Contribution of bronchoalveolar lavage to the diagnosis of posttraumatic pulmonary fat embolism

Abstract Objectives: To verify whether the determination of the percentage of cells recovered by bronchoalveolar lavage and containing fat inclusions is a useful diagnostic tool of posttraumatic pulmonary fat embolism.

Design: Prospective study.
Setting: Surgical Intensive Care Units in two university hospitals.
Patients: 56 successive trauma patients needing prolonged postinjury mechanical ventilation, including 4 with clinical definite fat embolism syndrome, 5 in whom the diagnosis had been clinically suspected but was impossible to confirm or exclude before bronchoscopy, and 47 with no clinical evidence of the syndrome. Control groups included 8 patients without previous trauma who developed ARDS and 6 healthy surgical patients.

Methods: Bronchoalveolar lavage was performed within the first posttraumatic 3 days in trauma patients, at the beginning of the pulmonary disease in non-trauma ARDS patients and just after anesthetic induction in healthy orthopedic patients. The magnitude of lipid content in alveolar cells was compared with the clinical pattern of the pulmonary fat embolism syndrome retrospectively evaluated at the seventh day postinjury in trauma patients.

Results: All the patients with definite fat embolism syndrome had more than 70% of lavage cells containing fat droplets. The group of patients in whom the diagnosis of the fat embolism syndrome was suspected had percentages of fat cells above 30% in 4 out of 5 patients. A percentage of fat cells above 30% was only observed in 7 out of the 47 patients without clinical evidence of the syndrome.

Conclusion: Lipid inclusions in alveolar cells are common during traumatic and non-traumatic respiratory failure. Determination of the percentage of cells recovered by bronchoalveolar lavage and containing fat droplets may contribute to the diagnosis of the fat embolism syndrome in mechanically-ventilated trauma patients with respiratory failure provided that the significant threshold would be 30%.

Key words: Bronchoalveolar lavage · Fat embolism · Trauma · Lung injury · Hypoxemia · Intensive care unit
Introduction

The fat embolism syndrome (FES) is an infrequent post-traumatic complication occurring especially in severely injured patients with pelvic or long-bone fractures [1]. The clinical diagnosis is often difficult to ascertain because the classic triad which characterizes this syndrome 24-72 hours after trauma, i.e. acute respiratory failure, neurologic dysfunction and petechial rash, is rarely completely found [2]. Furthermore, pulmonary or neurologic disorders may be appropriately attributed to direct pulmonary or cerebral injuries.

A test which would provide an early and accurate diagnosis of this syndrome may therefore be an interesting tool. Indeed, because trauma patients frequently developed early pulmonary or neurologic abnormalities, discrimination among patients with or without the FES may avoid additional investigations in patients with this pathology. Additionally, this test would facilitate the evaluation of preventive or curative therapy for this syndrome. Biological tests such as serum lipase activity or detection of fat globules in urine demonstrated poor sensitivity and specificity [2, 3]. More recently, the percentage of cells recovered by bronchoalveolar lavage (BAL) and containing fat droplets has been proposed as a rapid and specific method to establish the diagnosis of the FES [3]. However, the small number of trauma patients included in the study and the low value considered as a significant threshold (5%) may take the results of this study questionable.

We therefore undertook this prospective study to compare the BAL results performed during the first 3 days after trauma with the clinical pattern of the pulmonary FES retrospectively evaluated at the seventh day postinjury in mechanically ventilated trauma patients. Non trauma ARDS patients and healthy surgical patients were used as control subjects for acute lung injury and tracheal intubation, respectively.

Materials and methods

This prospective study was conducted in 2 Surgical Intensive Care Units during a 10-month period. The experimental protocol was approved by our institution's review committee on human investigation (CCPPRB of Bicêtre Hospital, N° 92-77). Each patient or his nearest relative gave informed consent before the procedure.

Study population

Trauma patients

Over the 10-month study period, 56 successive trauma patients with pelvic or long-bone fractures requiring postinjury mechanical ventilation for respiratory failure, neurologic disorders or prolonged sedation were studied. Non-inclusion criteria were a lipid infusion before the lavage, a delay between trauma and bronchoscopy of more than 72 h and/or evidence of pulmonary aspiration based on history and endoscopic findings. At the posttraumatic day 7, patients were allocated among three groups (definite, possible or no clinical evidence) according to the probability of having a FES by the attending physicians who were unaware of the BAL results.

Definite pulmonary FES. Patients were included in this group when respiratory failure with bilateral radiological pulmonary infiltrates and at least one of the other two following major features described by Gurd [4] were observed: delayed appearance of a petechial rash, neurologic disorders unrelated to head injury or any other condition. In patients who had associated thoracic or head injuries, the diagnosis was retained only if they developed the typical petechial rash.

Possible pulmonary FES. Patients were included in this group when they developed posttraumatic respiratory failure with radiological pulmonary infiltrates and mental disturbances which could be explained by direct lung or brain injuries. None developed the typical petechial rash.

No clinical evidence of pulmonary FES. Patients were included in this group when they did not develop pulmonary infiltrates on chest X-ray.

The Fat Embolism Index Score, previously described by Schonfeld [5], was modified and calculated for each trauma patient. Briefly, clinical signs and symptoms are weighted according to their relative specificity for the FES: petechiae, 5; diffuse alveolar infiltrates, 4; hypoxemia, 3; fever ≥ 38 °C, 1; heart rate ≥ 120 bpm, 1. Scores were accumulated over the first three days of hospitalization and were considered to be diagnostic of the FES if they were five or more.

Non trauma ARDS patients

Eight patients without previous trauma who developed an ARDS for various reasons were studied and served as control subjects with permeability pulmonary edema. None had a history of chronic lung disease and was known to be smoker. All met clinical and radiological criteria for the diagnosis of ARDS [6] and were hypoxemic (Table 1). The cause of the disease was acute pancreatitis in two patients, bacterial pneumonia in one, acute pyelonephritis in two and systemic sepsis in three. BALs were performed at the beginning of the disease. No patient received intravenous infusion of lipid during the 3 days before the lavage.

Healthy surgical patients

Six patients scheduled for elective orthopedic surgery were studied and served as control subjects with tracheal intubation. None was smoker and had an history or an evidence for present or previous respiratory disease. BAL was performed during the first 30 min following the induction of general anesthesia and tracheal intubation.