Does fast-tracking increase the readmission rate after pulmonary resection? A case-matched study

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Abstract

OBJECTIVES: The most recent evolution of patient management after thoracic surgery implies the concept of fast-tracking. Since 2008, our unit has implemented a programme based on clinical protocols and standardized pathways of care aimed to reduce the postoperative stay after major lung resection. The objective of this study was to verify the safety of this policy by monitoring the patient readmission rate.

METHODS: This is a prospective observational study on 914 consecutive pulmonary lobectomies performed at our institution from January 2000 to October 2010. Since we started the fast-tracking program in January 2008, we divided the patients into two groups: early period (678 patients, 2000–2007) and recent period (236 patients, 2008–October 2010). Several baseline and operative factors were used to build a propensity score that was applied to match the recent group patients with their early group counterparts. These two matched groups were then compared in terms of early outcomes and readmission rate. Readmission was defined as a re-hospitalization for any cause related to the operation within 30 days after discharge. We excluded from the analysis those patients with in-hospital mortality.

RESULTS: Propensity score yielded 232 well-matched pairs operated on in the early (non-fast-tracked patients) and most recent period (fast-tracked patients). The fast-tracking management resulted in a postoperative stay reduction of 2.8 days (P < 0.0001), with a 3-fold higher proportion of patients discharged before the sixth postoperative day (P < 0.0001). Nevertheless, we did not observe any differences in terms of readmission rate between the two periods.

CONCLUSIONS: In our experience, the implementation of a fast-tracking program after pulmonary lobectomy was very effective and safe. It led to a postoperative reduction of hospital stay without an increase in the readmission rate.

Keywords: Readmission • Fast-track • Pulmonary resection • Postoperative stay • Pathways of care

INTRODUCTION

During the last decade, the postoperative management of patients submitted to thoracic surgery has considerably changed. A refinement of both intraoperative procedures and perioperative strategies has led to a reduction of the postoperative hospital stay [1].

The introduction of the standardized clinical pathways of care and the use of novel technologies, together with an increased awareness of financial issues and a more patient-centred healthcare management have made it possible to streamline and fast-track the postoperative course in our specialty [1, 2].

Although appealing to patients, providers and administrators, there is scant scientific literature focused on this attitude and whether, for instance, the costs saved by an early discharge are shifted to increased frequency of outpatients’ medical accesses or hospital readmissions.

From this point of view, we chose to consider the readmission rate as one of the most important parameters indicating the failure of a fast-track management after thoracic surgery [3, 4].

Thus, the main objective of the present study was to verify whether the implementation of a fast-tracking program in our unit was associated with an increase in the readmission rate of patients submitted to major lung resection.

MATERIALS AND METHODS

This is a retrospective study performed on prospectively collected data. The study was approved by the local institutional review board and patients gave consent to collect and use their data in the registry for clinical and scientific purposes. We included in the present analysis 914 consecutive patients.
submitted to pulmonary lobectomy (91.5% primary neoplastic disease, 2.7% pulmonary metastases and 5.8% non-neoplastic disease) at our Institution since January 2000–October 2010 and discharged from the hospital after the primary operation.

The same team of board certified general thoracic surgeons operated on all the patients. Since January 2008, we have implemented intraoperative and postoperative standardized protocols aimed at fast-tracking patients submitted to major lung resections (Table 1) [5–8]. The patients were divided into two groups: an early-period group 1, before the start of the fast-track program (678 patients, 2000–2007); and a recent-period group 2, after the start of the fast-track program (236 patients, 2008–October 2010). For the purpose of this study, we excluded from the present analysis the patients who died during the initial hospital stay (18 of 678 in group 1, before the start of the fast-track program (236 patients, 2008–October 2010). The same team of board certified general thoracic surgeons operated on all the patients.

In agreement with previous evidence [9], a readmission was defined as a re-hospitalization (at any hospital) for any cause related to the primary operation occurring within 30 days after the initial discharge from our hospital. We did not consider as readmitted those patients who needed a new access to the healthcare system (i.e., emergency department, outpatient clinics), which was not followed by a hospitalization. Information about readmissions was extracted from our electronic database in which these episodes were recorded prospectively.

**Statistical analysis**

Normal distribution of numerical variables was assessed by the Shapiro Wilk normality test. Numerical variables with normal distribution were compared by the unpaired Student’s t-test and those without normal distribution by the Mann–Whitney U-test. Categorical variables were compared by the chi-square test or Fisher’s exact test as appropriate.

