

Incidence and Factors Related to Reintubation After Planned Extubation in Patients Receiving General Anesthesia in Srinagarind Hospital

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Abstract

Background: Reintubation after planned extubation (RAP) is associated with adverse outcomes. Understanding the incidence and related factors can reduce complications and improve outcomes.

Objectives: To identify the incidence, related factors, causes, and outcomes of RAP in patients undergoing general anesthesia (GA).

Methods: This retrospective descriptive study was done at the Srinagarind Hospital. After screening incident reports from January 2022 to June 2024, an RAP, which is defined as an intubation conducted within 24 hours after surgery was identified. The primary outcome was the incidence of RAP. The secondary outcomes were the characteristics, causes, and outcomes. Logistic regression analysis was used to identify the factors related to poor long-term outcomes.

Results: The incidence of RAP was 8.59 per 10 000 GA (40/46 543 patients). The incidence per 10 000 GA was higher among male (12.08), the elderly (22.80), patients with an American Society of Anesthesiologists (ASA) classification of 4 (24.72), patients with respiratory disease (63.09), and individuals undergoing hepatobiliary surgery (26.90). Most RAP (50%) occurred in the postanesthesia care unit. The most common indications for RAP were hypoxemia (32.5%), altered consciousness (25%), and airway obstruction (20%). RAP was primarily attributed to patient factor (65%). Male gender was associated with an odds ratio of 0.11 for poor long-term outcomes (95% CI, 0.02-0.51; $P = .005$).

Conclusions: RAP occurred at a lower rate than previously reported. Incidence of RAP was high among males, the elderly, classified as ASA 4, preexisting respiratory diseases, and hepatobiliary surgery. The major cause of RAP was related to patient-related factors.

Keywords: Incidence, Factors, Reintubation, RAP, General anesthesia, Planned extubation

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Introduction

In the process of general anesthesia (GA), endotracheal tube (ETT) intubation is necessary to secure the airway and ensure adequate ventilation throughout the surgery. The ETT also allows for the administration of inhalation anesthesia agents. Once the surgery is completed, the following extubation criteria, which are standard in our institution, are assessed to determine whether it was safe to extubate the patient; hemodynamic stability, spontaneous breathing with a tidal volume greater than 5 mL/kg, oxygen saturation (SpO_2) greater than 94%, end tidal carbon dioxide (EtCO_2) less than 50 mmHg, intact gag reflex, the ability to follow commands, sustained head raise for 5 seconds, and hand grasp.¹

Planned extubation occurs when the patient is considered stable enough and meets all extubation criteria. However, reintubation may be required if the patient experiences respiratory compromise.

Reintubation after planned extubation (RAP) refers to intubation that occurs after intended extubation following GA, typically within the first 24 hours after surgery.² RAP is a significant clinical concern for patients who have undergone GA. The need for reintubation indicates a potential failure of the planned extubation process, which can be associated with adverse outcomes such as increased morbidity, mortality, longer hospital stays, and higher healthcare costs.^{2,4}

Published reports indicate that the incidence of RAP in Thailand ranges from 8.5 to 35 cases per 10 000 procedures.^{2,3} Several factors may increase RAP risk, including patient-related factors (age, comorbidities), surgical factors (type and duration of surgery, complications), and anesthetic factors (duration of anesthesia, use of muscle relaxants).^{5,6} Despite these findings, the exact incidence of reintubation varies by clinical settings, regional practices, the type of anesthesia, and patient population.⁷

In 2011, Srinagarind Hospital reported the RAP incidence of 16.9 per 10 000 GA cases.⁶ Despite advances in anesthesia practices and changes in patient profiles over the past decade, RAP remains a concern. Decreasing the incidence of RAP is an indicator of anesthesia quality.⁵ Understanding the incidence and identifying the risk factors associated with RAP can contribute to reducing complications and improving patient outcomes. Furthermore, it is essential for the development of region-specific guidelines and interventions aimed at improving the safety of extubation and preventing the need for unnecessary reintubation. The study aimed to assess the incidence, related factors, potential causes, and clinical outcomes of RAP in patients undergoing GA.

