Predictors of Ambulatory Surgery Failure in General Surgery

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Abstract

Background: Ambulatory Surgery (AS) is a care model designed to improve healthcare efficiency and resource utilization. However, unplanned overnight stays, hospital admissions and readmissions remain important challenges. This study analyzes causes and factors associated with AS failure in a secondary-level hospital.

Methods: We performed a retrospective, observational and analytical study including 3,397 patients who underwent AS in the Department of General and Digestive Surgery between 2023 and 2024. AS failure was defined as an unplanned overnight stay, hospital admission, or readmission within 30 days. Variables analyzed included age, sex, timing of surgery (day, month, year, morning/afternoon), procedure duration, healthcare area, surgical category and type of anesthesia. Bivariate analyses were performed and independent predictors were identified using multivariable logistic regression (Hosmer–Lemeshow goodness-of-fit test).

Results: Overall, 799 patients (23.5%) experienced AS failure: 470 overnight stays, 131 hospital admissions and 238 readmissions. Independent predictors of failure were longer procedure duration, placement of a central venous access device (DAVC), and use of general or spinal anesthesia. Protective factors included surgeries performed in March–April and procedures starting in the morning. Key adjusted estimates included: duration (OR 1.008 per additional minute; 95% CI 1.004–1.012), DAVC (OR 2.77; 95% CI 2.05–3.75) and general/spinal anesthesia (OR 2.38; 95% CI 1.99–2.86).

Conclusions: The AS failure rate in our series was 23.5%. Procedure duration, surgical category (notably DAVC placement) and anesthesia type were the main associated factors. Optimizing scheduling and perioperative planning may help reduce failure rates and improve organizational efficiency in ambulatory surgery programs.

Keywords: Ambulatory Surgical Procedures; General Surgery; Treatment Failure; Organizational Efficiency; Patient Readmission.

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Introduction

Understanding the reasons for ambulatory surgery (AS) failure is essential to optimize efficiency, reduce costs, and, above all, improve patient safety. By identifying clinical and organizational factors associated with unplanned admissions, this study aims to provide readers with practical insights to enhance the quality and sustainability of AS programs.

Ambulatory Surgery (AS) is an organizational and healthcare management model that has emerged in response to increasing surgical demand and growing waiting lists. Procedures considered suitable for AS are those that require low-intensity and short-duration postoperative care (1). AS implies that patients are discharged on the same day as the intervention without overnight hospitalization. Several discharge scoring systems are used to determine readiness for discharge; the modified Post-Anesthetic Discharge Scoring System (PADSS) by Chung is one of the most widely employed (2).

"Failure of the ambulatory surgery pathway" refers to situations in which the primary objective of AS—safe same-day discharge without complications requiring hospital admission—is not achieved. The main causes of AS failure can be grouped into clinical causes (e.g., uncontrolled pain, postoperative bleeding, persistent nausea or vomiting, urinary retention, fever), organizational causes (e.g., surgical delays, lack of observation beds, transport problems) and social/personal causes (e.g., absence of an escort for discharge, inadequate home conditions, or lack of confidence on the part of the patient or family).

Several studies have examined factors associated with AS failure. Advanced age has been identified as a risk factor for admission after ambulatory procedures (3). Female sex has also been associated with a higher risk of unplanned admission; for example, one study reported unplanned admission rates of 12.6% in women versus 6.9% in men (4). Likewise, scheduling (specific days of the week or time of day) can influence unplanned admission rates—interventions performed during non-working days or late hours have been suggested to increase the likelihood of unexpected hospitalization.

The type of anesthesia employed is a key factor related to AS failure in several publications. The chosen anesthetic technique directly influences the risk of immediate postoperative events (nausea, vomiting, pain, urinary retention, etc.) that may necessitate unplanned admission. General anesthesia has been associated with higher rates of unplanned admission, mainly due to postoperative nausea and vomiting, more intense pain and delayed recovery (5).

Accordingly, the primary aim of the present study is to analyze failure of the AS regimen in a secondary-level hospital. Secondary aims are to describe the sociodemographic characteristics of patients undergoing ambulatory procedures, to provide a descriptive analysis of the causes of AS failure, and to identify factors associated with such failures.

Material and Methods

This was a retrospective, observational, and analytical study of a case series of patients who underwent ambulatory surgery in a secondary-level hospital between 2023 and 2024.

