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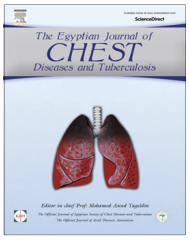

ORIGINAL ARTICLE

Role of fiberoptic bronchoscopy in management of smoke inhalation lung injury

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KEYWORDS

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Abstract *Background:* Smoke-inhalation injury (SII) is an unfavorable prognostic sign and a major cause of mortality in burn patients. Subsequently, it is important to diagnose early, determine accurately the injuries severity and to intervene early in these patients.

Objective: The objective of the present study is to evaluate the role of fiberoptic bronchoscopy (FOB) in management of SII as early diagnostic and prognostic tool.

Patients and methods: 57 patients suspected clinically to have SII were evaluated by submitting them to FOB. The following data were collected: total number of ventilator days, duration of intensive care unit (ICU) stay, pneumonia development, and patient outcome.

Results: 39 patients of 57 studied patients (68.4%) were proved bronchoscopically to have SII. Significant correlations were noted between bronchoscopic scoring and development of pneumonia ($R^2 = 0.344$; $P < 0.001$), total number of ventilator days ($R^2 = 0.479$; $P < 0.0001$) and ICU-stay ($R^2 = 0.211$; P = 0.01). Receiver operating characteristic curve analysis showed that an admission grade $\geqslant 3$ of bronchoscopic grading of SII predicted pneumonia development with a sensitivity of 77%, specificity of 92%, positive predictive value (PPV) of 85%, and negative predictive value (NPV) of 88%.

Conclusion: FOB may have a great value in evaluation, predicting prognosis and management of smoke inhalation lung injury. FOB obtained within few hours of admission was predictive of the total number of ventilator days and ICU-stay days and the development of pneumonia in patients with SII.

Introduction

Inhalation injury is defined as an injury to the epithelial lining of tracheobronchial tree and lower airways [1]. Smoke Inhalation injury is a major cause of morbidity and mortality in burn patients as it can trigger respiratory failure,

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pneumonia, septicemia and ARDS [2]. It is, along with age and total burn surface area (TBSA), one of the three most significant predictors of death after thermal injury. The incidence of SII in burn patients who require hospitalization ranges from 20% to 30% [3–6]. This incidence increases with the size of TBSA up to that patients with >80% TBSA have a 75–93% incidence of SII [7].

The reported mortality in this population is around 30%. The incidence of respiratory failure is significant after inhalational injuries, with subsequent hypoxemia, pneumonia, respiratory failure, prolonged ventilatory support and extended hospitalization [3–6].

Enclosed-space fires, loss of consciousness, facial burns and large TBSA (>40%) should raise the suspicion of SII [8]. Ideally, all victims suspected of having SII should undergo fiberoptic bronchoscopy in order to evaluate the possibility of SII [9]. It is important that SII be diagnosed early, thus predicting the risk of pneumonia development, the duration of mechanical ventilation that may be required and facilitating an appropriate treatment strategy [10].

FOB is the gold standard for the diagnosis and evaluation of the severity of airway inhalation injury. In addition, fiberoptic bronchoscopy is often used for airway hygiene, removing particulate matter, mucus plugging obstructing bronchi, and the large quantity of inflammatory secretion that forms because of cellular necrosis [11]. Furthermore, fiberoptic bronchoscopy can predict the evolution of patients from a respiratory standpoint and can early detect the development of pneumonia [7]. Bronchoscopic grading through the abbreviated injury score (AIS), can classify thermal injury to the airway into 5 grades: 0 (no injury), 1: (mild injury), 2: (moderate injury), 3: (severe injury), or 4: (massive injury), with progressive decrease in PaO_2/FiO_2 as the grading is increased [12]. Higher AIS at admission in patients with extensive burns, correlated with a longer duration of mechanical ventilation, a trend toward a greater frequency of tracheostomy, and a longer ICU stay [13]. Classically, imaging tests such as chest X-rays and CT scans have little or no value in the diagnosis of SII [9,11].

Aim of the present study

The aim of the present study is to evaluate the role of FOB as a diagnostic, prognostic and therapeutic tool in the management of suspected smoke inhalation lung injury.

Patients and methods

The present prospective study was performed in Al-Babtin Centre for Burns and Plastic Surgery, Ministry of Health, state of Kuwait in the period from September 2012 to January 2014.

Patient selection

57 patients were enrolled in this study. These patients experienced smoke inhalation ranging from 10 to 120 min and suspected clinically to have SII.

Inclusion criteria were as follows:

- Patients aged more than 6 years of age.
- Any burned patient arriving incubated on MV or requiring MV within 48 h of admission AND clinically suspected to have SII (SII was suspected on the basis of smoke exposure within a confined space or soot at the nares, pharynx, larynx, facial burns).
- History of loss of consciousness.
- Large TBSA ⩾40%.

Approval of our institutional Ethics Committees for the study protocol and written informed consent were obtained from each patient's family before inclusion in the study.

Measurements

The clinical data recorded included age, sex, TBSA, associated injuries, chest radiograph, inhalation injury grade by bronchoscopy, initial arterial blood gas analysis, initial plasma carboxyhemoglobin (CO-Hb) level drawn to document the severity and duration of smoke inhalation, total number of ventilator days, duration of intensive care unit (ICU) stay, pneumonia development, and patient outcome. The study defined pneumonia as consolidation on the chest radiograph film, body temperature of >38 °C or <36 °C, white blood cell count of ⩾12,000 cells/mm^3 or ⩽4000 cells/mm^3, and positive culture of sputum or endotracheal aspirates except for normal respiratory/oral flora. Extubation criteria were adequate when consciousness and capacity to maintain adequate arterial oxygen partial pressure/inspired oxygen fraction ratio (PaO_2/F_iO_2 = P/F ratio) > 200 provided by using simple oxygen devices (F_iO_2 <0.4 and with low levels of positive end-expiratory pressure (PEEP) of <5 cm H_2O).

Bronchoscopy

Bronchoscopy was performed according to a standardized protocol within 24 h of admission in all clinically suspected SII patients (57 patients). An Olympus BF260 videobronchoscope (Olympus Medical Systems Corporation; Tokyo, Japan) was used to perform all airway evaluations. Follow-up airway inspection was conducted according to the patients' condition.

39 patients (68.4%) were proved bronchoscopically to have SII. The mean age of the patients with SII was 41 ± 32 (range, 9–73 years), 30 patients (76.9%) were males and 9 patients were females (23.1%).

The degree of bronchial mucosal status was evaluated by using a standardized bronchoscopic scoring system based on the abbreviated injury score (AIS) criteria, as previously published [14]. This scoring was graded into five categories (0: no injury; 1: mild; 2: moderate; 3: severe; and 4: massive injury) (Table 1).

Statistical analysis

SPSS software was used for statistical analysis. Data were tabulated and presented as men ± SD, Pearson correlation analysis was used and $P < 0.05$ was considered as statistically significant.

Results

39 patients were proved bronchoscopically to have SII. The mean age of the patients with SII (39 patients) was 41 ± 32