The aim of the analysis was to match patients managed before and after the institution of the fast-track program according to baseline characteristics and to compare the readmission rate between the matched groups. The conditional probability to be managed in the recent-period (fast-tracked) (propensity score) was estimated by logistic regression analysis incorporating the following variables: age, gender, body mass index, smoking history-pack-years, American Society of Anesthesiology (ASA) score, Zubrod score, forced expiratory volume in one second–(FEV1), forced expiratory volume in one second to forced vital capacity ratio (FEV1/FVC ratio), carbon monoxide lung diffusion capacity (DLCO), residual volume to total lung capacity ratio (RV/TLC), carbon dioxide arterial tension and oxygen arterial tension, preoperative haemoglobin level, presence of coronary artery disease, neoadjuvant chemotherapy, and presence of an extended resection, defined as a resection associated with chest wall, diaphragm, great vessels or atrium.

All variables were at least 95% complete and sporadic missing values were imputed by taking the most frequent response category or averaging non-missing values for continuous variables. Greedy matching techniques were then used to select non-Chronic Obstructive Pulmonary Disease (COPD) counterparts to the COPD patients by choosing the patient with the nearest propensity score [10].

The procedure yielded 232 well-matched pairs managed in the early and recent periods. The readmission rate and other categorical variables of the two groups of propensity score matched patients were compared by the chi-square test or Fisher’s exact test as appropriate. Numeric variables were compared using the unpaired t-test (normal distribution) or the Mann–Whitney U-test (non-normal distribution).

**RESULTS**

The characteristics of the patients in the two groups (early and recent) before matching are shown in Table 2. We had a total of 52 readmissions in the entire population.

Fig. 1 shows the causes of readmission. In most of the cases, readmission was caused by respiratory problems (respiratory failure: 10 patients, pneumothorax: 8 patients, pneumonia: 5 patients), which motivated 44% of the new hospital admissions. We readmitted only one-third of the re-hospitalized patients to our hospital. Five of the 52 readmitted patients died during the re-hospitalization.

<table>
<thead>
<tr>
<th>Table 1: Clinical protocols applied for patient’s fast-tracking management</th>
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<tbody>
<tr>
<td><strong>Protocols</strong></td>
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<tr>
<td>Operative protocol</td>
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<td>Air leak control</td>
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<tr>
<td>Fissureless lobectomy</td>
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<td>Single chest tube</td>
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<td>Postoperative pathways of care and clinical protocols</td>
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<td>Standardized pathways of care</td>
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<tr>
<td>Clinical protocols for the chest tube management</td>
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<tr>
<td>Patient counselling</td>
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</tbody>
</table>
Propensity score analysis yielded 232 well-matched pairs of patients operated on in the early and recent phases, respectively (Table 3).

Compared with the early period, the most recent group (fast-tracked) showed a similar cardiopulmonary morbidity rate (16.5 versus 18%, \( P = 0.6 \)), a 2.8-day shorter postoperative hospital stay (mean length of stay \( \text{'early group'} = 8.6 \) days, \( \text{'recent group'} = 5.8 \) days, \( P < 0.0001 \)) and a 3-fold higher number of patients discharged before the sixth postoperative day (Table 4).

We were not able to find differences in the readmission rate between the two matched groups (5.2, 95 CI: 2.3–8.0 versus 5.6, 95% CI: 2.6–8.6).

**DISCUSSION**

The introduction of a total quality management [11, 12] in our specialty has progressively changed our practice over the past decade. Financial constraints and public accountability have
Table 3: Characteristics of the two matched groups

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Early group (232 patients)</th>
<th>Recent group (232 patients)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>67.7 (10.8)</td>
<td>68.2 (9.4)</td>
<td>0.7</td>
</tr>
<tr>
<td>FEV1%</td>
<td>85.7 (19)</td>
<td>84.6 (18.5)</td>
<td>0.6</td>
</tr>
<tr>
<td>DLCO%</td>
<td>77.5 (18.3)</td>
<td>76.7 (18.7)</td>
<td>0.5</td>
</tr>
<tr>
<td>ASAa</td>
<td>2 (0.6)</td>
<td>1.9 (0.6)</td>
<td>0.4</td>
</tr>
<tr>
<td>ECOG*</td>
<td>0.7 (0.7)</td>
<td>0.7 (0.8)</td>
<td>0.8</td>
</tr>
<tr>
<td>Induction chemotherapy (n, %)</td>
<td>22 (9.5%)</td>
<td>17 (7.3%)</td>
<td>0.4</td>
</tr>
<tr>
<td>CADa (n, %)</td>
<td>27 (11.6%)</td>
<td>27 (11.6%)</td>
<td>1</td>
</tr>
<tr>
<td>BMIA</td>
<td>26.5 (3.8)</td>
<td>26.3 (4.8)</td>
<td>0.2</td>
</tr>
<tr>
<td>Pack-years (n, %)</td>
<td>37.8 (30.6)</td>
<td>38.1 (28.7)</td>
<td>0.9</td>
</tr>
<tr>
<td>Extended resections b</td>
<td>16 (7%)</td>
<td>15 (6.5%)</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Results are expressed as mean (±SD), unless otherwise indicated.

