Postoperative outcome after coronary artery bypass grafting in chronic obstructive pulmonary disease

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BACKGROUND: It is uncertain if the presence and severity of airflow obstruction in chronic obstructive pulmonary disease (COPD) is predictive of surgical morbidity and mortality after coronary artery bypass grafting (CABG).

METHODS: Retrospective study of patients who underwent CABG between 1998 and 2003 in a university-affiliated hospital for whom a preoperative spirometry was available. COPD was diagnosed in smokers or ex-smokers 50 years of age or older in the presence of irreversible airflow obstruction. Patients were divided into three groups depending on the spirometry: controls (forced expiratory volume in 1 s [FEV_1] 80% or more, FEV_1/forced vital capacity [FVC] greater than 0.7), mild to moderate COPD (FEV_1 50% or more and FEV_1/FVC 0.7 or less) and severe COPD (FEV_1 less than 50% and FEV_1/FVC 0.7 or less).

RESULTS: Among the 411 files studied, 322 (249 men, 68±8 years of age) were retained (controls, n=101; mild to moderate COPD, n=153; severe COPD, n=68). The mortality rate (3.0%, 2.6% and 0%, respectively) was comparable among the three groups. Patients with severe COPD had a slightly longer hospital stay than controls (mean difference 0.7±1.4 days, P<0.05). Pulmonary infections were more frequent in severe COPD (26.5%) compared with mild to moderate COPD (12.4%) and controls (12.9%), P<0.05. Atrial fibrillation tended to be more frequent in severe COPD than in the other two groups.

CONCLUSION: Mortality rate associated with CABG surgery is not influenced by the presence and severity of airflow obstruction in patients with COPD. The incidence of pulmonary infections and length of hospital stay were increased in patients with severe COPD.

Key Words: *COPD; Coronary artery bypass; Heart surgery; Postoperative complications*

Pontage coronarien et bronchopneumopathie chronique obstructive : résultats postopératoires

CONTEXTE : On ne sait pas vraiment si la présence de gêne respiratoire et son degré de gravité peuvent être des prédicteurs de morbidité et de mortalité opératoires dans les cas de bronchopneumopathie chronique obstructive (BPCO) après un pontage coronarien.

MÉTHODE : Il s'agit d'une étude rétrospective de patients ayant subi un pontage coronarien entre 1998 et 2003 dans un centre hospitalier universitaire, pour lesquels nous disposions de résultats spirométriques préopératoires. Un diagnostic de BPCO a été posé chez des fumeurs et d'anciens fumeurs âgés de 50 ans et plus, qui présentaient une obstruction irréversible des voies respiratoires. Les patients ont été divisés en trois groupes suivant les résultats de la spirométrie : les témoins (volume expiratoire maximal par seconde [VEMS] : 80 % et plus; rapport VEMS/capacité vitale forcée [CVF] : supérieur à 0,7); BPCO légère ou modérée (VEMS : 50 % et plus; rapport VEMS/CVF : égal ou inférieur à 0,7); BPCO grave (VEMS : moins de 50 %; rapport VEMS/CVF : égal ou inférieur à 0,7).

RÉSULTATS : Sur 411 dossiers examinés, 322 ont été retenus (249 hommes; âge : 68±8 ans) (témoins : 101; BPCO légère ou modérée : 153; BPCO grave : 68). Le taux de mortalité s'est révélé comparable (3,0 %, 2,6 % et 0 %) dans les trois groupes. Le séjour à l'hôpital a été un peu plus long chez les patients atteints d'une BPCO grave que chez les témoins (écart moyen : 0,7±1,4 jour; P<0,05). Plus de patients atteints d'une BPCO grave (26,5 %) ont souffert d'une infection pulmonaire que de patients atteints d'une BPCO légère ou modérée (12,4 %) ou de témoins (12,9 %) (P<0,05). Une tendance plus marquée à la fibrillation auriculaire a été observée dans le groupe de BPCO grave que dans les deux autres groupes.

