Case Report

The Use of Fractional Exhaled Nitric Oxide In Investigation of Work-Related Cough in a Hairdresser

Gianni Pala, MD, Patrizia Pignatti, PhD, and Gianna Moscato, MD

Background  Occupational and environmental factors may be a cause of nonasthmatic eosinophilic bronchitis (NAEB). The diagnosis of occupational NAEB requires evidence of sputum eosinophilia. Nevertheless, a minority of patients are not able to produce suitable sputum specimens.

Methods  This case report describes a 25-year-old woman, working as a hairdresser since the age of 20 years and handling ammonium persulfate, who came under our observation for work-related rhinitis and cough.

Results  A specific inhalation challenge with ammonium persulfate elicited dry cough, without any significant change in forced expiratory volume in 1 s (FEV1). Sputum induction was unsuccessful both pre- and after specific inhalation challenge. Fractional exhaled nitric oxide (FeNO) values significantly increased after specific inhalation challenge, suggesting a diagnosis of occupational NAEB due to ammonium persulfate.

Conclusions  From this observation we suggest that FeNO measurement should be added to the investigation of work-related cough during specific inhalation challenge, and may be considered as an alternative to induced sputum to evaluate bronchial inflammation when sputum collection is unavailable or unsuccessful. Am. J. Ind. Med. 54:565–568, 2011. © 2011 Wiley-Liss, Inc.

KEY WORDS: occupational asthma; eosinophilic bronchitis; induced sputum; persulfate salts; fractional exhaled nitric oxide

INTRODUCTION

Nonasthmatic eosinophilic bronchitis (NAEB) is defined as a chronic cough in patients with no symptoms or objective evidence of variable airflow obstruction, normal airway hyperresponsiveness and sputum eosinophilia [Brightling, 2006]. Occupational and environmental factors may be a cause of persistent cough and NAEB is one of the possible causes [Tarlo, 2006]. When it occurs under occupational conditions, it can be considered as a variant of occupational asthma [Quirce, 2004]. Few cases of occupational NAEB have been described [Quirce, 2004], most due to high-molecular weight (HMW) agents. Ammonium persulfate is a low-molecular weight (LMW) agent well known as a cause of occupational rhinitis and asthma in hairdressers [Moscato et al., 2010], but no case of occupational NAEB due to this compound has been reported to date. The diagnosis of occupational NAEB requires evidence of increase in sputum eosinophils related to exposure to the offending agent [Quirce, 2004]. Nevertheless, nearly one-third of patients with respiratory allergy to ammonium persulfate are not able...
to produce suitable induced sputum specimens [Moscato et al., 2010], limiting our ability to investigate the possible inflammatory status of lower airways.

It is now possible to assess airway inflammation in asthma patients by measuring the fractional exhaled nitric oxide (FeNO) during an office visit [ATS/ERS, 2005]. Although there is international consensus regarding the testing methodology, nevertheless there are still questions to be answered regarding the clinical interpretation of FeNO findings in specific situations [Lim and Mottram, 2008].

In this report we propose FeNO measurement as an alternative to induced sputum for confirming a diagnosis of occupational NAEB due to ammonium persulfate.

CASE REPORT

This case report describes a 25-year-old woman, a mild smoker, referred to us with work-related rhinitis and cough. She had been working as a hairdresser since the age of 20 years. Two years after commencing work she developed nasal obstruction and itching and dry cough only while at work when handling hair-bleaching products containing ammonium persulfate salts. The workplace was provided with a ventilation system and extractor fans. Symptoms improved with oral corticosteroid intake (betametasone) prescribed by a general practitioner and by complete work exposure avoidance during weekends and holidays.

