJ. Delayed recovery of consciousness after anaesthesia. Contin Educ Anaesth Crit Care Pain 2006; 6: 124-8.
- (4) Steward DJ, Volgyesi G. Stabilometry: A new tool for the measurement of recovery following general anaesthesia for out-patients. Can Anaesth Soc J 1978; 25: 4-6.
- (5) Fischer J, Mathieson C. The history of the Glasgow Coma Scale: Implications for practice. Crit Care Nurs Q 2001; 23: 52-8. 6. Aldrete JA, Kroulik D. A postanesthetic recovery score. Anesth Analg 1970; 49: 924-34.
- (6) Aldrete JA, Kroulik D. A postanesthetic recovery score. Anesth Analg 1970; 49: 924-34.
- (7) Misal US, Joshi SA, Shaikh MM. Delayed recovery from anesthesia: A postgraduate educational review. Anesth Essays Res 2016; 10: 164-72.
- (8) Tsai HJ, Chen CC, Chang KY. Patients and surgery-related factors that affect time to recovery of consciousness in adult patients undergoing elective cardiac surgery. J Chin Med Assoc 2011; 74: 345-9.
- (9) Shaikh SI, Lakshmi RR. Delayed awakening after anaesthesia- A challenge for an anaesthesiologist. Int J Biomed Adv Res 2014; 5(8): 352-354.
- (10) Zelcer J, Wells DG. Anaesthetic-related recovery room complications. Anaesth Intensive Care 1987; 15: 168-74.
- (11) Bowie MW, Slattum PW. Pharmacodynamics in older adults: A review. Am J Geriatr Pharmacother 2007; 5: 263-303.
- (12) Buchanan FF, Myles PS, Cicuttini F. Effect of patient sex on general anaesthesia and recovery. Br J Anaesth 2011; 106: 832-9.
- (13) Apfelbaum JL, Grasele TH, Hug CC, Jr, McLeskey CH, Nahrwold ML, Roizen MF, et al. The initial clinical experience of 1819 physicians in maintaining anesthesia with propofol: Characteristics associated with prolonged time to awakening. Anesth Analg 1993; 77(4 Suppl): S10-4.
- (14) Garg R, Punj J, Pandey R, Darlong V. Delayed recovery due to exaggerated acid, base and electrolyte imbalance in prolonged laparoscopic repair of diaphragmatic hernia. Saudi J Anaesth 2011; 5: 79-81.
- (15) Feeney JE. Delayed recovery from general anesthesia due to hyperosmolar hyperglycemic non-ketotic acidosis. Anesth Prog 1978; 25: 45-6.
- (16) Kumar V V, Kaimar P. Subclinical hypothyroidism: A cause for delayed recovery from anaesthesia?. Indian J Anaesth 2011; 55: 433-4.