CONCLUSIONS : La présence de gêne respiratoire et son degré de gravité chez les patients atteints d'une BPCO n'ont pas influé sur le taux de mortalité associé au pontage coronarien. Par contre, la fréquence des infections pulmonaires a été plus élevée dans les cas de BPCO grave et le séjour à l'hôpital, plus long.

Chronic obstructive pulmonary disease (COPD) is often considered as a risk factor for postoperative morbidity and mortality after coronary artery bypass grafting (CABG). This is based on previous studies showing an association between a diagnosis of COPD or a low forced expiratory volume in 1 s (FEV_1) and post-CABG mortality and morbidity (1-6). However, in the past decade, surgical and anesthesia techniques have improved substantially, leading to reduced postoperative complications so that more recent studies have failed to clearly establish a link between COPD and increased morbidity and mortality after CABG (7-10). However the current literature is difficult to interpret in regard to the risk associated with CABG in COPD; in many studies, no spirometry is available while in others, the diagnosis of COPD does not meet the current recommendations.

The objective of the present study was therefore to revisit whether the presence and severity of airflow obstruction associated with COPD are predictive of postoperative mortality and morbidity after CABG.

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PATIENTS AND METHODS

Study population

The present retrospective study was conducted at Hôpital Laval, a Cardiopulmonary Institute affiliated with Laval University (Sainte-Foy, Quebec). The cardiac surgery database of the institution was searched to screen for patients who had undergone isolated CABG between January 1998 and December 2003, excluding those combined with valve surgery. From this database, 411 patients with a clinical diagnosis of COPD or who had performed a preoperative spirometry were identified. The medical chart of each of these patients was reviewed by one of the investigators. From these 411 patients, 89 patients were excluded (see exclusion criteria below). The remaining 322 patients were studied and divided into three groups: control, mild to moderate COPD and severe COPD. Because of the retrospective nature of the study, which involved collection and analysis of clinical data, no consent was obtained from the patients. The permission to use the clinical data in an anonymous fashion in a scientific report was obtained from the institutional ethics committee.

Patients with an FEV_1 80% or greater and FEV_1/forced vital capacity (FVC) greater than 0.7 constituted the control group, irrespective of their smoking history. COPD was defined by the presence of the following criteria: age of 50 years and older; current or past smoking exposure; and spirometric evidence of irreversible airflow obstruction. According to the 2004 American Thoracic Society/European Respiratory Society position paper on the diagnosis and treatment of COPD, patients with COPD were categorized into two groups based of the degree of airflow obstruction: mild to moderate COPD with an FEV_1 50% or more and FEV_1/FVC 0.7 or less, and severe COPD with an FEV_1 less than 50% and FEV_1/FVC 0.7 or less (11).

Patients were excluded if they were younger than 50 years of age, had a history of asthma, a restrictive pattern on spirometry (FEV_1 less than 80% and FEV_1/FVC greater than 0.7), if no spirometry was available or if it was performed more than three months before surgery or was not technically valid (12).

Data collection

The preoperative patients' characteristics, details related to the surgery and postoperative complications were recorded for each patient. Preoperative data included age, sex, body mass index, smoking history (current/past or never) and comorbid conditions: recent myocardial infarction (less than one month), left ventricular failure (left ejection fraction less than 40%), diabetes, hypertension, renal failure, peripheral vascular disease, atrial fibrillation and prior CABG or coronary angioplasty. Pulmonary and cardiac medications were also noted. Based on personal characteristics and comorbid conditions, two predictors of perioperative mortality were computed: the Parsonnet score (13) (with a calculated score composed of 35 variables corresponding to a mortality risk that ranges from 0% to more than 20%) and the American Society of Anesthesiologists class (14) (from class I to V). Surgical priority was defined as follows: emergent – coronary disease dictating surgery within hours, urgent – cardiac instability requiring in-hospital care until surgery, and elective – patients in stable condition discharged from the hospital after cardiac catheterization, to be readmitted at a later date for surgery (7). The number of grafts per patient, type of graft (internal mammary artery, venous, radial artery), use of cardiopulmonary bypass and its duration were also recorded.