Study population and inclusion criteria. Cases were identified through the hospital's Ambulatory Surgery registry. Eligible patients were 18 years, of both sexes, and underwent ambulatory procedures performed by the Department of General and Digestive Surgery. Interventions were categorized as abdominal wall, proctology, breast, central venous access devices (CVAD), soft tissue tumors (STT), or other procedures. Patients with incomplete records or who underwent surgery under an inpatient regimen were excluded.

Definition of ambulatory surgery failure. In our series, failure was defined as any situation in which the patient was not discharged on the day of surgery or required readmission within 30 days. We classified failure into three categories:

- Overnight stay: discharge occurring between 00:00 and 23:59 hours on the day following surgery.
- Hospital admission: patient did not meet the modified Chung PADSS discharge criteria and required inpatient admission of 2 days after surgery.
- Readmission: admission within 30 days of the procedure for any reason, whether directly related or not to the initial surgical process.

Variables analyzed. Failure of AS (overnight stay, hospital admission, or readmission) was assessed in relation to the following independent variables: age, sex, day, month, and year of intervention; healthcare area of residence; morning vs. afternoon session; duration of surgery; type of anesthesia; and surgical category (abdominal wall, breast, proctology, CVAD, STT, and others).

Statistical analysis. First, a descriptive analysis was performed to summarize the characteristics of the study population. Quantitative variables were expressed as mean and standard deviation or as median and interquartile range, according to distribution. Qualitative variables were summarized using absolute and relative frequencies. Second, bivariate analyses were conducted to explore associations between AS failure and each independent variable. Student's t-test or Mann–Whitney U test was used for continuous variables, while the chi-square test or Fisher's exact test were applied to categorical variables, as appropriate. Finally, multivariable logistic regression was performed to identify independent predictors of AS failure, with model calibration assessed using the Hosmer–Lemeshow goodness-of-fit test. Statistical analyses were conducted with SPSS version 21.

Results

Descriptive analysis. A total of 3,423 patients were identified in the hospital's clinical documentation registry. Twenty-six cases were excluded due to incomplete information, leaving a final sample of 3,397 patients.

The mean age was 53 years (range: 14–91 years). Males accounted for 64.4% of the study population.

Most surgeries were performed on Wednesdays and Thursdays, which together represented 48.3% of all procedures, whereas only 11% were performed on Fridays. The mean monthly surgical volume was 289 patients, with peaks in February, May, and October, and the lowest activity in August. No significant differences were observed between patients operated on in 2023 (48.8%) and 2024 (51.2%).

Regarding surgical category, 50.9% of patients underwent abdominal wall surgery, followed by proctology (23.3%), CVAD placement (8.4%), soft tissue tumors (6.6%), breast surgery (5.5%), and other procedures (5.2%).

Concerning anesthesia, spinal anesthesia was used in 49% of patients, local anesthesia and/or sedation in 42.2%, general anesthesia in 5.8%, and intravenous regional anesthesia in 3%.

By surgical session, 1,757 patients were operated in the morning and 1,640 in the afternoon. The mean procedure duration was 35 minutes.

When analyzing AS failure, 470 patients required overnight stay, 131 required hospital admission, and 238 were readmitted. The mean length of stay among readmitted patients was 11 days (95% CI: 8.7–13.2). Overall, 799 patients (23.5% of the total) experienced AS failure.

Bivariate analysis. After the descriptive analysis, we examined the association between ambulatory surgery (AS) failure and the independent variables (Table 1).

With respect to the day of surgery, Tuesdays and Thursdays showed the highest failure rates (25.9% and 25.6%, respectively), whereas Fridays had the lowest (15.2%). Regarding the month of surgery, February had the highest failure rate (28%), while April (16.2%), March (17.9%), and August (19.6%) showed significantly lower rates.

Table 1. Association between ambulatory surgery (AS) failure and sex, surgical category, type of anesthesia, surgical session, and year of intervention.

