

THE RELATIONSHIP BETWEEN PEAK EXPIRATORY FLOW RATE BEFORE BRONCHOSCOPY AND ARTERIAL OXYGEN DESATURATION DURING BRONCHOSCOPY

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Abstract- A significant reduction in arterial blood oxygen saturation during fiberoptic bronchoscopy has been proved but it is not yet known whether all patients need supplemental oxygen during this procedure. The aim of study is to examine the relationship between peak expiratory flow rate (PEFR) before bronchoscopy and oxygen desaturation during bronchoscopy. Measurement of PEFR (% predicted) performed before bronchoscopy and arterial O₂ desaturation was assessed with a pulse oximeter during bronchoscopy. Study performed in 66 patients with a median age 53 years, who had been referred to our bronchoscopy unit. None of the patients received supplemental oxygen before the procedure. Thirty nine cases (59%) had an episode of O₂ desaturation during bronchoscopy. Of them 25 cases (38%) had sustained O₂ desaturation, requiring oxygen therapy while 14 cases (21%) had momentary desaturation (< 20s) not requiring O₂ therapy. Oxygen therapy was administered in 58% of cases with PEFR % < 60 and in 83% of cases with PEFR % less than 45 (*P*, 0.008 and 0.001, respectively). We also observed a significant fall in mean O₂ saturation during bronchoscopy (88 ± 4 %) compared to prebronchoscopy levels (95 ± 2 %) (*P* < 0.0001). It is concluded that PEFR < 60% and especially < 45% is a reliable predictor of hypoxemia and the need to O₂ therapy during bronchoscopy.

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Acta Medica Iranica, 46(2): 95-98; 2008

Key words: Fiberoptic bronchoscopy , O₂ desaturation , peak expiratory flow rate

INTRODUCTION

Since the invention of fiberoptic bronchoscopy, hypoxemia is one of its well-known complications (1). Its causes are varied from upper airway obstruction, bronchoalveolar lavage, pneumothorax, sedation-induced hypoventilation and inadequate oxygen supplementation to bleeding and laryngospasm (2, 3).

Pulse oximetry increases the safety of the procedure and all patients should be monitored by a standard pulse oximeter (4). Oxygen supplementation is recommended in all hypoxemic patients with a goal of oxygen saturation (O₂ sat) more than 90% to reduce the risk of significant hypoxemia during the procedure and also in the postoperative recovery period (4).

Some authors studied the predicting value of prebronchoscopy forced expiratory flow (FEV1) for occurrence of hypoxemia during the procedure (5). We planned a study to evaluate if any relation between peak expiratory flow rate (PEFR) and incidence of hypoxemia during bronchoscopy.

Received: 20 Aug. 2006, Revised: 3 Oct. 2006, Accepted: 22 Oct. 2006

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MATERIALS AND METHODS

Sixty-six consecutive subjects who were referred for fiberoptic bronchoscopy to our bronchoscopy unit were enrolled in the study. We examined patients by flexible fiberoptic bronchoscope (Olympus- BF100) in the supine position using topical anesthesia as 2% lidocaine (lignocaine) gel and spray for local anesthesia of nasal and vocal cords. Bronchoalveolar lavage (BAL) and bronchial or transbronchial lung biopsies were performed.

Each subject's PEFR had been measured just before undergoing bronchoscopy. The patient blew forcefully and suddenly to a handheld peak flowmeter (Micro Peak, Micro Medical.UK) for three times in sitting position and the best measurement was assumed as his or her prebronchoscopy PEFR. Then the subject's PEFR percent predicted (PEFR %) in relation to general population had been estimated from a standard chart named as ERS 93 Polgar. We classified patients according to their PEFR % to three groups: those with PEFR \geq 80%, those with PEFR between 60-79%, and those with PEFR \leq 59%.

Arterial oxygen saturation (O₂ sat) of all patients were monitored before, during and two hour after bronchoscopy by a pulse oximeter (NPB-195). Hypoxemia was defined as O₂ sat < 90%. None of the patients received supplemental O₂ therapy before bronchoscopy. Those who had sustained hypoxemia (O₂ sat < 90%, for more than 20 seconds) were treated by supplemental oxygen 2-6 l/min via nasal prongs with goal of O₂ sat \geq 90%.

Patients under 14 years of age, those with prebronchoscopy hypoxemia, those on long term supplemental oxygen therapy and those uncooperative with peak expiratory flow measurement were not enrolled into the study.

We used these data to study any relationship between prebronchoscopy PEFR% and degree of arterial oxygen desaturation during and after bronchoscopy. Chi square and correlation coefficient test were used for statistical analysis. *P* value of < 0.05 was considered as statistically significant.

RESULTS

Sixty-six patients (35 men, 31 women) with a median age of 53 years (14-82 yrs) met the entrance criteria of the study. Of them 39 subjects (59%) experienced at least one episode of hypoxemia. A significant fall in mean oxygen saturation during bronchoscopy (88 ± 4 %) occurred in comparison to before bronchoscopy (95 ± 2 %) (*P* < 0.0001). Hypoxemia was temporary in 25 out of 39 cases. Persistent hypoxemia lasting more than 20 seconds was seen in 24, 27 and 58% of subjects with PEFR% of \geq 80, 60-79 and \leq 59%, respectively (Fig. 1).

The lower the PEFR%, the greater the risk of persistent hypoxemia (*P* = 0.008). By scattering the minimum oxygen saturation during bronchoscopy against PEFR% (in those with a PEFR% of less than 60%), a positive correlation between them has been observed (*r* = 0.41, *P* = 0.036) (Fig. 2). The incidence of hypoxemia was even greater when subjects were divided into two groups according to PEFR% of below or above 45% (83% vs. 28%, respectively) (Fig. 3).