Spirometry

Spirometries were performed according to previously described guidelines (12). FEV_1, FVC and FEV_1/FVC were expressed according to the reference values published by the European Respiratory Society in 1993 (15). All spirometry tracings were reviewed by a medical team composed of two pulmonologists and two pulmonary fellows.

Cardiopulmonary bypass procedure

After the insertion of a pulmonary artery catheter, general anesthesia was administered with sufentanil, 2 µg/kg to 15 µg/kg; midazolam, 1 mg to 3 mg; and pancuronium, 0.1 mg/kg. A propofol infusion was also started at the beginning of cardiopulmonary bypass and stopped before extubation. During cardiopulmonary bypass, all patients were heparinized with 9000 U/m^2 of body surface plus 5000 U in the cardiopulmonary bypass circuit. They received protamine sulfate at the end of the cardiopulmonary bypass. Cardiopulmonary bypass was initiated with a single double-stage venous cannula and an aortic cannulation. Mild hypothermia was reached passively, and all surgeries were performed using a membrane oxygenator (Terumo, USA). Most patients were extubated within 12 h postoperatively. Off-pump CABG procedures were conducted with different stabilizers, a device used to minimize the movements of the beating heart while performing the bypass.

Outcomes

The primary outcome was postoperative mortality at 30 days. Secondary outcomes included the length of hospital stay, length of stay in intensive care unit, prolonged mechanical ventilation (greater than 48 h), reintubations, pulmonary infections, pneumothorax, pleural effusions, atrial fibrillation, other arrhythmias, mediastinitis and sternal wound dehiscence. Pulmonary infections included pneumonia and bronchitis. Pneumonia was defined by radiological evidence of new infiltration, consolidation or cavity, and antibiotic use in the presence of one of three following criteria: purulent sputum, positive blood culture or positive bronchial secretion culture. Bronchitis was defined by presence of purulent sputum production and antibiotic use. Pleural effusion was included in the analysis only if requiring drainage during the hospitalization. Arrhythmias other than atrial fibrillation included supraventricular arrhythmias, atrioventricular block requiring pacemaker, ventricular tachycardia, ventricular fibrillation and asystole.

Statistical analysis

All data were compared among the three groups. Mean and standard deviation were determined for the continuous variables and categorical variables were expressed using the count or percentage of observed events. According to the data, Student's *t* test or Wilcoxon rank sum test for difference in location was used to analyze continuous variables. Pairwise comparisons based on Tukey's multiple-comparison procedure were performed for the three study groups. Between-group comparisons for postoperative outcomes were adjusted by taking into account preoperative pulmonary consultation as a covariate. Categorical variables were analyzed with the Fisher's exact tests. The results were considered significant if $P \leq 0.05$.

RESULTS

Preoperative patient characteristics

The 322 patients were categorized into one of three groups: control (n=101), mild to moderate COPD (n=153) and severe COPD (n=68). Spirometric data for each group are shown in

