

The relationship between peak expiratory flow rate (PEFR) before bronchoscopy and arterial oxygen desaturation during bronchoscopy

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Abstract

Objective

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 this study is to examine the relationship between PEFR before bronchoscopy and oxygen desaturation during bronchoscopy.

Material and Methods

Measurement of PEFR (% predicted) performed before bronchoscopy and arterial O₂ desaturation was assessed with a pulse oximeter during bronchoscopy. Study performed on 66 patients with a median age of 53 years, who had been referred to our bronchoscopy unit. None of the patients received supplemental oxygen before the procedure.

Results

39 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).

Conclusion

It is concluded that PEFR % < 60 and especially < 45 is a reliable predictor of hypoxemia and the need to O₂ therapy during bronchoscopy.

Keywords: Bronchoscopy, O₂ desaturation, Peak Expiratory Flow Rate.

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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 (O_2 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 FEV1 for occurrence of hypoxemia during the procedure (5). We planned a study to evaluate if any relation between PEFR and incidence of hypoxemia during bronchoscopy.

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 peak expiratory flow rate (PEFR) had been measured just before undergoing bronchoscopy. The patient blew forcefully and suddenly to a handheld peakflowmeter (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 % in three groups: those with $PEFR \geq 80\%$, those with PEFR between 60-79%, and those with $PEFR \leq 59\%$.

Arterial oxygen saturation (O_2 sat.) of all patients were monitored before, during and two hours after bronchoscopy by a pulse oximeter (NPB-195). Hypoxemia was defined as O_2 sat. $< 90\%$. None of the patients received supplemental O_2 therapy before bronchoscopy. Those who had sustained hypoxemia (O_2 sat. $< 90\%$, for more than 20 seconds) were treated by supplemental oxygen 2-6 l/min via nasal prongs with goal of O_2 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 ($88 \pm 4\%$) occurred compared to bronchoscopy ($95 \pm 2\%$) ($p < 0.0001$). 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 ≥ 80 , 60-79 and $\leq 59\%$, respectively (Figure 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 ($r=0.41$, $p=0.036$) (Figure 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) (Figure 3).

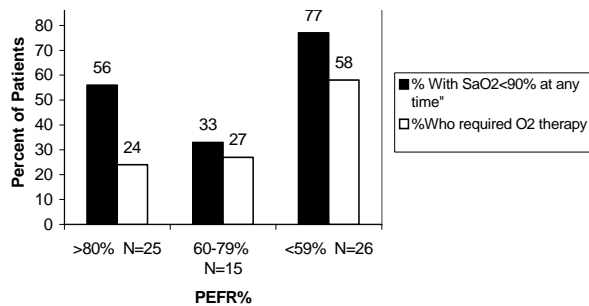


Figure 1. O₂ desaturation and requirement of oxygen according to prebronchoscopic PEFR%.

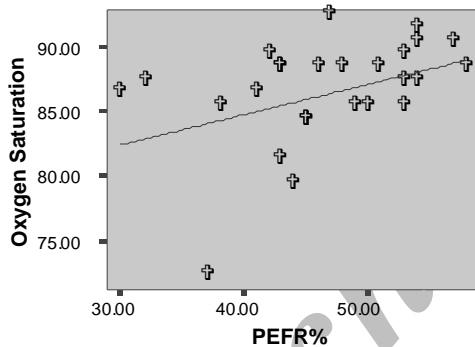


Figure 2. Scatter gram of O₂ saturation against PEFR% in patients with PEFR% < 60 ($p=0.036$).

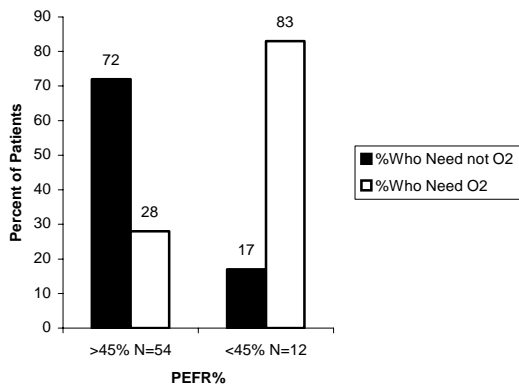


Figure 3. O₂ desaturation and requirement of oxygen in patients with PEFR % < 45 ($p=0.001$).

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. showed significant fall in mean forced expiratory volume in first second (FEV₁) immediately postbronchoscopy in both the asthmatic and normal groups. There was also significant O₂ desaturation during biopsy in asthmatic subjects which was not related to asthma severity (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 that 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 being a simple method to measure of pulmonary function, there is no study using peak flow meter for prediction of hypoxemia during fiberoptic bronchoscopy. 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 for 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.

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