Can we find predictive factors for unplanned overnight admission?

F. Barros, M. Monteiro*, M.E. Matos†, P. Lemos**

Abstract

Aim: To identify risk factors for unplanned admission following ambulatory surgery.

Methods: Case-control analysis, involving 6740 patients from our Day Surgery Unit, between 2001 and 2005. Variables investigated were: gender, age, ASA classification, type of anaesthetic, surgical speciality, duration of anaesthesia, pain, nausea/vomiting, haemorrhage, and anaesthetic consultation. Chi-square tests were first performed for each variable. Afterwards, logistic regression was carried out on those variables found significant.

Results: The unplanned admission rate was 0.8% . Factors associated with admission were: gynaecological surgery, nausea/vomiting, bleeding, severe pain and duration of anaesthesia >120 minutes.

Conclusion: The acknowledgement of risk factors such as these may improve the safety and efficacy of day surgery.

Keywords: Ambulatory surgery; Ambulatory surgical procedures; Patient admission; Post-operative complications; Quality indicators.

Authors' addresses: * Department of Anaesthesiology, Intensive Care and Emergency, Hospital Geral de Santo António, Porto, Portugal. †Department of Population Studies, Instituto de Ciências Biomédicas Abel Salazar, Universidade do Porto, Portugal.

Corresponding author: F. Barros *Tel:* +351 962 638 540 *E-mail:* fbmcdb@gmail.com

Introduction

Ambulatory surgery has been growing exponentially. In 1985, in the United States, 30% of elective surgery was performed on an ambulatory basis. Currently, this value is 60% and is expected to increase over 70% in the near future [1]. In Portugal, from 1999 to 2005, the percentage of elective surgery performed in the outpatient surgical setting increased 4-fold, reaching 22% in 2005 [2]. The range of acceptable ambulatory surgery procedures has also been expanding, as has the medical complexity of the patients being treated. In order to keep pace with this trend, anaesthetic and surgical techniques have been evolving to maintain or improve the desired outcomes [1, 3-5].

The unexpected hospital admission rate after outpatient surgery is a method of evaluating these outcomes, and also an important morbidity and quality indicator [1, 6]. Not only does hospital admission following ambulatory surgery likely to represent an adverse clinical situation, but it also adds to costs and disrupts both surgical and inpatient facility routines. The main objective of this study was to identify the factors that independently affected hospital admission at our day surgery unit. The incidence of hospital admission and its underlying causes were also evaluated.

Material and Methods

Hospital Geral de Santo António is a tertiary care and university hospital. Its hospital based day surgery unit (DSU) has 2 operating rooms, a 4 bed post-anaesthesia care unit, and a phase II recovery area with 12 beds and 8 reclining chairs. The annual caseload is, on average, 1600 patients. Operative procedures performed cover general surgery, vascular surgery, dermatology, gynaecology, neurosurgery, neuropathology, orthopaedic surgery and urology. The main surgical activity occurs from 8:30 A.M. to 02:00 P.M., Monday through Friday. After 02:00 P.M. minor surgery under local anaesthesia is performed without the presence of an anaesthetist. The Phase II recovery area is open until 08:00 PM. Discharge criteria comply with the post-anaesthesia discharge scoring system (PADSS) and, therefore, require a score of 9 or greater, in addition to an adult escort, to consider the patient fit for discharge home. Otherwise, patients are admitted to the hospital. This latter situation represents an unplanned overnight admission.

The DSU keeps an updated clinical database for quality control purposes, comprising all the patients submitted to surgery under anaesthesia. This database does not include patients submitted to minor surgery, in the afternoon.

From this database, we carried out a case-control study involving all the patients that underwent surgery at the DSU from the 3rd January 2001 to the 13th December 2005, 6740 patients in total.

The control group consisted of all the patients discharged home from the DSU during the period studied.

Events following hospital admission or the re-admission rate were not investigated. As there were no human subjects involved, and patients' identification in the database was kept concealed, informed consent was not sought, nor ethical review committee approval.

For each patient we considered only one cause for admission. In case there was more than one, the most serious cause, from a clinical point of view, was considered. Reasons for admission were classified as surgical, anaesthetic, medical or social.

Variables investigated were gender, age, American Society of Anesthesiologists (ASA) physical status classification, type of anaesthesia, surgical speciality, duration of anaesthesia, post-operative pain, post-operative nausea and vomiting, haemorrhage and pre-operative anaesthesia consultation.