	Independent variables	AS Failure No	Yes	p-value
Sex	Male	1648 (75.4%)	539 (24.6%)	p= 0.038
	Female	950 (78.5%)	260 (21.5%)	
Surgical Category	Abdominal wall	1319 (76.2%)	411 (23.8%)	p<0.001
	Proctology	604 (76.2%)	189 (23.8%)	
	CDAD	183 (64%)	103 (36%)	
	STT	198 (88.8%)	25 (11.2%)	
	Breast	160 (85.6%)	27 (14.4%)	
	Other	134 (75.3%)	44 (24.7%)	
Type of anesthesia	Spinal	1199 (72.1%)	464 (27.9%)	p <0.001
	Local and/or sedation	1192 (83.1%)	243 (16.9%)	
	General	129 (65.5%)	68 (34.5%)	
	Intravenous regional	78 (76.5%)	24 (23.5%)	
Surgical Session	Morning	1518 (85.1%)	266 (14.9%)	p <0.001
	Afternoon	1080 (67%)	533 (33%)	
Year of surgery	2023	1203 (46.3%)	456 (57.1%)	p <0001

In terms of year, there was a significant decrease in AS failure between 2023 and 2024 (27.5% vs. 20%, respectively). Failure rates varied across age groups, with the highest rates observed among patients aged 41–60 years. A notable decrease in failure was observed in patients aged 60–80 years and in those younger than 21 years. Sex was also significantly associated with AS failure: 24.6% in men versus 21.0% in women.

No significant differences were observed according to healthcare area of origin ($p = 0.971$) or rural versus urban residence ($p = 0.798$). Surgical category was significantly associated with AS failure. CVAD procedures had the highest rate (36%), whereas breast surgery had the lowest (14.4%).

Anesthesia type was also relevant: general anesthesia had the highest failure rate (34.5%), followed by spinal anesthesia (27.9%). In contrast, local anesthesia with sedation showed a significantly lower rate (16.9%). Surgical session showed marked differences: morning procedures had a failure rate of 14.9% compared with 33.0% in afternoon procedures.

Finally, procedure duration was also associated with AS failure, with the highest rates observed in interventions lasting 21–40 minutes.

Multivariable analysis. A multivariable logistic regression was performed to identify independent predictors of ambulatory surgery (AS) failure (Table 2). The following factors were identified as independent predictors: Procedure duration: Longer surgeries were significantly associated with higher odds of AS failure (OR 1.008 per additional minute; 95% CI 1.004–1.012; $p < 0.001$). This indicates that, for every 10 minutes of additional operative time, the risk of failure increased by approximately 8%. Central venous access device (CVAD) placement: This category showed the highest risk, with an almost threefold increase in the odds of AS failure compared with other procedures (OR 2.77; 95% CI 2.05–3.75; $p < 0.001$). Anesthesia type: Use of general or spinal anesthesia was strongly associated with AS failure (OR 2.38; 95% CI 1.99–2.86; $p < 0.001$), more than doubling the risk compared with local anesthesia with sedation.

Table 2. Independent predictors of ambulatory surgery (AS) failure (multivariable logistic regression).

Independent variables	p-value	Odds Ratio	95% Confidence Interval (CI)
Procedure duration (per min)	,000	1,008	1,004-1,012
CVAD	,000	2,772	2,048-3,752
March/April (vs. other months)	,000	,596	,467-,760
General/spinal anesthesia	,000	2,384	1,985-2,863
Morning sesión (vs. afternoon)	,000	,331	,277-,394

Conversely, two factors were found to be protective: Month of surgery (March–April): Procedures performed during these months had significantly lower odds of AS failure (OR 0.60; 95% CI 0.47–0.76; $p < 0.001$). Morning procedures: Operations scheduled in the morning session were associated with a substantial reduction in failure risk (OR 0.33; 95% CI 0.28–0.39; $p < 0.001$). These results suggest that both surgical and organizational factors play a key role in determining the success of AS programs. Optimizing patient selection, anesthetic management, and operating room scheduling could significantly reduce the rates of unplanned admissions, overnight stays, and readmissions.

Discussion

In this study, we analyzed 3,397 patients undergoing ambulatory surgery (AS) in a secondary-level hospital, of whom 799 (23.5%) experienced AS failure, defined as unplanned overnight stay, hospital admission, or readmission. This rate is higher than those reported in many published series, although the discrepancy may be partly explained by differences in the operational definition of failure across studies.

