

# Causes of increased length of hospitalization on a general thoracic surgery service: a prospective observational study

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**Objective:** To characterize medical and nonmedical reasons for delayed discharge on a general thoracic surgery unit. **Design:** A prospective observational cohort study. **Setting:** A university-affiliated tertiary care institution. **Patients:** Between February 1999 and July 2000, the in-hospital progress of 130 patients who had undergone an elective thoracic surgical procedure was evaluated prospectively. Baseline characteristics (age, sex, comorbid conditions and pulmonary function test results) were documented. **Main outcome measures:** Complications that delayed the time when the patient was medically ready for discharge. The day the patient was deemed fit for discharge (medically required length of stay) was compared with the actual day of discharge (actual length of stay). **Results:** The 3 most frequent complications that prevented discharge by postoperative day 6 were persistent air leaks, pulmonary infections and atrial fibrillation. The presence of a persistent air leak increased the medically required length of stay by a mean of 13.1 days (95% confidence interval [CI] 11.0–15.2 d), pneumonia by 9.6 days (95% CI 4.96–14.2 d) and atrial fibrillation by 2.4 days (95% CI –2.6 to 7.4 d). The mean medically required length of stay was 6.9 days, and this differed from the mean day on which the patient was actually discharged (7.35 d,  $p < 0.01$ ), which contributed 44 excess days of hospitalization per 100 patients. The 2 most common causes of this discrepancy were the lack of home support (10.2% of patients) and the unavailability of convalescent facilities (7.1% of patients). Prolonged hospital stay for nonmedical reasons was associated with increased mean age (67.4 v. 60.7 yr,  $p = 0.05$ ). **Conclusions:** Length of hospitalization after elective thoracic surgery may be prolonged for medical or nonmedical reasons. Although complications like persistent air leak and pneumonia have an impact on medically required length of stay, social factors may also significantly delay discharge.

**Objectif :** Décrire les motifs médicaux et non médicaux du report des déshospitalisations dans un service de chirurgie thoracique générale. **Conception :** Étude de cohortes prospective par observation. **Contexte :** Établissement de soins tertiaires affilié à une université. **Patients :** Entre février 1999 et juillet 2000, les progrès de 130 patients hospitalisés ayant subi une chirurgie thoracique élective ont été évalués de façon prospective. Les caractéristiques de base (âge, sexe, comorbidité et résultats des tests fonctionnels respiratoires) ont été consignées. **Principales mesures de résultats :** Les complications ayant retardé le moment où le patient était prêt, du point de vue médical, à sortir de l'hôpital. La date à laquelle le patient a été considéré en état de sortir de l'hôpital (durée du séjour médicalement nécessaire) comparée à la date effective de la déshospitalisation (véritable durée du séjour). **Résultats :** Au sixième jour de la période postopératoire, les trois complications ayant empêché le plus fréquemment la sortie d'hôpital étaient les fuites d'air persistantes, les infections pulmonaires et la fibrillation auriculaire. En moyenne, la fuite d'air persistante a allongé le séjour médicalement nécessaire de 13,1 jours (intervalle de confiance [IC] à 95 %, 11,0-15,2 j), la pneumonie l'a allongé de 9,6 jours (IC à 95 %, 4,96-14,2 j), et la fibrillation auriculaire, de 2,4 jours (IC à 95 %, 2,6 à 7,4 j). La durée moyenne du séjour médicalement nécessaire s'établissait à 6,9 jours et différait de la période moyenne écoulée avant que les patients soient effectivement déshospitalisés (7,35 j,  $p < 0,01$ ), qui représentait 44 jours d'hospitalisation en trop pour 100 patients. Les deux

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causes les plus courantes de cet écart étaient l'absence de soutien à domicile (10,2 % des patients) et la non-disponibilité des établissements de convalescence (7,1 % des patients). On a établi un lien entre le prolongement de l'hospitalisation pour des motifs non médicaux et l'âge moyen plus élevé (67,4 c. 60,7 ans,  $p = 0,05$ ). **Conclusions :** Suite à une chirurgie thoracique élective, l'hospitalisation peut être prolongée pour des motifs médicaux ou non médicaux. Même si les complications, comme une fuite d'air persistante et la pneumonie, ont une incidence sur la durée du séjour médicalement nécessaire, des facteurs sociaux peuvent aussi retarder considérablement la déshospitalisation.