The type of anaesthesia was classified as general, regional, combined general-regional technique or sedation along with local anaesthesia.

The duration of anaesthesia was defined as the length of time between induction and emergence in the operating room.

Because of the small number of admissions separately related to dermatology, neurosurgery, neuropathology and orthopaedics, these were gathered in a single group for statistical analysis.

Although post-operative pain was evaluated according to the visual analog scale (VAS), it was recorded in a categorical scale as mild (VAS ≤3), moderate (VAS 4-6) or severe (VAS >6). We assumed for each

patient the most severe pain experienced during the DSU stay. Nausea and vomiting situations recorded consisted of those patients with relevant nausea, isolated vomiting, or vomiting episodes.

Haemorrhage consisted of any degree of peri-operative bleeding considered significant by the surgeon, or that impelled an action like dressing change or wound re-closure.

The decision to refer patients for an anaesthesia consultation was left to the surgeon's discretion, but healthy patients (ASA I) were excused that appointment. Statistical analysis consisted of a two stage process.

First, we performed an univariate analysis, through separate chi-square tests, to investigate the relationship between each variable and hospital admission. Next, we performed a multivariate analysis using the variables that were associated with hospital admission in the previous chisquare tests ($P < 0.05$). In this latter analysis, we used logistic regression to determine which variables were independently related to hospital admission. Using this method we were able to describe the magnitude of each relationship, and control for the influence of confounding variables in the statistical model. Odds ratios, 95% confidence intervals and P values were thus calculated for each variable in the regression model. If the 95% confidence interval did not include 1, or $P < 0.05$, the corresponding variable was considered a risk factor for hospital admission.

Statistical analysis was performed using SPSS 12.0 for Windows (SPSS Inc., Chicago, IL, EUA)

Results

The incidence of hospital admission was 0.8% (n = 55). Fifty eight per cent of patients were evaluated at an anaesthesia consultation. Patients' age ranged from 6 months to 89 years, mean and standard deviation (SD) were 41 ± 17 years old. Most patients were ASA I or II (46 and 45%, respectively), but also ASA III (7%), and even ASA IV (2%). ASA IV patients consisted of end-stage chronic renal failure patients on dialysis, submitted to brachial artery to axillary vein jump graft, or placement of a Tenckhoff catheter. Female gender (56%) was predominant.

7013 surgical procedures were performed. General surgery was responsible for most patients (Table 1), but surgical treatment of varicose veins was the most frequently performed surgical procedure (Table 2). The most complex operations included thyroid lobectomy, laparoscopic cholecystectomy, and lumbar microdiscectomy (Table 3).

Table 1 Distribution of patients by surgical speciality.

Surgical speciality	Patients (n = 6740) Number (%)
General surgery	3077 (45.7)
Vascular surgery	924 (14.0)
Dermatology	6 (0.1)
Gynaecology	808 (11.8)
Neurosurgery	149 (2.4)
Neuropathology	256 (3.8)
Orthopaedics	962 (13.8)
Urology	558 (8.4)

Table 2 Most frequent surgical procedures.

Type of procedure	Number (%)
Surgical treatment of varicose veins	1024 (14.6)
Surgical treatment of pilonidal disease	698 (10.0)
Inguinal hernia repair	586 (8.4)
Median nerve decompression	497 (7.1)
Laparoscopic tubal ligation	474 (6.8)
Haemorrhoidectomy	261 (3.9)
Total number of procedures = 7013	

Table 3 Most complex surgical procedures.

Type of procedure	Number (%)
Thyroid lobectomy	153 (2.8)
Laparoscopic cholecystectomy	77 (1.1)
Lumbar microdiscectomy	66 (0.9)
Brachial artery to axillary vein jump graft	47 (0.7)
Cranioplasty	11 (0.2)
Total number of procedures = 7013	

Table 4 Causes for admission (N = 55).

Causes	Number (%)
Surgical (n = 40)	(72.7)
Bleeding control	20
Postoperative ileus control	7
Bowel perforation	3
Extensive surgery	5
Uterine perforation	1
Wound oedema	1
Sensory/motor deficit	1
Peripheral nerve block	1
Dural perforation	1
Anaesthetic (n = 5)	(9.1)
Nausea & vomiting	4
Pain	1
Medical (n = 6)	(10.9)
Hypoxaemia	3
Anxiety	2
Faintness	1
Social (n = 4)	(7.3)
Discharge refusal by the patient	2
Other	2

General anaesthesia was the most frequent anaesthetic technique (56%). Combined anaesthesia was used in 19% of patients. Sedation with local anaesthesia was the anaesthetic option in 16% of cases. Duration of anaesthesia ranged between 10 minutes and 4 hours, mean and SD were 49 ± 27 minutes.