TABLE 1
Preoperative patients' characteristics and spirometric data

	Control (n=101)	Mild-moderate COPD (n=153)	Severe COPD (n=68)	P
FEV_1 (L)	2.54±0.56[a]	1.85±0.59[b]	0.98±0.24[c]	<0.001
FEV_1 (predicted)	101.7±15.5[a]	72.4±18.2[b]	38.7±7.7[c]	<0.001
FVC (L)	3.29±0.71[a]	3.06±0.87[b]	2.07±0.57[c]	<0.001
FVC (predicted)	103.3±15.2[a]	94.0±19.7[b]	64.2±14.5[c]	<0.001
FEV_1/FVC	0.78±0.05[a]	0.61±0.08[b]	0.49±0.10[c]	<0.001
Age (years)	67.5±8.2	67.9±7.5	68.5±6.1	0.69
Sex (Male/Female)	77/24	117/36	55/13	0.76
Body mass index (kg/m^2)	28.2±5.0[a]	27.1±4.8[ab]	25.9±4.6[b]	0.049
Positive smoking history	77 (74)[a]	146 (97)[b*]	67 (100)[b]	<0.001
Recent myocardial infarction	28 (27.7)	44 (28.8)	20 (29.4)	0.97
Left ventricular failure	16 (19.3)	25 (17.7)	11 (17.5)	0.96
Diabetes	28 (27.7)	35 (22.9)	20 (29.4)	0.48
Hypertension	25 (24.8)	45 (29.4)	24 (35.8)	0.30
Renal failure	4 (4.0)[a]	12 (7.8)[ab]	10 (14.7)[b]	0.047
Peripheral vascular disease	37 (36.6)	37 (24.2)	16 (23.5)	0.07
Atrial fibrillation	6 (5.9)	10 (6.5)	5 (7.4)	0.92
Prior CABG or coronary angioplasty	13 (12.9)	22 (14.4)	11 (16.2)	0.84
ASA class	3.2±0.4	3.3±0.5	3.3±0.5	0.10
Parsonnet score	12.3±7.5	11.8±7.8	11.8±6.9	0.89

**3% patients with unknown smoking history. Values are number of observations (%) or mean ± SD. Means with different letters are statistically significant, P<0.05. ASA American Society of Anesthesiologists; CABG Coronary artery bypass grafting; COPD Chronic obstructive pulmonary disease; FEV_1 Forced expiration volume in 1 s; FVC Forced vital capacity*

TABLE 2
Preoperative pulmonary and cardiac medication

	Control (n=101)	Mild-moderate COPD (n=153)	Severe COPD (n=68)	P
Pulmonary				
Short-acting β2-agonist	31 (30.7)[a]	83 (54.3)[b]	57 (83.8)[c]	<0.001
Long-acting β2-agonist	7 (6.9)[a]	15 (9.8)[a]	18 (26.5)[b]	<0.001
Ipratropium	9 (8.9)[a]	40 (26.1)[b]	38 (55.9)[c]	<0.001
Tiotropium	0 (0.0)[a]	3 (5.1)[ab]	3 (11.5)[b]	0.045
Inhaled corticosteroid	29 (28.7)[a]	70 (45.8)[b]	52 (76.5)[c]	<0.001
Oral corticosteroid	1 (1.0)[a]	6 (3.9)[a]	11 (16.2)[b]	<0.001
Theophylline	0 (0.0)[a]	8 (5.2)[ab]	8 (11.8)[b]	<0.001
Cardiac				
beta-blockers	42 (41.6)	64 (41.8)	24 (35.3)	0.65
Calcium channel blockers	70 (69.3)	103 (67.3)	48 (70.6)	0.90
ACE inhibitors/AT II receptor blockers	49 (48.5)	80 (52.3)	34 (50.0)	0.83
Digoxin	7 (6.9)	11 (8.7)	4 (7.7)	0.96
Amiodarone	8 (7.9)	4 (3.2)	3 (6.0)	0.24
Diuretics	36 (35.6)	51 (33.3)	18 (26.5)	0.45
Nitrates	64 (63.4)	107 (69.9)	40 (58.8)	0.23
Acetylsalicylic acid	68 (67.3)	94 (61.4)	38 (55.9)	0.32
Hypolipemic agents	67 (66.3)	93 (60.8)	37 (54.4)	0.29

Values are number of observations (%) or mean ± SD. Means with different letters are statistically significant, P<0.05. ACE Angiotensin-converting enzyme; AT II Angiotensin II; COPD Chronic obstructive pulmonary disease

Table 1. The three groups were comparable for most of the demographic data (Table 1). Patients in the control group had higher body mass index values compared with patients in the severe COPD group. The three groups were comparable according to the number of comorbid conditions except for renal failure, which was more prevalent in the severe COPD group. The Parsonnet score and the American Society of Anesthesiologists class were similar in all groups.