Thoracic surgery is a major component of surgical services in a general hospital. In an attempt to evaluate the quality of the Thoracic Surgery Service at the Royal Victoria Hospital, Montreal, a tertiary care hospital, we previously reviewed the charts of all 925 patients who underwent surgery on this service between 1986 and 1996. We also reviewed the senior residents' morbidity and mortality reports submitted with each rotation, and the general death registry for the hospital. We were thus confident that we had captured every death occurring in our institution after thoracic operations. For that period the death rate was 2.9% for all patients without exclusion: highest for pneumonectomy (5.5%) and lowest for lobectomy (0.5%). However, in contrast to mortality reporting, we discovered a lack of consistency and accuracy in recording morbidity. There was a great discrepancy between the charts and the residents' records. This deficiency limited our understanding of the factors that contribute to a delay in discharge, thereby preventing the introduction of corrective measures to increase efficiency. In order to accurately describe reasons for a prolonged length of hospital stay and to develop a consistent method for reporting complications, we prospectively documented the progress of all thoracic surgery patients over 1.5 years, highlighting medical and social reasons that contributed to their need to remain in hospital.

**Methods**

Between February 1999 and July 2000, we prospectively evaluated the in-hospital progress of 130 consecutive patients who underwent a tho-

racic surgery procedure at our hospital. To more accurately characterize the complications specific to a general thoracic surgery ward, we excluded those who had outpatient operations and those who were off-service and therefore not cared for primarily by the operating team. This left a cohort of 98 patients. All operations and follow-up visits were performed by the same surgeon (J.E.M.). Patient baseline characteristics were documented on a specific case report form. These included age, sex, comorbid conditions and pulmonary function test results. The type of operation and the pathologic diagnosis were also documented. The forms had a line specific for each postoperative day on which the surgeon documented any complication and assessed whether the patient was medically ready for discharge. The day the patient was deemed fit for discharge (medically required length

of stay) was compared with the actual day of discharge (actual length of stay). The social or medical factors that prevented patients from being discharged were carefully recorded. Statistical analysis was performed using SPSS package. Results are reported as medians and ranges unless otherwise stated. Outcomes were compared using the Mann-Whitney U-test. Probability values less than 0.05 were considered significant.

**Results**

Patient characteristics at baseline are described in Table 1 and the various conditions for which patients required hospital admission in Table 2. The most common reason for a surgical admission was resection for a primary lung neoplasm in 75 patients (76%). Other common causes included lung infection and pulmonary metastases.

The median length of hospital stay was 6 days (range from 1-29 d), with 57 (58%) patients being discharged in 6 days or less. We there-

**Table 1**

**Baseline Characteristics of 98 Patients Who Underwent Thoracic Surgery Between February 1999 and July 2000**

Characteristic	Value
Age, yr	
Mean	61.9
Range	17-86
Sex, no. (and %)	
Male	53 (54)
Female	45 (46)
Smoking status, no. (and %)	
Smokers	39 (40)
Nonsmokers	59 (60)
Preoperative pulmonary function tests	
FEV <sub>1</sub> , L	
Mean	2.2
Range	0.58-4.53
DLCO, %	
Mean	69
Range	14-104
FEV <sub>1</sub> = forced expiratory volume in the first second, DLCO = diffusing capacity of the lung for carbon monoxide.	

**Table 2**

**Indications for Admission to Hospital of 98 Patients Who Underwent Thoracic Surgery Between February 1999 and July 2000**

Indication	No.
Neoplastic	
Squamous cell carcinoma	19
Adenocarcinoma	19
Bronchoalveolar carcinoma	11
Pulmonary metastases	10
Benign tumours and others	16
Infective	
Aspergilloma	3
Empyema, histoplasmosis	5
Other indications	
Blebs	5
Other	10

fore used a stay longer than 6 days to define prolonged hospitalization. The 3 most frequent complications that prevented patients from going home on postoperative day 6 were persistent air leaks requiring chest tube drainage ( $n = 12$ , 12.3%), nosocomial pulmonary infections ( $n = 6$ , 6.1%), and atrial fibrillation ( $n = 5$ , 5.1%) (Table 3). These conditions each had a significant impact on the time required for the patient to be medically fit for discharge using univariate analysis (Table 4). A persistent air leak increased the hospital stay by 13.1 days (95% confidence interval [CI] 11.0–15.2 d). Similarly, pneumonia increased the length of stay for medical reasons by 9.6 days (95% CI 4.96–14.2 d) whereas atrial fibrillation increased length of stay for medical reasons by only 2.4 days (95% CI –2.6 to 7.4 d) (Table 4).