Most common reasons for admission were related to surgery (Table 4).

Univariate analysis revealed that gender, age, ASA status and anaesthesia consultation were not associated with hospital admission. On the contrary, surgical speciality, type of anaesthesia, duration of anaesthesia, post-operative pain, post-operative nausea and vomiting, and haemorrhage were statistically significant (Table 5).

After logistic regression, the variables still associated with hospital admission were surgical speciality, duration of anaesthesia, pain, nausea and vomiting, and haemorrhage (Table 6).

The type of anaesthesia was not independently related to hospital admission. In the case of pain, only the most severe pain influenced admission. Table 6 shows, through odds ratios, the relative weight of each predictive factor on admission. Risk of admission is directly related to the duration of anaesthesia, and rises exponentially.

Discussion

The incidence of hospital admission at our DSU (0.8%) is similar to the average value mentioned in the literature (1%) [6]. However, the heterogeneity of ambulatory surgery programmes may preclude comparisons. Low rates of admission make studies about predictive factors more demanding because they require larger numbers of patients. Despite being a case-control study, data came from a pre-existing prospective and updated database. That circumstance enabled us to get complete information concerning every patient. Moreover, all discharged patients served as controls, making matching unnecessary. Nevertheless, the retrospective nature of the study and the unrelated original purpose of the existing database, created shortcomings, namely, exclusion of other risk factors, e.g., ending hour of surgery [7, 14], previous abdominal surgery [8] or pre-operative haemoglobin concentation [8].

In our study, every surgical procedure was planned to end at 02:00 P.M.

We chose to investigate the effect of the type of surgery through surgical speciality, like others have done [7, 9, 10, 11], but this option was not consensual [12, 13].

Age, gender, ASA status and anaesthesia consultation were not predictive factors of hospital admission.

In the study of Gold et al [12] age was a predictive factor (30 year intervals). Mingus et al [9] reached the same conclusion (age greater than 65 years) but only for surgery lasting less than 60 minutes. The findings of Fortier et al [7], Twersky et al [11], Linares et al [13] were in accord with our results.

In one study [11], female gender was a predictive factor of avoidable admission, i.e., for social or administrative reasons. But another [7] concluded that male gender affected admission.

The lack of influence of ASA status on hospital admission was also a conclusion of one other study[11]. One explanation ascribes this finding to a selection bias. Only stable patients are accepted for outpatient surgery. Nonetheless, Fortier et al [7] and Linares et al [13] found that ASA II and III patients were more likely to be admitted than ASA I patients. Mingus et al [9] reached the same conclusion (ASA III and IV vs. I and II) for surgery lasting less than 60 minutes. Regarding ASA IV patients, only Mingus et al [9] refered to their inclusion. Could this circumstance be attributed to controversies in ASA classification? Specifically, how to classify end-stage renal disease patients on dialysis, ASA III or IV? In any event, a critical and proper selection of patients should not result in higher admission rates for ASA III or IV patients.

Evidence that the type of anaesthesia was not a predictive factor of hospital admission was also apparent in one other study [7]. Nonetheless, other authors concluded that general anaesthesia [9, 11, 12], regional anaesthesia [9, 11], subarachnoid block with deep sedation [13], and even monitored anaesthesia care [9], affected admission. These discrepancies may indicate distinct drugs or routes of administration. Moreover, the same studies did not investigate other variables, like pain [9, 12], nausea and vomiting [9, 11], or haemorrhage [9, 13] which could confound the aforementioned associations. Besides, we could argue that studying the type of anaesthesia lacked benefit because it would always be dependent on the type of surgery.

Our study revealed that post-operative nausea and vomiting (PONV) influences hospital

admission. Others had similar conclusions [7, 12, 13]. The incidence of PONV in our study

(2.0%) reflects a routine anti-emetic prophylaxis protocol at our DSU since July 2001. The proportion of admissions attributed to PONV were 7.2% in this study, and 6% [9], 7% [11], 14% [7] and 18% [12], in other studies.