ASA: American Society Anesthesiologists Score; ECOG: Eastern Cooperative Oncology Group Performance Status Score; BMI: body mass index; CAD: coronary artery disease.

Extended resection is defined as a pulmonary resection associated with chest wall, diaphragm, superior vena cava, atrium resection or pleuropneumonectomy.

Table 4: Outcome comparisons between the two groups of matched patients

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Early group (232 patients)</th>
<th>Recent group (232 patients)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readmission (n, %)</td>
<td>12 (5.2%)</td>
<td>13 (5.6%)</td>
<td>0.8</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>8.6 (4.7)</td>
<td>5.8 (3.5)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Stay &lt; 6 days (n, %)</td>
<td>44 (19%)</td>
<td>144 (62.1%)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Cardiopulmonary</td>
<td>38 (16.4%)</td>
<td>42 (18.1%)</td>
<td>0.6</td>
</tr>
<tr>
<td>complications* (n, %)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results are expressed as mean (±SD), unless otherwise indicated.

*Cardiopulmonary complications are defined in accordance with ESTS database definitions and include the following: pneumonia, atelectasis, needing bronchoscopy, pulmonary oedema, pulmonary embolism, assisted mechanical ventilation for longer than 24 h or any need for re-intubation, supraventricular arrhythmia or ventricular arrhythmia requiring treatment, myocardial ischaemia, cardiac failure, acute renal insufficiency, cerebrovascular accident.

In our specialty, there are only a few studies investigating the feasibility and cost-effectiveness of fast-tracking policy [2, 14, 17]. Some of them have tried to identify risk factors able to predict a readmission after a fast-tracking management of thoracic surgery patients [3, 9].

Indeed, the rate of readmission can be interpreted as one of the markers of failure of this policy, inevitably involving increased costs for the healthcare system and a potentially life-threatening occurrence for the patients.

This aspect has not been previously investigated in a rigorous comparative manner.

Thus, the aim of this study was to verify if the institution of a fast-tracking program in our unit was associated with a higher readmission rate after pulmonary lobectomy.

We chose to restrict the analysis to pulmonary lobectomy only, as the most representative and numerous types of operation in our specialty and the one that would be most affected by fast-tracking protocols (specifically of chest tube management).

For the purpose of this investigation a readmission rate was defined as a re-hospitalization (at any hospital) for any cause related to the primary operation occurring within 30 days after the initial discharge from our hospital, borrowing the definition reported by Varela et al. [9]. Other authors have used different definitions and included not only re-hospitalized patients but also those with a post-discharge emergency department evaluation [3]. This must be taken into consideration in the comparison of different studies.

To minimize selection biases in the context of a retrospective analysis, we used propensity score case matching to obtain two comparable groups of patients in each period (non-fast-tracked versus fast-tracked).

We were not able to find differences in the readmission rate of the two matched groups.

At the same time, we confirmed that a fast-tracking policy can significantly shorten the hospital stay, without negatively influencing the complication rate and the mortality.

Our readmission rate seems comparable to that showed by other centres operating in a similar system care setting [9].

Caution should be taken in the interpretation of readmission rates reported in different papers for discrepancies in the inclusion criteria and variable definition.

This study may have potential limitations.

(1) We deliberately chose not to analyse the outcome and costs of the readmission episodes. Besides being outside the scope of this study, many patients were readmitted to other hospitals and, owing to the nature of the study, it was difficult retrieving all the data to perform a reliable analysis in this regard. These interesting aspects warrant future prospective investigations.

(2) The results of this study refer to pulmonary lobectomy patients. The generalizability of these findings to other operations needs to be confirmed by other studies.

(3) Owing to differences in socio-economic, logistic and geographical characteristics, patient care protocols and readmission management policies make comparability with other hospitals or healthcare systems difficult. The reproducibility of our findings in other settings deserve therefore independent confirmation by other studies.

In conclusion, we can affirm that, in our setting, the evolution of the traditional postoperative management towards a modern fast-tracked one appeared to be safe for patients submitted to pulmonary lobectomy. This gave us the opportunity to optimize...
the clinical and structural resources maintaining a constant rate of morbidity and mortality.

Conflict of interest: none declared.

REFERENCES


APPENDIX. CONFERENCE DISCUSSION

Dr M. Dahan (Toulouse, France): Michele, you just showed us that by using a fast-track program in preparing patients, and with the use of new medical protocols, it was possible to shorten the hospital stay following lobectomy by approximately three days without endangering the patients. Your main assessment criterion was the readmission rate, a criterion that you have perfectly defined. I have one comment and three questions.

