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Short Communication

Evaluation of iatrogenic pneumothorax cases in the intensive care unit: A retrospective investigation

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This study aimed to determine iatrogenic pneumothorax cases diagnosed in hospitalized patients and evaluate the etiological reasons along with the factors which affect prognosis. A retrospective investigation was made of the hospital records of cases that developed iatrogenic pneumothorax during hospitalization in intensive care unit of our hospital between April 2007 and December 2010. Age, sex, etiological factors, symptoms, treatment procedure and treatment period were evaluated. 37 out of 1374 patients developed pneumothorax while hospitalized. All patients were treated with tube thoracostomy. Patients who underwent ventilator therapy had significantly longer periods of tube thoracostomy than those who had spontaneous breathing. It is always possible to encounter iatrogenic pneumothorax in Training Hospitals which undertake advanced research and education. The most important factor in prognosis is to remember the risk of pneumothorax. Following procedures which carry a risk of pneumothorax development, patients should be evaluated with direct radiography to eliminate a vital complication such as pneumothorax. Patients undergoing ventilatory treatment may need longer time of treatment with tube thoracostomy.

Key words: Iatrogenic pneumothorax, pneumothorax, iatrogenic disease.

INTRODUCTION

Whatever the reason is, collection of air between the pleural layers which leads to pulmonary collapse is defined as pneumothorax (Light, 1994). Iatrogenic pneumothorax, however, develops due to a mechanical trauma during a diagnostic or therapeutic intervention and is a life-threatening complication (De Hoyos and Fry, 2010). Weisberg reported that 6.1% of all pneumothorax cases are iatrogenic (Weissberg and Refaely, 2000). The aim of this study was to evaluate all pneumothorax cases in the intensive care respectively, regarding their age, sex, etiological factors, symptoms, treatment type and treatment duration. Also duration of treatment is compared between patients with spontaneous ventilation and patients under positive pressure ventilation.

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MATERIALS AND METHODS

Iatrogenic pneumothoraces in the intensive care unit of the Anesthesiology and Reanimation Department between April 2007 and December 2010 were retrospectively evaluated from the department's records. Age, sex, the intervention which caused pneumothorax (central veneous catheterisation, tracheostomy, ventilatory treatment, resuscitation), symptoms (sudden dyspnea, tacypnea, subcutaneous emphysema), type and duration of treatment were evaluated. Patients referred to the emergency unit with cardiopulmonary arrest, and who had developed pneumothorax due to resuscitation and then admitted to intensive care unit were excluded from the study. Patients were also divided into two subgroups. Group 1: patients with spontaneous breathing. Group 2: patients under ventilatory treatment with positive pressure ventilation. Duration of tube thoracostomy is compared between these two groups.

Statistical analysis

For numeric variables, mean ± standard deviation (Mean ± SD), median-minimum (min) and maximum (max) values were used for descriptive statistics. Categorical variables were expressed as numbers and percentages. For the comparison of two groups, Mann-Whitney U test was used. A value of $p<0.05$ was accepted as statistically significant. All statistical analysis was made with SPSS 15.0 program.

RESULTS

Sum of 1374 patients were admitted to intensive care unit and 37 (2.69%) patients were found to have pneumothorax due to interventions within the mentioned period. Sex distribution was 28 (75.7%) males and 9 (24.3%) females with an average age of 47.51 ± 9.85 years (range 21 to 61 years). All patients were treated with tube thoracostomy. The etiological factors which led to pneumothorax in these cases were as follows: in 13 (35.1%) cases; ventilator treatment with positive pressure ventilation, in 10 (27.1%) cases; resuscitation, in 9 (24.3 %) cases; central veneous catheter insertion, in 5 (13.5 %) cases; percutaneous tracheostomy. Ventilatory mode was pressure- syncronized intermittant mandatory ventilation (P-SIMV) or pressure support ventilation (PSV) for cases which pneumothorax developed during ventilator treatment. Eleven of these patients were hospitalized for the treatment of pneumonia acquired on the basis of chronic obstructive pulmonary diseases. Two patients were hospitalized for treatment of pneumonia acquired on the basis of Duchenne muscular dystrophia. Total number of santral venous catheters inserted in mentioned period was 861. The incidence of pneumothorax due to santral venous catheters was 1.05%. All of the santral venous catheters which caused pneumothorax were inserted by two or more years experienced residents. The route of the catheters inserted which caused pneumothorax was subclavian for all cases. In mentioned period, total number of tracheostomies performed was 68. The incidence of pneumothoraces due to tracheostomies was 7.35%. All of the tracheostomies were performed by specialists under heavy sedation using percutaneous rotation-dilation technique. Only 9 of 37 patients who developed pneumothorax were conscious and 5 (55.5%) of them had complaints of dyspnea and chest pain. The other 4 patients had no symptoms. 14 of 37 patients had subcutaneous emphysema (37.8%).