Severe post-operative pain also increased the likelihood of admission in the present study. Fortier et al [7], despite referring to pain as a predictive factor, did not mention its intensity. The major influence of the duration of anaesthesia on admission, as we found in our study, compares favorably with the effect of the duration of surgery [7, 9, 11, 13] or the time in the operating room [12], of other authors. These distinct times probably relate to the same phenomenon: extension of surgery. Nevertheless, only a multivariate comparison between them could determine whether more than one had an independent nature.

Gynaecology was shown to be a predictive factor in our study. The logistic regression model allows us to conclude that this effect is independent of other variables studied, i.e., it cannot be attributed, for example, to haemorrhage, nausea and vomiting, or pain. The reasons why gynaecology could have had this effect may include a greater rate of conversion from laparoscopy to laparotomy, surgical team characteristics, or previous abdominal surgery [8].

None of these variables were investigated. Additional studies are necessary to explain this finding.

Others have found urology to be a predictive factor [7, 11, 12], and related the fact to a greater incidence of haemorrhage or urinary retention. Only Fortier et al [7] simultaneously studied haemorrhage. Otorhinolaryngology has also been mentioned as a risk factor [7] but we did not study this variable, as we do not have this speciality in our DSU. Linares et al [13] mentioned procto-perineal-sacrococcygeal procedures (without studying haemorrhage), and Gold et al [12] also considered lower abdominal surgery and laparoscopy as predictive factors.

According to Fancourt-Smith et al [10], one possible explanation why a surgical speciality might influence hospital admission, relates to the proportion of diagnostic procedures performed by that speciality in the DSU. Findings at those diagnostic procedures could justify admission. After reviewing the causes for admission in our study, we did not find evidence supporting this hypothesis. Hedayati and Fear [14] investigated predictive factors for admission in laparoscopic gynaecological surgery. They mentioned a greater likelihood of

Table 5 Univariate analysis.

	Patients			
Factor	**Total number (n=6740)**	**Admitted (n=55)**		
		Number	**%**	**P Value**
Gender				0.09
Male	2963	18	(0.6)	
Female	3777	37	(1.0)	
Age (years)				0.06
≤ 20	754	1	(0.1)	
21-40	2563	19	(0.7)	
41-60	2490	23	(0.9)	
> 60	933	12	(1.3)	
ASA				0.21
1	3107	19	(0.6)	
2	3028	28	(0.9)	
3	501	6	(1.2)	
4	104	2	(1.9)	
Anaesthesia				0.04
General	3807	40	(1.0)	
Regional	603	1	(0.2)	
General and regional	1267	10	(0.8)	
Sedation with local	1063	4	(0.4)	
Speciality				< 0.001
General surgery	3077	15	(0.5)	
Vascular surgery	924	15	(1.6)	
Gynaecology	808	15	(1.8)	
Urology	558	5	(0.9)	
Others*	1373	5	(0.4)	
Anaesthesia duration (min)				< 0.001
< 60	4854	15	(0.3)	
60-120	1682	25	(1.5)	
121-180	179	8	(4.5)	
> 180	25	7	(28.0)	
Pain				< 0.001
Mild	6167	40	(0.6)	
Moderate	560	13	(2.3)	
Severe	13	2	(15.4)	
Nausea and vomiting				< 0.001
No	6604	47	(0.7)	
Yes	136	8	(5.9)	
Haemorrhage				< 0.001
No	6646	37	(0.6)	
Yes	94	18	(19.1)	
Anaesthesia consultation				0.05
No	2967	17	(0.6)	
Yes	3773	38	(1.0)	

*Dermatology, neurosurgery, neuropathology and orthopaedics. Corresponding total patients/patients admitted (%): 6/0 (0.0); 149/5 (3.4); 256/0 (0.0) and 962/0 (0.0), respectively.

Table 6 Logistic regression – multivariate analysis.