The mean medically required length of stay was 6.9 days and differed from the actual length of stay (7.35 days,  $p = 0.01$ ), contributing 44 excess days of hospitalization per 100 patients (Table 5). The 2 most common causes of this discrepancy were the lack of home support (10 patients) and the unavailability of convalescent facilities (7 patients). Prolonged hospital stay for nonmedical reasons was associated with increased mean age (67.4 v. 60.7 yr,  $p = 0.05$ ). There was a strong positive correlation between age and overall length of stay ( $\beta = 0.1$ ,  $p = 0.008$ , univariate linear regression). Factors

that may predict those patients who are at risk for having a social factor that would prevent discharge include age over 75 years, female gender, a cancer diagnosis and a poor diffusing capacity of the lung for carbon monoxide (Table 6).

**Discussion**

There is an abundance of data on determinants of discharge after chest surgery. However, most papers have focused primarily on cardiac surgery, likely because thoracic surgery often plays a less prominent role on a service that is frequently combined with a cardiac service.

We decided to conduct a prospective observational study over 1.5 years to characterize 2 very important elements of a general thoracic surgery service: first to determine the factors, both nonmedical and medical, that prolonged hospital stay; and second to highlight the importance of prospectively assessing and documenting postoperative complications in order to establish an honest and educational quality control system on a general thoracic surgery service.

The pressures to reduce inpatient hospitalization are nationwide and bed use on one service may influence patient flow throughout the institution. For example, a national pilot study conducted by a team of researchers in Winnipeg found that in over 85% of cases when someone waited in the emergency room more

than 1 day for a bed, there was another patient in the same hospital at the same time whom doctors said was well enough to be cared for elsewhere.<sup>1</sup> The Quebec Ministry of Health reported a 40% reduction in hospital beds between 1991 and 2000 secondary to hospital closures and mergers. Specifically, at the McGill University Health Centre there has been a 21% reduction in acute care beds even though the average length of stay has only been reduced by 2%.<sup>2</sup> Therefore, to effectively cope with this strain on bed availability, we attempted to highlight factors that unnecessarily prolong hospital stay.

A major advantage of the prospective nature of this study was that we could differentiate the time the patient was medically fit for discharge and the actual time of discharge.

**Table 3**

**Medical Reasons Delaying the Discharge by Postoperative Day 6 of Patients Who Underwent Thoracic Surgery: Prospective (February 1999 to July 2000) and Retrospective (1986–1996) Studies**

Complication	Study	
	Prospective, no. (and %) N = 98	Retrospective, (no. and %) N = 925
Persistent air leak	12 (12.3)	13 (1.4)
Pneumonia	6 (6.1)	17 (1.8)
Atrial fibrillation	5 (5.1)	11 (1.2)
Desaturation (< 90% without oxygen)	3 (3.1)	NR
Poorly controlled pain	3 (3.1)	NR
Other	8 (8.1)	NR

NR = not recorded.

**Table 4**

**Effect of Leading Complications on the Time the Patient Is Considered Medically Ready for Discharge (98 Patients Who Underwent Thoracic Surgery)**

Complication	Hospital stay required medically, d	p value
Air leak		
Yes	18.75	< 0.0001
No	5.69	
Pneumonia		
Yes	16.40	< 0.0001
No	6.82	
Atrial fibrillation		
Yes	9.60	0.07
No	7.20	

**Table 5**

**Effects of Social and Medical Factors on Prolonged Hospitalization**

Factor	Prolonged hospitalization/100 patients, d
Social*	44
Medical	
Persistent air leak	160
Pneumonia	58
Atrial fibrillation	12

\*Lack of home support and unavailability of convalescent facilities

There was a significant difference between these 2 times contributing 44 days per 100 patients to the average length of stay. Therefore, many patients were cared for in a more expensive tertiary care hospital when they could have been well cared for in a nonacute setting. Our results also demonstrate that age, female gender and a cancer diagnosis may be predictors of prolonged hospitalization secondary to social needs. Our results only approach significance owing to the small cohort of patients. In another study at our institution Kaplow and associates<sup>3</sup> adopted a managed care appropriateness program to evaluate the appropriateness of the days of stay for their patients who were on one medical service. Of 100 consecutive patients, 33% of the days were deemed inappropriate, 43% of them inappropriate because patients remained in hospital even though they were medically fit to be cared for in a less acute setting such as a convalescent home. Therefore, we emphasize the importance of establishing a quicker and more efficient transfer of care to a setting geared toward rehabilitation so as to improve patient recovery. This would also reduce the cost burden on the health care system.