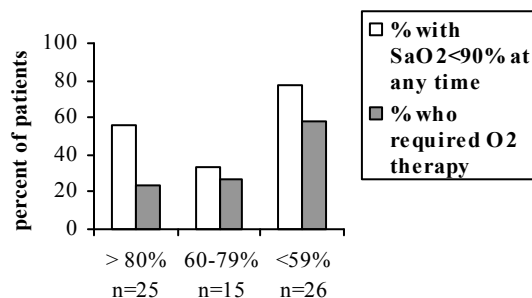


Fig. 1. O₂ desaturation and requirement of oxygen according to prebronchoscopic PEFR (% pred).

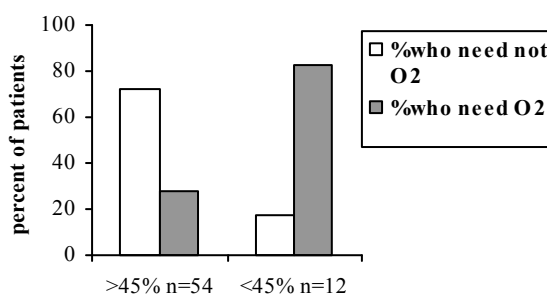


Fig. 2. O₂ desaturation and requirement of oxygen in patients with PEFR % < 45 (*p* = 0.001).

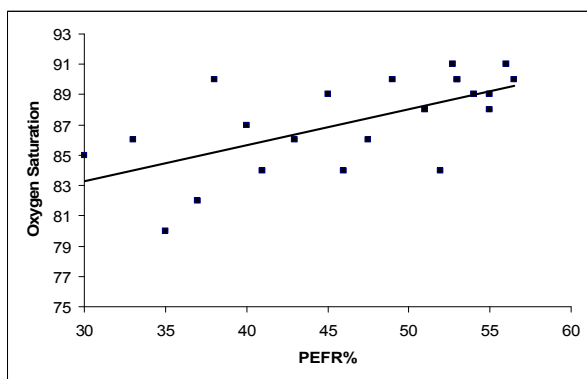


Fig. 3. Scatter gram of O₂ saturation against PEFR % in patients with PEFR % < 60 ($P = 0.036$).

DISCUSSION

Hypoxemia during fiberoptic bronchoscopy is a common complication, which may persist for several hours (6). Marantera *et al.* studied 100 consecutive patients in their bronchoscopy unit and concluded these four results: 1) the pulse oximeter is as good as conventional blood gas analysis for quantifying O₂ saturation. 2) ninety-seven percent of patients experienced a decrease in O₂ saturation from 1 to 25 %. 3) Sitting position during bronchoscopy can aggravate hypoxemia. 4) Bronchoalveolar lavage (BAL) can cause hypoxemia, but instillation of fluids in the trachea, bronchial biopsy and also duration of the procedure did not affect it (7).

Some studies in the literature focused on the effect of bronchoscopy on pulmonary function tests. Peacock *et al.* studied the effect of bronchoscopy on lung function by measuring pulmonary function tests after bronchoscopy, and showed the most prominent hypoxemic effect was due to instillation of lignocaine into the airways. In patients with lung disease (except for central obstructing carcinoma and or asthma) the insertion of the bronchoscope causes little additional desaturation (8).

Djukanovic *et al.* compared FEV1 values between asthmatics and normal subjects. They measured FEV1 and PC20 (the concentration of methacholine which induced 20% reduction in FEV1) 5 days before bronchoscopy and repeat them immediately after bronchoscopy, in order to find any change. They showed significant fall in both asthmatics and normal subjects, which in the first group correlated with prebronchoscopy PC20 (9).

Van Vyve *et al.* showed similar results in both asthmatics and normal subjects. They did not find any correlation between asthma severity and degree of O₂ desaturation (10). Predicting value of spirometry for occurrence of hypoxemia during bronchoscopy is the subject of many studies and ended in somewhat similar results. Jones and colleagues had studied the relationship between FEV1 measurement and the requirement for supplemental oxygen therapy during bronchoscopy. They showed the lower FEV1 the greater the risk of O₂ desaturation (5).

Fang *et al.* suggested although all procedures can cause desaturation, bronchoalveolar lavage was the most important predictor of desaturation during fiberoptic bronchoscopy (11).

Although a simple measure of pulmonary function, there is no study using peak flow meter for prediction of hypoxemia. So, we planned a study for examining this hypothesis. In our study most of the patients (62%) did not need any supplemental oxygen and those with hypoxemia lasting less than 20 seconds improved without any intervention. No one of 39 hypoxemic subjects experienced any complication related to this adverse effect. Patients with PEFR percent predicted (PEFR %) of $\geq 80\%$ showed less chance for O₂ desaturation during bronchoscopy, but still this group was not safe from this complication.

This implies oxygen desaturation with bronchoscopy can occur at any level of pulmonary function (even with normal PEFR %) and support the current thesis of monitoring every subject during the procedure by a pulse oximeter. On the other hand a low PEFR % before bronchoscopy, of course not a contraindication to bronchoscopy can be used as a reliable predictor of hypoxemia during the procedure (when falls less than 60%, and especially less than 40%). Measurement of PEFR % by a cheap, easy to use and noninvasive instrument can predict patients who are at high risk for hypoxemia and promote prevention of its potentially dangerous complications.

Acknowledgement

We would like to thank our bronchoscopy unit technicians, Mr. Alami and Mr. Zare for their grate helping this study.

Conflict of interests

The authors declare that they have no competing interests.

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