The comment relates to the impact of such a dedicated pathway on the health system and its costs. In France, as in some other European countries, such impact is not really measurable because of an ‘all-inclusive’ system of payment. Besides, you didn’t mention or study any dimension which allowed assessment of the potential individual benefit perceived by the patient. For the hospital, the only probable effect is a measurable increase of activity that such an accelerated course might generate.

My first question is whether you have measured an increase in activity since 2008. My second question relates to readmission. How did you retrieve readmission 8 or 10 years ago, which is a big job? And the third question. As a result of this study, could you identify predictors of readmission? If so, can you give us the key?

Dr Salati: Your first question concerned the reason why we chose to apply this program in our unit, if it had an impact on an increase in activity. Well, this was not the main goal of the implementation of a fast-tracking program in our unit. We made this choice to obtain organizational and clinical benefits, obviously. Regarding the organizational reasons, we received a fixed payment for each operation we perform, but we have some other forms of reimbursement that are related to other parameters, such as the length of stay, of course. Moreover, we also have flexible use of resources and personnel, so at the end of the week we have a reduction of the personnel in order to reduce the costs, and the reduction of the length of stay is in line with this choice of the hospital. And obviously we also had some clinical benefits, because secondary effects of the implementation of a fast-tracking program are the reduction of pain, faster functional recovery of the patient, as well as a reduction of the psychological impact of the hospitalization.

But the main reason for implementing a fast-tracking policy was not the achievement of an increase in the surgical activities, because we have the same number of spaces in the OR. So this is another problem.

Concerning the collection of data on readmission episodes, we gathered these prospectively within our database. We didn’t go back to look at each chart to see whether a patient was readmitted or not, because we entered these data each month during the institutional follow-up, the functional follow-up, that we undertake one or three months after the operation. And so we collected some characteristics of the readmissions.

Concerning the predictors of readmissions, no, we did not perform this analysis in the study, because this wasn’t the main objective, the main goal of the study. But some other authors have done this, and in those papers, the predictors of readmission were the patients who had undergone pneumonectomy, and major comorbidity that could predict readmission after discharge.

Dr S. Mattioli (Bologna, Italy): Dr Salati, in your abstract you state that ‘a fast-tracking program after pulmonary lobectomy resulted very effective and safe.’ My question is, do you think that the indicator you chose, readmission rate, is apt to define a medical procedure as effective? As far as I know, the health of the patient, for example, pulmonary function preservation, is one of the aims of lobectomy.

Dr Salati: It could be debated. I don’t know if it is the best way to define our indicator to affirm that it is safe. But we need just a litmus paper to verify if our new policy had a detrimental effect on the quality of the health care delivered, and we thought that this could be the best one.

Dr A. Martin-Ucar (Nottingham, UK): I noted that, while we are all complaining that our patients are getting more high risk and older, your ASA grades in the newer population are much lower than in the old one. Have you got any explanation? Are you more defensive now?

Dr Salati: I think this is just chance. We didn’t modify the way we selected the patients before the operation. I think it is just the effect of the nature of the study, that is, a retrospective analysis.

Dr K. Athanassiadi (Athens, Greece): I assume that some of your patients went home having a drainage device such as a Heimlich valve or other portable device. Did you calculate the cost for the state insurance, because in other European countries, the cost of the hospital and state insurance are calculated together. Could you please?

Dr Salati: Yes, you are right, some of our patients went home with a chest tube, a very low proportion, but it happened. About the cost, we didn’t perform a specific analysis on this outcome, but we think that the characteristics of the readmission episodes and outcomes related to these episodes should be further investigated, hopefully in a prospective fashion. For instance, costs of failure to rescue, for example, the mortality after discharge, didn’t appear in our surgical paper. But at present, I have no data about this.

Dr C. Tezel (Istanbul, Turkey): Generally, we have been able to discharge patients on postop day 2 or 3 with or without Heimlich valves. Thus by the application of Heimlich valves, hospital stay was incredibly shortened. I believe that the title of the program, ‘fast tracking’ addresses the problem. We did not discharge the patient with all medical or post-resectional problems resolved, and we also did not underestimate the problems that we might face. However, ‘fast-track’ implies that because we are doing something ‘fast’, there might be associated problems. Therefore instead of ‘fast-track’ I would rather call it ‘timely discharge’ which would preclude possible misunderstandings.

Dr G. Leschber (Berlin, Germany): I would like to make a last comment, in the setup of your study, you said readmission within 30 days to any hospital.

Dr Salati: Yes.

Dr Leschber: So looking at just your data, are all the readmitted patients definitely included? How would you know whether there was someone admitted to another hospital within your retrospective analysis?

Response by Michele Salati, MD, Ancona, Italy.

Dr Salati: The greater proportion of patients were admitted to hospitals other than our own. Only 30% of readmitted patients came to our own hospital.