Methods

Setting

Data were collected from January 2022 to June 2024 at Srinagarind Hospital, Khon Kaen University. Perioperative complications, including RAP, that occurred within 24 hours postoperatively were recorded on an incident report form and subsequently entered into the anesthesia database. The present study was approved by the Khon Kaen University Ethics Committee for Human Research (HE671154) in accordance with the Declaration of Helsinki and International Conference on Harmonisation (ICH) good clinical practice guideline. Written informed consent was not needed due to the retrospective and anonymous nature of the study.

Design and Participants

The present study was a retrospective descriptive study. All patients who received GA between January 2022 and June 2024 were included; patients who experienced RAP were eligible for this study. RAP was defined as intubation that was performed after considering extubation when undergoing surgery under GA during the first 24 hours postoperatively.⁶ The incident reports from the department database during the study period were screened, if an RAP was identified, the data record form was completed. The exclusion criteria were incomplete data and patients who had reintubation after unplanned or accidental extubation. The research team, which consisted of anesthesiologists and nurse anesthetists from the risk management committee, analyzed each factor.

The reported variables were based on the seminar supported by more than two-thirds of the participants.

Data Collection

The data collected in RAP patients included demographics, baseline characteristics, characteristics of the event such as the location of the event, time of the event, initial indication of intubation, the main cause of RAP, decision for planned extubation, and clinical outcomes. The main causes of RAP were categorized into 3 groups; anesthesia-related factors (including the prolonged anesthetic effect or respiratory depression from opioids), patient-related factors (such as age, severe comorbidities, and poor medical condition), and surgical-related factors (such as type and duration of surgery, and surgical complications). The immediate outcome was collected at 24 hours, and the long-term outcomes were collected at 7 days after RAP. The long-term outcomes were categorized as complete recovery, prolonged respiratory support (requiring mechanical ventilation), and death.

The number of patients who received GA during the study period was extracted from the Anesthesiology Department's annual report to calculate the incidence, number of patients were classified according to the baseline characteristics and intraoperative data included sex, age group (pediatric, adult, and elderly), American Society of Anesthesiologists (ASA) classification, emergency surgery, underlying disease, and type of surgery.

Outcome Measures

The primary outcome was the incidence of RAP in patients who received GA. The secondary outcomes were related factors, characteristics of event, causes, clinical outcomes, and predictors for poor long-term clinical outcomes in RAP patients.

Statistical Analysis

The incidence of RAP was calculated according to baseline characteristics and expressed per 10 000 GA. The data were analyzed using descriptive statistics and presented as numbers and percentages. Logistic regression analysis was used to identify factors related to poor long-term outcomes (prolonged respiratory support for more than 7 days or death within 7 days). The odds ratio (OR) and 95% CI were estimated. All the tests were 2-tailed. A *P* value less than .05 was considered significant. Data were analyzed and exported using the Stata version 18.0 (StataCorp. Version 18. College Station, TX: StataCorp LLC; 2023).

Results

From January 2022 to June 2024, 46 543 patients underwent GA with 40 patients experiencing RAP leading to an incidence of 8.59 per 10 000 GA cases. The reintubation rate was higher among males (67.5%) with an incidence of 12.08 per 10 000 GA. The median (range) age of reintubation patients was 67 (2-90) years. The incidence of reintubation varied by age group: 22.80, 5.97, and 4.42 per 10 000 GA for the elderly, pediatric, and adult populations, respectively. As ASA classification increased the rate of RAP corresponding increased; ASA classification 4 had the greatest incidence of RAP, at 24.72 per 10 000 GA. The most common coexisting diseases in our participants were hypertension, respiratory disease, and neurological diseases. The RAP rates were higher among patients with respiratory disorders (63.09 per 10 000 GA), neurological illnesses (41.21 per 10 000 GA),

and chronic kidney diseases (32.57 per 10 000 GA). The majority of RAP patients were undergoing head and neck surgery; however, the highest incidence was found in patients who underwent hepatobiliary surgery (26.90 per 10 000 GA) (Table 1).