Table 2 shows cardiac and pulmonary medication used by the patients of the three groups. No statistically significant differences were found for all the cardiac medications among the three groups, even for the use of beta-blockers which were used by 41.6%, 41.8% and 35.3% in control, mild to moderate COPD and severe COPD groups, respectively; P=0.65. Fifteen per cent, 30% and 41% of patients were seen preoperatively by a respirologist in the control, mild to moderate COPD and severe COPD groups, respectively.

Surgical procedures

Nine experienced surgeons contributed to the present study, each of them performing over 250 heart surgeries per year. Cardiopulmonary bypass was used in a similar proportion of patients in the three groups (greater than 90%) (Table 3). There was no difference in the duration of cardiopulmonary bypass and number of grafts among the three groups. Internal mammary artery grafting was used less frequently in COPD patients. The proportions of emergent/urgent and elective surgeries were comparable among the three groups.

Postoperative events

Among the 322 patients included in study, there were seven deaths: three in the control group and four in mild to moderate COPD group (Table 4). The causes of death included cardiogenic shock (n=2), perioperative myocardial infarction (n=1), severe arrhythmia (n=1), multiorgan dysfunction syndrome (n=1), pulmonary embolism (n=1) and cerebrovascular accident (n=1). Hospital stay was slightly longer in both COPD groups, although this difference reached statistical significance only for the comparison between controls and severe COPD (Table 4). Length of stay in the intensive care unit and the proportion of patients requiring prolonged mechanical ventilation or reintubation were similar in the three groups.

Pneumonia was more frequent in patients with COPD than in the control group, whereas the incidence of bronchitis was only increased in the severe COPD group (Table 4). Other pulmonary complications, including pneumothorax and pleural effusions, were found in a similar proportion of patients in the three groups. Atrial fibrillation tended to occur more frequently in severe COPD patients, although the difference was not statistically significant (35.6%, 30.1% and 45.6% in control, mild to moderate COPD and severe COPD groups, respectively, P=0.08). Other arrhythmias, mediastinitis and sternal wound dehiscence had comparable incidence in the three groups. Adjusting the between-group comparisons for the different postoperative outcomes taking into

TABLE 3
Surgical characteristics

	Control (n=101)	Mild-moderate COPD (n=153)	Severe COPD (n=68)	P
CBP	95 (94.1)	142 (93.4)	62 (91.2)	0.77
CBP duration (min)	80.2±27.9	78.1±25.0	74.3±25.6	0.37
Number of grafts	3.6±1.0	3.4±0.9	3.5±1.1	0.50
Mammary artery graft	87 (86.1)[a]	109 (71.2)[b]	47 (69.1)[b]	0.02
Surgical priority (emergent-urgent/elective)	21/80	24/129	10/58	0.50

Values are number of observations (%) or mean ± SD. Means with different letters are statistically significant, P<0.05. CBP Cardiopulmonary bypass; COPD Chronic obstructive pulmonary disease

TABLE 4
Postoperative mortality and morbidity

	Control (n=101)	Mild-moderate COPD (n=153)	Severe COPD (n=68)	P
Mortality	3 (3.0)	4 (2.6)	0 (0.0)	0.48
Days of hospitalization (days)	10.6±8.7[a]	11.3±10.2[ab]	11.3±6.0[b]	0.02
LICU (days)	2.4±1.7	2.7±3.4	2.5±1.7	0.68
Prolonged mechanical ventilation	6 (5.9)	4 (2.6)	2 (3.0)	0.37
Reintubation	3 (3.0)	5 (3.3)	3 (4.6)	0.85
Bronchitis	13 (13)[a]	13 (8.5)[a]	16 (23.5)[b]	0.01
Pneumonia	0 (0)[a]	8 (5.2)[b]	2 (2.9)[b]	0.04
Pneumothorax	4 (4.0)	13 (8.5)	3 (4.4)	0.33
Pleural effusion	1 (1.0)	9 (5.9)	3 (4.4)	0.15
Atrial fibrillation	36 (35.6)	46 (30.1)	31 (45.6)	0.08
Other arryhthmia	13 (12.9)	13 (8.5)	11 (16.4)	0.20
Mediastinitis	2 (2.0)	1 (0.7)	1 (1.5)	0.55
Sternal wound dehiscence	2 (2.0)	1 (0.7)	1 (1.5)	0.55