When the therapy period of the patients was evaluated, it was found that tube thoracostomy continued for 8.94 ± 3.65 days (median 8 days) on average. The shortest period of tube thoracostomy was 4 days for a patient who developed pneumothorax during subclavian catheter insertion while the longest was 21 days for a patient who developed pneumothorax during tracheostomy. The patients were categorised into two subgroups according to the presence of spontaneous breathing or positive pressure ventilation. There were 9 patients spontaneously breathing without any ventilatory support and 28 patients were supported with a positive pressure ventilation mode. The duration of tube thoracostomy in spontaneous breathing and positive pressure ventilation group were 6.77 ± 1.93 and 9.64 ± 3.82 days, respectively. Duration of tube thoracostomy treatment was statistically significant between two groups ($p = 0.038$) (Table 1).

DISCUSSION

When iatrogenic pneumothoraces were retrospectively evaluated in this study, those which developed due to ventilatory treatment were found to be prominently supernumerary. And duration tube thoracostomy is longer for cases undergoing ventilatory treatment compared to cases with spontaneous ventilation. The complication risk increases as the number of follow-up patients under ventilator therapy in intensive care units increases and invasive interventions become more frequent. Thus, iatrogenic pneumothorax is observed more often as an expected complication which leads to longer stays in intensive care units and increased mortality risk. In general, chest pain and dyspnea are the most prominent symptoms in pneumothorax (Light, 1993). Pain which begins suddenly on the side that the pneumothorax develops and which increases with breathing is typical in pneumothorax. It is usually diagnosed with direct radiography (Weissberg and Refaely, 2000; Light, 1993). Only more than half of our cases (55.5%) who were conscious had complaint of chest pain and dyspnea. CVC is the leading reason for iatrogenic pneumothorax (McGee and Gould, 2003; Sassonn et al., 1992; Spiliotis et al., 1992). Pneumothorax has been reported as the most frequent complication during CVC intervention with an incidence of 1.5 to 2.3% (Merrer et al., 2001; Mansfield et al., 1994; Sitzmann et al., 1985). Lockwood et al. (1984) reported this as 12.4%. The incidence in our series was 1.05%. The route of catheter inserted was subclavian for all cases. Pneumothorax due to CVC may not be symptomatic in early periods. A case has been reported where tension pneumothorax developed during general anesthesia 10 days after central catheterization (Plewa et al., 1995; Spiliotis et al., 1992). Pneumothorax after CVC progresses gradually, so monitoring of these cases is essential.

Moolgard et al. (2004) claimed that direct radiography after CVC is not sufficient to detect pneumothorax; however, in our series all the cases of pneumothorax after CVC were diagnosed by direct radiography and 44.5% of these CVC cases were asymptomatic while only 5 (55.5%) patients had dyspnea and chest pain which indicates the importance of radiological evaluation. Ventilation with positive pressure in CVC patients may result in mortality by causing tension pneumothorax.

Table 1. Comparision of duration of tube thoracostomy between patients with spontaneous breathing and under positive pressure ventilation (PPV).

Duration of tube thoracostomy (days)	n	(mean ± SD)	Median	Min-max
Spontaneous breathing	9	6.77 ± 1.93	6	4-10
PPV	28	9.64 ± 3.82	9	5-21
Total	37	8.94 ± 3.65	8	4-21

Despars et al. (1994) reported that 2 out of 98 iatrogenic pneumothorax patients died due to that reason. Thus, it is important to evaluate patients who had CVC during intensive care unit stay regarding the risk of pneumothorax. Another factor for possible complications in the intensive care units is the pneumothorax which developed due to positive pressure ventilation. There is increasing incidence as ventilator therapy becomes more widespread. Having air in extra pulmonary areas was first defined as barotrauma but later investigations revealed that it is not the pressure but the volume which causes alveolar damage, thus it is now called pulmonary volutrauma (Pingleton, 1988; International Consensus Conferences in Intensive Care Medicine: Ventilator-associated lung injury in ARDS, 1999). In iatrogenic pneumothorax, there may be no initial symptoms, but in cases where positive pressure ventilation is applied, partial pneumothorax leads to total pneumothorax or even tension pneumothorax which may result in sudden death (Sassoon et al., 1992). In our series, because of the fact that both patients resuscitated and patients who had tracheostomy had positive pressure ventilation, they were allocated to the positive pressure ventilation group. Thirteen (35.1%) cases developed pneumothorax during ventilator therapy. In our patients who were followed up with positive pressure ventilation, symptoms were observed to be more severe, collapse size was larger and tube thoracostomy periods were longer. We think that the severe pulmonary collaps and mediastinal shift is because large air leaks due to positive pressure ventilation from alveoli or air way damage. We believe that the reason for longer tube thoracoatomy periods in such patients is the lack of normal negative pressure within the hemithorax which occurs during spontaneous ventilation; and the lack of complete contact of the pulmonary parenchyma and the thoracic wall which stops the air leak.

In conclusion, major causes of iatrogenic pneumothoraces are santral veneous catheterization, resustation, tracheostomy and positive pressure ventilation. Positive pressure ventilation increases severity of initial symptoms of pneumothorax and duration of tube thoracostomy treatment.

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