Table 1. Incidence of Reintubation After Planned Extubation Per 10 000 General Anesthesia Categorized by Baseline Characteristics

Characteristic	No. of Patients		Incidence Per 10 000 GA
	Total Anesthetics	Reintubation	
Total case	46 543	40	8.59
Sex			
Male	22 343	27	12.08
Female	23 142	13	5.62
Age, y			
1-17	8 370	5	5.97
18-65	27 119	12	4.42
> 65	10 086	23	22.80
ASA classification			
1	11 276	0	0
2	24 408	24	9.83
3	9035	12	13.28
4	1618	4	24.72
5	111	0	0
Emergency surgery	7430	12	16.15
Underlying disease			
Hypertension	13 230	17	12.85
Respiratory disease	1902	12	63.09
Neurological disease	1941	8	41.21
Chronic kidney disease	2456	8	32.57
Diabetes	5487	4	7.29
Cardiovascular disease	1441	2	13.88
Type of surgery			
Head and neck	5048	9	17.85
General surgery	10 507	6	5.71
Hepatobiliary surgery	1859	5	26.90
Neurosurgery	3328	5	15.02
Eye	4290	4	9.32
Orthopedic	5450	4	7.34
Endoscopy	10 369	4	3.86
Thoracic surgery	988	2	20.24
Kidney, ureter, and bladder	1332	1	7.51

Abbreviations: ASA, American Society of Anesthesiologists; GA, general anesthesia.

The majority of RAP occurred in the postanesthesia care unit (PACU) (50%) and ward (27.5%), and in the operating room (22.5%), respectively. Many RAP events (62.5%) happened during normal working hours. The 3 most indicated signs requiring reintubation were hypoxemia (32.5%), altered of consciousness (25%), and airway obstruction (20%). Regarding the main cause of RAP, patient factors accounted for 65%, followed by surgical factors (20%) and anesthesia-related factors (16%). The 2 most specific causes of patient-related factors were respiratory distress (30%) and seizure or stroke (15%). Most reintubations (57.5%) resulted from an inappropriately planned extubation (Table 2).

The immediate outcome within 24 hours was a retained endotracheal intubation (97.5%). There were 19 patients (47.5%) who had unplanned intensive care unit (ICU) admission. At 7 days after surgery, 12 patients (30%) experienced poor long-term outcomes, 11 patients (27.5%) required prolonged mechanical ventilation and there was 1 patient death (Table 3).

The estimated OR (95% CI) for factors associated with poor long-term clinical outcomes were determined. Univariable logistic regression analyses were performed to identify clinically relevant potential risk factors for poor long-term outcomes in patients who required reintubation. Variables included sex, aged 65 years or older, ASA classification 3 or greater, emergency surgery, presence of underlying disease, type of surgery, occurrence during non-working hours, and the primary cause of reintubation. The analysis demonstrated that male sex was significantly associated with a reduced risk of poor long-term outcomes (OR [95% CI], 0.11 [0.02-0.51]; $P = .005$) (Table 4).