Values are number of observations (%) or mean ± SD. Means with different letters are statistically significant, P<0.05. COPD Chronic obstructive pulmonary disease; LICU Length of stay in intensive care unit

account pulmonary consultation as a covariate did not modify the results.

DISCUSSION

In the present study, we found that patients with severe COPD can undergo CABG without increased mortality risk when compared with patients with normal pulmonary function or with mild to moderate COPD. The postoperative outcome in patients with severe airflow obstruction was similar to those with either normal lung function or mild to moderate COPD with the exception of an increased risk of pulmonary infections, a tendency to postoperative atrial fibrillation and a slightly increased length of hospital stay.

These findings are at variance to those previously reported in some studies (1-6). In their study, Grover et al (1) found that an FEV_1 less than 1.25 L was associated with an increased post-CABG mortality (11.7% versus 3.8% in patients with an FEV_1 greater than 1.25 L). Although these patients had low FEV_1, the type of spirometric abnormalities (obstructive versus restrictive) was not specified. The same authors also reported that a clinical diagnosis of COPD (irrespectively of the FEV_1 value) was associated with an increased postoperative mortality (6.4% versus 4.3%). Kurki et al (5) found an association between a diagnosis of COPD or any pulmonary disorder with an FEV_1 50% or less and postoperative morbidity after CABG. Postoperative morbidity end points included various complications such as neurological events, arrhythmia, pulmonary infections, wound infections, renal failure, cardiogenic shock and even death. Other studies have also associated COPD with an adverse post-CABG outcome (2,3,6). However, in these studies, no spirometric data were reported and the postoperative mortality rate for COPD patients was very high, reaching up to 33.3% in some studies. Conversely, more recent studies (7-10) failed to identify mild to moderate COPD as a risk factor of postoperative mortality and morbidity.

In this regard, our study may help in clarifying these discrepant findings. First, all patients had a preoperative spirometry and they were classified based on the degree of airflow obstruction. In addition, patients with reduced FEV_1 due to restrictive disorder were excluded. Finally, surgeries were performed in a more recent period than previous studies, with improved anesthesia and surgical techniques and postoperative pulmonary care. This could explain the favourable postoperative outcome of our patients, even in the presence of severe airflow obstruction. Our results are consistent with postoperative mortality rates reported in recent studies (16-18).

Many physiological and biochemical changes could contribute to pulmonary dysfunction after cardiac surgery (19-21). Cardiopulmonary bypass use, internal mammary artery grafting and general anesthesia are some factors that can alter lung mechanics and gas exchange, and induce lung injury by stimulating production of various proinflammatory mediators (21). Some studies identified COPD as a risk factor for prolonged mechanical ventilation (22) or postoperative pneumonia (23). In the present study, an increased risk of postoperative pulmonary infections in patients with severe COPD was found. The number of patients necessitating prolonged mechanical ventilation or showing other pulmonary complications was comparable among the three groups. It is important to note that patients in both COPD groups had fewer artery mammary grafts compared to those belonging to the control group, a potential bias in favour of reducing pulmonary complications in COPD (21). The deleterious effects induced by cardiopulmonary bypass on pulmonary mechanics could be reduced by the use of less invasive heart surgery such as beating heart surgery and minimally invasive direct CABG (24,25). Whether increasing use of these novel techniques will further improve postoperative outcome in COPD is unknown.

