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Risk factors of postoperative nosocomial pneumonia after resection of bronchogenic carcinoma

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Summary
Background: Postoperative pneumonia following resection of bronchogenic carcinoma is a severe complication with a high rate of morbidity and mortality. The objective of this study is to determine the clinical and epidemiologic characteristics and the risk factors of postoperative pneumonia in patients undergoing resection of bronchogenic carcinoma in a third-level university hospital.
Methods: We performed a study of cases (with postoperative pneumonia) and controls (without pneumonia) nested in a prospective cohort of 604 patients who had undergone surgery for bronchogenic carcinoma in clinical stages I–IIIa between January 1999 and June 2004, where each case was grouped with 3 controls (3:1) of the same age (±5 years) and cancer staging by means of TNM classification.
Results: The incidence of postoperative pneumonia was 22 cases (3.6%). Overall in-hospital mortality of patients who underwent resection of bronchogenic carcinoma was 32 patients (5.3%). In-hospital mortality due to postoperative pneumonia was 7 cases (31.8%). In the

Abbreviation: AJCC, American Joint Committee on Cancer; APACHE, Acute Physiology and Chronic Health Evaluation; ARDS, acute respiratory distress syndrome; ATS, American Thoracic Society; AUC, area under the curve; BMI, body mass index; BUN, blood urea nitrogen; CEA, carcinoembryonic antigen; CFU, colony forming units; CI, confidence interval; COPD, chronic obstructive pulmonary disease; CPIS, clinical pulmonary infectious score; DLCO, diffusion lung capacity for carbon monoxide; ECOG, Eastern Cooperative Oncology Group; FEV_1, forced expiratory volume in the first second; ICU, intensive care unit; IDSA, Infectious Disease Society of America; OR, odds ratio; PCA, patient-controlled analgesia; PPM, potentially pathogenic microorganisms; PPP, predicted postoperative product; ROC, receiver-operating-characteristics; TI + MV, tracheal intubation and mechanical ventilation; TNM, tumor-lymphatic nodes-metastasis; VAP, ventilator-associated pneumonia; VAS, visual-analog scale.

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postoperative pneumonia group, microorganisms were isolated in 10 cases (45.5%). The following factors appear in the multivariate analysis as statistically significant independent risk factors for postoperative pneumonia: body mass index <26.5 kg/m^2 (adjusted odds-ratio (OR) per unit 0.64, 95% confidence interval (CI) 0.45—0.90, $p = 0.011$), predicted postoperative FEV_1 <50% pred. (adj. OR per unit 0.92, 95% CI 0.85—0.99, $p = 0.037$), and reintubation after surgery (adj. OR 18.1, 95% CI 1.3—256.6, $p = 0.032$).

Conclusions: Identifying the risk factors (some of which can by modified by medical intervention) may improve the course of lung cancer treated with surgery.

Introduction

Surgical resection is the best therapeutic option for patients with bronchogenic carcinoma, and is the treatment of choice in the initial stages, as it provides the best probability of a cure.[1] Nevertheless, this treatment is subject to complications. The general incidence of postoperative complications after thoracic surgery is approximately 30%.[2]

Postoperative respiratory complications are the most frequent and the most common cause of mortality after lung resection.[1,3,4] The incidence of postoperative pneumonia ranges between 2% and 20%.[1,5,6] Despite advances in surgical techniques, anesthesia, and the perioperative period, nosocomial pneumonia is one of the principal causes of postoperative mortality,[7–9] especially severe after thoracic surgery,[5,8,9] ranging between 22% and 67%.[6,10,11]

Several risk factors for postoperative pneumonia have been published, including advanced age, male sex,[12] smoking,[2] poor nutrition, chronic obstructive pulmonary disease (COPD), preoperative deterioration of lung function, prolonged duration of surgery and surgical stress, extent of the resection (pneumonectomy), surgery on the right side,[2] and postoperative mechanical ventilation.[1,2,4,6–9,11–16]

Potentially pathogenic microorganisms (PPM) are usually responsible for respiratory infections, regardless they belong to the oropharyngeal or gastrointestinal flora. The PPM usually associated with nosocomial pneumonia are *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Enterobacteriaceae*, and other non-fermenting gram-negative bacilli (such as *Stenotrophomonas maltophilia*).[9] Postoperative pneumonia prolongs the length of stay in hospital and increases the use of resources.[4,8]

For these reasons, there is growing interest in identifying the factors associated with risk, prevention, diagnosis and treatment of respiratory infections after resection of lung cancers. The objective of this study was to determine the clinical and epidemiologic characteristics and the risk factors of postoperative pneumonia after resection of bronchogenic carcinoma in a third-level university hospital.

Materials and methods

Patients

The study was approved by the Ethics Committee of our institution (*Comitè Ètic d'Investigació Clínica*, registration number 2010/6159).

This study was conducted in the Thoracic Surgery Department of Hospital Clínic, Barcelona, Spain, a tertiary university hospital. Patients who had undergone resection of bronchogenic carcinoma in clinical stages I—IIIa were prospectively followed for 5 years, between January 1999 and June 2004. We identified all consecutive cases with postoperative pneumonia and matched them with 3 patients without pneumonia in a nested case-control study. The matching criteria were age (±5 years) and cancer staging by means of pathological TNM classification.

Exclusion criteria were a diagnosis of respiratory infection in the previous 30 days, antibiotic treatment for any reason in the 4 weeks prior to the current admission, hospital admission in the previous 3 months due to respiratory problems, severe immunosuppression, treatment with corticosteroids (>20 mg of prednisone/d) and/or emergency thoracic surgery.

Intravenous cefazolin (2 g) was administered preoperatively for wound infection prophylaxis in 76 patients (90.5%) while amoxicillin-clavulanic (1 g) was administered in 8 patients (9.5%). Another dose was administered the next day and also during the procedure if surgery lasted more than 4 h. If the patient had been allergic to penicillin, vancomycin or clindamycin had been dispensed.

Posterolateral thoracotomy was performed in all patients. Management of postoperative pain included epidural anesthesia with ropivacaine combined with fentanyl using a patient-controlled analgesia (PCA) pump during 2 or 3 days and bolus of methadone prior to withdrawal of the catheter. The chest drain policy was to remove it when there was no air leak and the debit was less than 200 cc in 24 h.

Pneumonectomy patients who were in the anesthetic recovery room or intensive care unit (ICU) were extubated when they were stable, conscious and tolerated a spontaneous breathing trial.

We proceeded, as previously described by our group, to reintubation if any of the following clinical events arose: respiratory or cardiac arrest; respiratory pauses with loss of consciousness or gasping for air; psychomotor agitation inadequately controlled by sedation; massive aspiration; persistent inability to remove respiratory secretions; heart rate below 50 beats per min with loss of alertness; and severe hemodynamic instability without response to fluids and vasoactive drugs. Additional criteria were respiratory failure with deterioration of blood gases (arterial pH, $PaCO_2$, PaO_2.) or tachypnea despite use of non-invasive ventilation for 4 h.[17]