Table 2. Characteristics of Events in Reintubation After Planed Extubation

Characteristic	No. (%)
Event location	
Operating room	9 (22.5)
Postanesthesia care unit	20 (50.0)
Ward	11 (27.5)
Time of events	
Working hour	25 (62.5)
Non-working hour	15 (37.5)
Initial indication for reintubation	
Hypoxemia	13 (32.5)
Alteration of consciousness	10 (25.0)
Airway obstruction	8 (20.0)
Respiratory failure	7 (17.5)
Hypoventilation/apnea	2 (5.0)
Hemodynamic instability	0 (0)

Table 2. Characteristics of Events in Reintubation After Planned Extubation (Continued)

Characteristic	No. (%)
Main cause of reintubation	
Anesthesia-related factor	6 (15.0)
Prolong anesthetic effect	5 (12.5)
Respiratory depression from opioids	1 (2.5)
Patient's factor	26 (65.0)
Respiratory distress	12 (30.0)
Seizure or stroke	6 (15.0)
Upper airway obstruction	5 (12.5)
Pulmonary edema	2 (5.0)
Shock or multiple medical problems	1 (2.5)
Surgical factor	8 (20.0)
Upper airway obstruction after head and neck surgery	6 (15.0)
Seizure after neurosurgery	2 (5.0)
Decision for planned extubation	
Appropriate	17 (42.5)
Inappropriate	23 (57.5)

Table 3. Clinical Outcomes of Reintubation After Planned Extubation

Characteristic	No. (%)
Immediate outcome (within 24 h)*	
Retained endotracheal tube > 24 h	39 (97.5)
Unplanned intensive care unit admission	19 (47.5)
Desaturation	18 (45.0)
Hypotension	1 (2.5)
Cardiac arrest	1 (2.5)
Complete recovery	1 (2.5)
Long-term outcome within 7 d	
Complete recovery	28 (70.0)
Prolonged respiratory support	11 (27.5)
Death	1 (2.5)

* Patient may impact multiple immediate outcomes.

Table 4. Logistic Regression Analysis for Predictors of Poor Long-Term Outcomes of Reintubation After Planned Extubation

Variable	OR (95% CI)	P Value
Male sex	0.11 (0.02-0.51)	.005
Age > 65 y	0.65 (0.17-2.53)	.531
ASA classification ≥ 3	0.95 (0.24-3.75)	.952
Emergency surgery	3.00 (0.73-12.40)	.129

Table 4. Logistic Regression Analysis for Predictors of Poor Long-Term Outcomes of Reintubation After Planned Extubation (Continued)

Variable	OR (95% CI)	P Value
Underlying		
Hypertension	2.52 (0.63-10.05)	.190
Respiratory disease	0.36 (0.07-1.98)	.240
Neurological disease	3.00 (0.61-14.86)	.178
Chronic kidney disease	1.53 (0.30-7.79)	.606
Diabetes	0.76 (0.07-8.12)	.819
Type of surgery		
General surgery	1.00 (Reference)	NA
Head and neck surgery	4.00 (0.32-49.60)	.280
Neurosurgery	20.00 (0.93-429.90)	.056
Non-working hour	2.11 (0.53-8.41)	.289
The main cause of reintubation		
Anesthesia factor	0	NA
Patient factor	1.94 (0.43-8.79)	.390
Surgical factor	1.53 (0.30-7.79)	.606

Abbreviations: ASA, American Society of Anesthesiologists; NA, not applicable; OR, odds ratio.

Discussion

This study's incidence of RAP was 8.59 per 10 000 GA, which was lower than the 16.9 per 10 000 GA found in our institution's 2011 study.⁶ The incidence of RAP in Thailand was shown to be as high as 27 per 10 000 GA in early 21st century studies,^{2, 8} although it has now decreased to between 8.6 and 14.16 per 10 000 GA in recent years.^{5, 9, 10} Reintubation was one of the respiratory complications that were significantly related to postoperative respiratory depression.¹¹ The recent decline in RAP rates likely from advancements in anesthetic practices, which now incorporate short-acting drugs, less-sedating agents, regional anesthesia, and enhanced recovery after surgery (ERAS) protocols to facilitate faster recovery and minimize respiratory depression.¹² The decreasing incidence of RAP also reflects improvements in the quality of our anesthesia care. The study in developed countries reported the incidence of RAP was 6 to 9.9 per 10 000 GA which is comparable with our study.^{13, 14}

According to our findings, RAP occurred in men at twice the rate of women. This result was consistent with research by Chen et al¹⁵ on patients who experienced acute airway compromise following GA and Wilson et al¹⁶ on patients who had anterior cervical discectomy and fusion surgery.