	Odds ratio	
Factor	**(95% confidence interval)**	**P value**
Speciality		
Others	1.0	
Gynaecology	12.0 (5.3 - 27.1)	< 0.001
Nausea and vomiting		
No	1.0	
Yes	6.3 (2.4 - 16.1)	< 0.001
Haemorrhage		
No	1.0	
Yes	42.6 (20.9 - 86.7)	< 0.001
Pain		
Mild	1.0	
Moderate	2.1 (1.0 - 4.5)	0.05
Severe	13.6 (1.6 - 115.2)	0.01
Anaesthesia duration		
< 60	1.0	
60 – 120	7.6 (3.3 - 17.8)	< 0.001
121 – 180	25.3 (8.2 - 78.0)	< 0.001
> 180	279.7 (74.4 - 1052.0)	< 0.001
Anaesthesia technique*		
Others	1.0	
General	1.0 (0.5 - 2.0)	0.99

*General anaesthesia (except combined anaesthesia) versus all others (combined, regional, sedation with local).

admission for laparoscopic tubal ligation compared to diagnostic laparoscopy. Mingus et al [9] did not find any association between surgical speciality and hospital admission. Haemorrhage was the most common cause for admission, as in other studies [7, 11], and also a major predictive factor as in the study by Fortier et al [7].

Conclusions

The most important predictive factors for hospital admission are surgical. Therefore, the type of procedure and surgeon's experience are crucial to avoid unplanned admission.

Given that the duration of anaesthesia influences hospital admission, scheduling potentially lengthy procedures as inpatients could decrease the unplanned hospital admission rate. Control over pain and PONV increases the efficacy of an ambulatory surgery programme.

References

1. White PF, Freire AR. Ambulatory outpatient anesthesia. In: Miller RD, ed. ***Miller's Anesthesia***. Philadelphia, USA: Elsevier, volume 2, 2005: 2589–2635.
2. Lemos P, Regalado A, Soares J, Alves E. A evolução recente da cirurgia ambulatória em Portugal – Resultados do IV inquérito nacional. ***Rev. Port. Cirurgia Ambulatória*** 2006; **7**: 5–15.
3. Jarrett P, Staniszewski A. The development of ambulatory surgery and future challenges. In: Lemos P, Jarrett P, Philip B, eds. ***Day Surgery – Development and Practice***. Porto, Portugal: Clássica Artes Gráficas, 2006: 21–34.
4. Gudimetla V, Smith I. Pre-operative screening and selection of adult day surgery patients. In: Lemos P, Jarrett P, Philip B, eds. ***Day Surgery - Development and Practice***. Porto, Portugal: Clássica Artes Gráficas, 2006: 125–138.
5. Raeder J. Anaesthetic techniques for ambulatory surgery. In: Lemos P, Jarrett P, Philip B, eds. ***Day Surgery - Development and Practice***. Porto, Portugal: Clássica Artes Gráficas, 2006: 185–208.
6. Lemos P, Regalado AM. Patient outcomes and clinical indicators for ambulatory surgery. In: Lemos P, Jarrett P, Philip B, eds. ***Day Surgery - Development and Practice***. Porto, Portugal: Clássica Artes Gráficas, 2006: 257–280.
7. Fortier J, Chung F, Su J. Unanticipated admission after ambulatory surgery – a prospective study. ***Can J Anaesth*** 1998; **45**: 612–619
8. Meeks GR, Waller GA, Meydrech EF, Flautt FH Jr. Unscheduled hospital admission following ambulatory gynecologic surgery. ***Obstet Gynecol*** 1992; **80**: 446–450.
9. Mingus ML, Bodian CA, Bradford CN, Eisenkraft JB. Prolonged surgery increases the likelihood of admission of scheduled ambulatory surgery patients. ***J Clin Anesth*** 1997; **9**: 446–450.
10. Fancourt-Smith PF, Hornstein J, Jenkins LC. Hospital admissions from the surgical day care centre of Vancouver General Hospital 1977–1987. ***Can J Anaesth*** 1990; **37**: 699–704.
11. Twersky RS, Abiona M, Thorne AC, et al. Admissions following ambulatory surgery: outcome in seven urban hospitals. ***Ambulatory Surg*** 1995; 141–146.
12. Gold BS, Kitz DS, Lecky JH, Neuhaus JM. Unanticipated admission to the hospital following ambulatory surgery. ***JAMA*** 1989; **262**: 3008–3010.
13. Linares Gil MJ, Esteve Gomez A, Garrido Morales P, Pelegri Isanta D, Pi i Siques F, Gomar C, Prat Marin A. [Predictive factors of hospital admission in ambulatory surgery at a regional hospital]. ***Med Clin (Barc)*** 1999; **112**: 361–364.
14. Hedayati B, Fear S. Hospital admission after day-case gynaecological laparoscopy. ***Br J Anaesth*** 1999; **83**: 776–779.