Patients in the severe COPD group had an important alteration in their pulmonary function, with a mean FEV_1 less than 1 L. One potential explanation for the low occurrence of postoperative morbidities in these individuals is that they may have been selected in a more restrictive way during their preoperative evaluation compared with patients with less pulmonary impairment. The number of comorbid conditions, the Parsonnet score and the American Society of Anesthesiologists class were similar in the three groups suggesting that the health status was similar in patients with severe COPD compared with the other groups. It would have been interesting to study the postoperative outcome of very severe COPD. Twenty-five patients with an FEV_1 less than 35%

were included in the present study. Postoperative mortality and morbidity was similar compared to patients with an FEV_1 between 35% and 50% predicted. It should be noted that no patients had an FEV_1 less than 20% or were on long-term oxygen therapy. Thus, we cannot comment on the operative risk in these individuals.

Another interesting finding of our study is the high prevalence of postoperative atrial fibrillation in the three groups, up to 45.6% in severe COPD. This may be due to high prevalence of other well-established risk factors including advanced age (more than 50% of studied population were older than 70 years of age), cardiopulmonary bypass use and beta-blocker withdrawal. Whether factors such as electrolyte imbalance, right atrial manipulation and atrial myocardial ischemia (26) could have played a role was not evaluated in the present study. There was a trend toward more frequent postoperative atrial fibrillation in patients with severe compared with mild to moderate COPD. Although it did not reach statistical significance, this trend is consistent with studies that identified COPD as a significant risk factor for this specific arrhythmia (26,27).

In the present investigation, the overall rate of postoperative sternal dehiscences (1.2%) and mediastinitis (1.2%) was similar to the reported incidence of these complications (28,29). Although COPD has been proposed as a risk factor for these complications (28,29), the rate of sternal dehiscences and mediastinitis were not increased in patients with COPD in our study. One possible explanation is that less frequent use of mammary artery grafting in COPD may have promoted sternal healing by reducing the occurrence of sternal ischemia. However, caution is warranted in the interpretation of these findings given the small number of sternal dehiscences (n=4) and mediastinitis (n=4) in our patients.

Because a valid spirometric tracing was a requirement to be included in the study, and because spirometry is not routinely performed preoperatively, patients involved in the present investigation represent only a subset of all patients undergoing a CABG in our institution. Accordingly, there could be a bias toward the selection of more symptomatic patients in whom a greater rate of postoperative complications could also be expected. However, the impact of this potential bias is likely to be small because the postoperative mortality and morbidity in this cohort of patients is similar to what is reported in the cardiac surgery literature (16-18). On the other hand, in some patients, the diagnosis of COPD was probably made at the time of the surgery as suggested by the considerable portion of patients with unequivocal spirometric evidence of COPD who did not receive any pharmacological treatment for this condition. This observation is consistent with a previous epidemiological study (30) and with the notion that COPD is under-recognized and undertreated. These potential selection biases should not detract from the usefulness of the present investigation. In fact, this study represents a real life situation where clinicians are confronted with the results of a spirometry in the preoperative evaluation of a patient undergoing a CABG. Pneumonia and bronchitis were defined according to standard clinical criteria. We acknowledge the limitation of these definitions, particularly in a postoperative context where the differential diagnosis of new lung infiltrates is vast. Only clinical episodes for which clinicians thought that a specific treatment with antibiotics was necessary were taken into account into the analysis. This was done in an attempt to minimize the number of false-positive episodes of respiratory tract infections in this retrospective analysis.

In conclusion, the current study shows that the presence and worsening of airflow obstruction are not associated with greater risk of mortality following CABG surgery in COPD compared with patients with normal spirometric function. Severe COPD patients when compared with mild to moderate COPD patients and patients with normal spirometry had a similar postoperative outcome with the exception of more frequent pulmonary infections, a trend toward more frequent atrial fibrillation and a slightly longer hospital stay. Coronary revascularization surgery appears to be a safe procedure in COPD.

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