When considering age groups, we discovered that the highest incidence of RAP was seen in elderly patients (age > 65 years). The elderly were also found to be a significant independent risk factor for RAP in many previous studies.^{3, 15, 17} Chinachoti et al² found that extreme age group (< 1 year and > 70 years) increased the incidence of RAP. Infants and geriatrics are more susceptible to respiratory depression following GA. In these patients, careful anesthetic drug selection, dosage titration, and monitoring are crucial to minimize this risk.

Our results showed the incidence of RAP increased along with ASA classification which might be due to higher ASA classification related to more severe illnesses and comorbidities. This study reported a high incidence of RAP seen in patients with respiratory diseases, neurological diseases, and chronic kidney disease. Previous research has also shown that patients with ASA classification of 3 or higher and patients with respiratory disease (chronic obstructive pulmonary disease) were at risk for RAP.¹⁵⁻¹⁸

In regard to the type of operation, the majority of previous research demonstrated RAP most frequently happened in thoracic, airway, and head and neck surgeries.^{3, 14, 15, 18} Contrary to our findings, the highest incidence of RAP (26.90 per 10 000 GA) was found in patients undergoing hepatobiliary surgery. It might be because our institution is in the pandemic area of liver disease and hepatobiliary surgery is on the rise every year.¹⁹

Most RAP events (75%) happened immediately after surgery in the operating room or postanesthesia care unit, which is comparable to the Thai study's findings (67.5%).² The most common causes of RAP in the present study were patient factors, surgical-related factors, and anesthesia-related factors, respectively. This result is similar to a recent study conducted in 2022 at Songkhla Hospital, which found that patient factors accounted for 55% of RAP.¹⁰ In contrast, RAP was mostly caused by anesthesia-related risk factors in most of the earlier reports.^{2, 5, 6, 8} This decrease in anesthesia-related factors may suggest an overall improvement in anesthetic safety. One possible explanation, though not directly assessed in our study, is the widespread adoption of modern practices such as rapid-recovery anesthetic drugs and ERAS protocols, which have been shown to improve postoperative outcomes.^{12, 20} This hypothesis warrants further prospective studies to confirm the association.

We found that inappropriate decisions for planned extubation contributed to 57% of RAP. Identifying high-risk patients for RAP can help clinicians decide whether to delay extubation, use noninvasive ventilation or other alternative techniques, or prepare for potential complications postextubation. A better understanding of the underlying mechanisms and predictive factors associated with RAP may lead to improved guidelines for anesthesia management and post-operative care.

Despite males having a higher incidence of RAP, however, they had lower odds of poor long-term outcomes after RAP. In critically ill patients also found that men are admitted to the ICU more commonly than women but have better functional outcomes than women.²¹ Further investigation is needed to explore the reasons behind this trend.

Our study had some limitations. The retrospective nature resulted in missing data and lack of systematically documented extubation criteria for individual RAP cases, limiting our ability to analyze the relationship between specific extubation criteria and RAP outcomes. Hence, a prospective study will help to clarify the findings. Our sample size may have been insufficient to identify possible risk factors for poor long-term outcomes. In the future, we hope to increase the sample size by performing a multicenter prospective survey.

Conclusions

RAP occurred infrequently and at a lower rate than in previous reports. The incidence of RAP was high among males, the elderly, patients with ASA classification 4, patients with preexisting respiratory disease and neurological disease, and hepatobiliary surgery. The major cause of RAP was patient-related factors.

Additional Information

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Ethics Approval: The present study was approved by the Khon Kaen University Ethics Committee in Human Research (HE671154 on 13 March 2025).

Clinical Trial Consideration: This study does not report on a clinical trial.

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