METHODS

The patient was admitted to our hospital free of any therapy and was asked to avoid smoking during the whole examination period. She underwent the common diagnostic pathway for the investigation of occupational respiratory allergy (duration of the whole examination period: 7 days—Table I). On the day of admission (Day 1) basal spirometry, a methacholine challenge test [performed by means of a nebulizer (MEFAR, Brescia, Italy) connected to a dosimeter], skin prick tests to common allergens and to ammonium persulfate, patch tests (FIRMA, Florence, Italy) and serum determination of IgE were performed. On Days 2 and 3 patient lung function was monitored by hourly measurement of peak expiratory flow rate. On Day 4 FeNO measurement [ATS/ERS, 2005] [performed with NIOX-MINO® (Aerocrine AB, Solna, Sweden) at a constant flow rate of 50 ml/s] [Lim and Mottram, 2008], sputum induction [Quirce et al., 2010; Moscato et al., 2010] and nasal secretion collection [Moscato et al., 2010; Pignatti et al., 2010] were performed. On Day 5 a control challenge test with ethanol was performed and the day after (Day 6) the patient underwent the specific inhalation challenge with ammonium persulfate (240 min cumulative exposure in a 7.46 m³ inhalation challenge room) [Moscato et al., 2010]. FeNO measurement, sputum induction, nasal secretion collection, and methacholine challenge test were repeated 24 after exposure to ammonium persulfate (Day 7). Peak expiratory flow rate was also measured during the whole examination period.

RESULTS

Basal spirometry was normal (FEV₁ 3.10 L—95% predicted) and methacholine challenge test was negative (Table II). Skin prick tests were slightly positive to Dermatophagoides pteronyssinus and Dermatophagoides farinae (mean wheal diameter 2 mm), and negative to ammonium persulfate [Moscato et al., 2010]. Patch tests were positive to nickel sulfate (light nonvesicular erythema). Total serum IgE concentration was 78.3 kU/L (normal value <120 kU/L).

No significant FEV₁ variation (≥10%) nor nasal reaction was shown during the control challenge with ethanol. The specific inhalation challenge with ammonium persulfate elicited nasal itching, sneezing, rhinorrhea, mucosal edema (via anterior rhinoscopy) and nasal obstruction, with reduction in peak nasal inspiratory flow from 60 to 0 L/min and dry cough 240 min after the end of the exposure, without any significant change in FEV₁ values. Peak expiratory flow values were in the normal range during the whole examination period (diurnal variation <20% throughout). Methacholine challenge test performed 24 hr after specific inhalation challenge was negative (Table II). Sputum induction was unsuccessful both pre- and after specific inhalation challenge, owing to the onset of nausea during the procedure. A significant increase in FeNO values was registered 24 hr after exposure to ammonium persulfate (from 35 ppb at baseline to 143 ppb after specific inhalation challenge). An increase in nasal secretion eosinophils [from 78.9% (12.6 × 10⁴/ml) to 84.9% (16.1 × 10⁴/ml)] and peripheral blood eosinophils [from 7.2% (0.34 × 10⁹/L) to
DISCUSSION

The importance of a correct diagnosis of NAEB is underscored by some recent reports suggesting that this condition is rarely self-limiting [Brightling, 2006] and that the risk of developing asthma should be considered, particularly in the absence of adequate treatment and monitoring. That is particularly relevant in the occupational setting since occupational asthma is a cause of disability and has a significant socio-economic impact. In the present case the failure to collect a proper induced sputum sample could have led to an incomplete diagnosis.

The level of FeNO is correlated with sputum eosinophilia, mucosal eosinophilia, and broncoalveolar lavage eosinophilia [Lim and Mottram, 2008]. In the nonoccupational setting some studies have shown its usefulness in the investigation of chronic cough, and its high negative predictive value for NAEB [Oh et al., 2008]. In our case FeNO values markedly increased after exposure to ammonium persulfate during the specific inhalation challenge strongly suggested a diagnosis of occupational NAEB due to ammonium persulfate exposure [Quirce, 2004].

8.2% (4.34 × 10^9/L) was also registered (Table II). A diagnosis of occupational rhinitis was made [Moscato et al., 2008]. In addition, the clinical history of work-related dry cough, the induction of cough in the absence of any significant functional change and the increase in FeNO values during the specific inhalation challenge strongly suggested a diagnosis of occupational NAEB due to ammonium persulfate exposure [Quirce, 2004].

REFERENCES


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<th>TABLE II. Results of the Tests Performed Before and After Specific Inhalation Challenge (SIC)</th>
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FeNO, fractional concentration of exhaled nitric oxide (normal value = 40 ppb) [Oh et al., 2008].
PD₂₀FEV₁, provocative dose of methacholine causing a 20% fall in FEV₁ (normal value = 1,600 µg).
FNNO, fractional concentration of nitric oxide in exhaled air (normal value = 35 ppb) [Oh et al., 2008].
Normal values: FeNO = 40 ppb, PD₂₀FEV₁ = 1,600 µg.