Medical complications had a more significant effect on prolonged length of stay when compared with social factors. The 3 most common medical causes for increased length of stay were persistent air leaks, pneumonia and atrial fibrillation.

Persistent air leaks seem to have the largest impact on hospital stay, increasing the length of stay by 13 days. Often patients respond well to simple chest tube drainage; however, this may require many frustrating days in hospital. Many have advocated outpatient treatment using a Heimlich valve, a small calibre tube connected to a flutter valve, with which the patient is discharged with careful monitoring. The use of the Heimlich valve has been shown to reduce the duration of chest drainage and the length of hospital stay in patients with pneumothoraces<sup>4</sup> and to reduce hospital stay after various types of thoracic procedures.<sup>5</sup> Unfortunately, difficulty in organizing an adequately staffed clinic has prevented our institution from implementing such a program.

Nosocomial pneumonia, defined as radiographically defined infiltrates treated with antibiotics, was another common complication, occurring in 6.1% of patients. Tedder and colleagues<sup>6</sup> also noted a similar rate of 6.6%. Furthermore, they commented that pneumonia was responsible for 15.4% of postoperative deaths. The patients who have the highest risk for pneumonia are those admitted to intensive care units and intubated. Prompt extubation and a short stay in the intensive care unit should therefore be encouraged.

The third most common medical cause for a delay in discharge was atrial fibrillation, increasing length of stay by 2.4 days. This occurred in 5%

of patients. Cardinale and associates<sup>7</sup> reported a 12% rate of atrial fibrillation in patients who underwent pulmonary resection for lung cancer. They demonstrated no difference in length of stay between those who had atrial fibrillation and those who did not. However, they emphasized age, a history of hypertension and associated lymph-node resection as positive predictors for this arrhythmia. In a previous study, prophylactic antiarrhythmic agents did not demonstrate an efficacy superior to their potential side effects.<sup>8</sup> Amiodarone, for example, has been related to a higher incidence of adult respiratory distress syndrome after pneumonectomy.<sup>9</sup> Our study indicated that atrial fibrillation has a very small effect on hospital stay and therefore expectant management may be appropriate to avoid complications from prophylactic antiarrhythmic drugs.

The second goal of our study was to assess the quality of documentation, comparing a thoracic surgery-specific case report form with simple charting. We compared the retrospective chart review with the prospective case-report form (Table 3), which was revised daily. There was a significant difference in rates of occurrence for the 3 main complications, with significant underreporting of these complications determined by retrospective review of medical records. This highlights the limitations inherent in retrospective data collection when used to determine complications for the purpose of quality improvement. Morbidity and mortality records from residents were notoriously inaccurate. Feldman and associates,<sup>10</sup> studying a general surgery service, demonstrated that although most severe complications are recorded at morbidity and mortality rounds, a large proportion go unreported. Therefore, it is important to adopt a more accurate method of reporting like a service-specific case-report form to prospectively monitor outcome and improve self-assessment and quality of care.

**Table 6**

**Predicting Prolonged Hospitalization (PH) Secondary to Social Factors in 98 Patients Who Underwent Thoracic Surgery**

Characteristic (and no. of patients)	PH, no. (and %)	Characteristic (and no. of patients)	PH, no. (and %)	<i>p</i> value*
Age ≥ 75 yr (18)	4 (22)	Age < 75 yr (80)	8 (10)	0.17
Male (49)	4 (8)	Female (49)	8 (16)	0.13
Cancer (69)	10 (14)	No cancer (29)	2 (7)	NS
MCPD (26)	3 (12)	No MCPD (72)	9 (13)	NS
DLCO < 70% (40)	7 (18)	DLCO ≥ 70% (58)	5 (9)	0.20
FEV <sub>1</sub> < 2.75 L (18)	2 (11)	FEV <sub>1</sub> ≥ 2.75 L (80)	10 (13)	NS

\* $\chi^2$  analysis  
MCPD = medical complications preventing discharge, DLCO = diffusing capacity of the lung for carbon monoxide, FEV<sub>1</sub> = forced expiratory volume in the first second.

**Conclusions**

The length of hospital stay after elective thoracic surgery may be prolonged for both medical and nonmedical reasons. Air leaks and pneumonia are the 2 medical complications that have the most significant impact on length of stay. Social causes — lack of home care and convalescent facilities — also prolonged hospital stay, highlighting the importance of early discharge planning for those who may benefit from convalescent care.

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