Our analysis identified several independent predictors of AS failure. Longer procedure duration was strongly associated with increased risk, highlighting the importance of careful selection of cases suitable for AS and efficient surgical planning. CVAD placement emerged as the category with the highest failure rate, which may reflect the specific characteristics of these patients, often older, immunocompromised, or already hospitalized, and in whom discharge is commonly delayed for clinical or logistical reasons.

Anesthetic technique also had a major impact. General and spinal anesthesia were both associated with a markedly higher risk of AS failure compared with local anesthesia with sedation. This finding is consistent with the physiological side effects of these techniques, including postoperative nausea and vomiting, urinary retention, prolonged recovery, and delayed mobilization, which may hinder same-day discharge.

In contrast, two protective factors were identified: procedures scheduled in the morning session and those performed in March–April. Morning surgery likely allows more time for postoperative observation and management of complications before the end of the day, facilitating same-day discharge. The seasonal effect observed in March–April may reflect organizational factors, such as higher operating room efficiency or resource availability, although further studies would be needed to confirm this association.

Overall, these findings underscore that both clinical (surgical complexity, anesthesia, duration) and organizational (scheduling, resource allocation) variables significantly influence the success of AS.

Our observed failure rate of 23.5% is higher than most reports in the literature, which often describe rates ranging between 5% and 15% (6). However, this variability is largely due to heterogeneous definitions of "failure." While some authors only consider hospital admission or readmission, we also included overnight stays, which increases sensitivity but also raises the apparent rate.

The influence of age and sex has been variably reported. In our series, men had a higher failure rate, consistent with some authors (8), although others have reported the opposite (9). This discrepancy suggests that demographic factors may be less relevant than clinical or organizational determinants.

Our results confirm that spinal anesthesia remains the most frequently used technique in AS in our setting, but it also showed the highest failure rate. This aligns with previous reports indicating that spinal anesthesia, especially when long-acting agents are used, can prolong recovery and delay discharge (10). Conversely, local anesthesia with sedation has consistently been associated with faster recovery, lower complication rates, and greater feasibility in ambulatory settings, making it a safe and effective alternative (11).

Procedure duration has also been recognized in several studies as a risk factor for AS failure (12). Our findings are consistent with this evidence and reinforce the recommendation to restrict longer or more complex procedures to settings with adequate postoperative monitoring or even inpatient care.

Regarding surgical category, abdominal wall surgery was the most frequent, consistent with other series (12). CVAD placement, however, was the procedure most associated with failure, in line with prior publications describing this population as higher risk due to age, comorbidities, and immunosuppression (13).

Taken together, our results support the need for ongoing evaluation of AS programs, considering not only patient-related and surgical factors but also organizational aspects such as scheduling and resource allocation.

Future prospective and multicenter studies are needed to validate these results and to further explore the impact of social and organizational factors on AS failure. Such studies would help to design targeted strategies for improving patient pathways and consolidating the role of AS as a safe and efficient model of surgical care.

This study has several limitations. First, its retrospective design makes it dependent on the quality and completeness of medical records. Second, it was conducted in a single center, which may limit the generalizability of the results. Third, we did not include certain potentially relevant variables, such as functional status, comorbidities, or social factors (e.g., family support, living conditions), which can also influence the likelihood of unplanned admission. Fourth, the operational definition of AS failure used in this study may not be fully comparable with those of other publications, complicating direct comparison of failure rates. Finally, we were unable to specifically classify failures according to clinical, social, or organizational causes, which would have provided additional insight into the reasons for unplanned admissions.

The originality of our work lies in analyzing a large patient cohort from a secondary-level hospital while simultaneously considering both clinical and organizational factors. Few studies have assessed the influence of operating room scheduling (morning vs. afternoon) or calendar effects on AS outcomes, making our findings particularly relevant for resource planning and efficiency optimization.

Conclusion

In our series of 3,397 patients, nearly one in four experienced failure of ambulatory surgery. Longer procedure duration, CVAD placement, and the use of general or spinal anesthesia were the strongest predictors of failure, while morning scheduling and specific calendar periods reduced risk. These findings highlight the importance of optimizing patient selection, anesthetic strategy, and organizational planning to improve the safety and efficiency of ambulatory surgery programs.

Our findings may guide practical interventions in operating room scheduling, patient selection, and anesthesia planning to reduce unplanned admissions and improve the performance of AS programs.

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