Eur J Gen Med 2014; 11(3):153-156
DOI : 10.15197/sabad.1.11.61

Original Article

Neurophysiological Changes in Patients with Chronic Obstructive Pulmonary Diseases

Recep Demir, Lütfi Özel, Gökhan Özdemir, İdris Kocatürk, Hızır Ulvi

ABSTRACT

Peripheral neuropathy commonly occurs in patients with chronic obstructive lung disease (COPD). The aim of our study was to investigate the possible effects of COPD on the peripheral nervous system. We enrolled 31 patients (16 women and 15 men), mean age 66.12, with COPD into the study. Arterial oxygen tension (PaO2)> or = 65 mmHg was considered as the cut-off value designating tissue hypoxia. According to this cut-off value, the subjects were divided into two groups: Group I (n=16), PaO_2< 65 mmHg and Group II (n=15), PaO_2> or = 65 mmHg. In all patients and controls, motor and sensory nerve conductions were studied with an electromyogram (EMG). We detected neuropathy in 93,5% of the study patients on EMG. In the Group I, severity of neuropathy was correlated with the degree of hypoxemia, but no correlation was observed in the Group II. In conclusion, the incidence of sensorial neuropathy was more than expected, the rate of axonal neuropathy was significantly higher in the group I than group II and the severity of neuropathy was correlated with the degree of hypoxemia in group I. From these data we suggest that electrophysiological studies may be useful in assessing the peripheral neuropathy in patients with COPD.

Key words: *Pulmonary disease, electrophysiological study, peripheral neuropathy, nerve conduction, hypoxemia*

Kronik Obstrüktif Akciğer Hastalığı olan Hastalarda Nörofizyolojik Değişiklikler

ÖZET

Kronik obstrüktif akciğer hastalığı olan hastalarda (KOAH) periferik nöropati yaygın olarak görülmektedir. Çalışmamızın amacı KOAH'ın periferik sinir sistemi üzerine olan muhtemel etkilerini incelemekti. Çalışmamızda 31 hastayı inceledik. Bunların 16'sı kadın, 15'i erkek ve yaş ortalama 66.12 idi. Arteriyal oksijen basıncının > veya = 65 mmHg olarak doku hipoksisini belirleyen cut-off değeri olarak alındı. Bu cut-off değerine göre, kişiler Grup I (n=16), PaO2 < 65 mmHg ve Grup II (n=15), PaO2 > veya = 65 mmHg ikiye ayrıldı. Hasta ve kontrol grubunda, motor ve duysal sinir ileti çalışmaları elektromyografi (EMG) ile değerlendirildi. Çalışmamızda hastaların %93.5'inde EMG'de nöropati tesbit edildi. Grup I'deki hastalarda nöropati şiddeti ile hipoksinin derecesi arasında ilişki mevcuttu, ancak Grup II'deki hastalarda böyle bir ilişki saptanmadı. Duysal nöropati insidansı beklenenden daha fazlaydı. Aksonal nöropati oranı Grup I'de, Grup II'ye göre anlamlı olarak daha yüksek gözlendi. Grup I'de nöropatinin şiddeti, hipokseminin derecesi ile ilişkiliydi. Bu veriler ışığında, biz KOAH'lı hastalarda periferik nöropatinin elektrofizyolojik incelenmesinin yararlı olabileceğini öneriyoruz.

Anahtar kelimeler: *Akciğer Hastalığı, elektrofizyolojik inceleme, periferik nöropati, sinir iletimi, hipoksemi*

Ataturk University, Medical Faculty, Department of Neurology, Erzurum, Turkey

Received: 08.07.2013, Accepted: 23.07.2013

Correspondence: *Recep Demir*
Department of Neurology, Faculty of Medicine, Ataturk University, Erzurum, Turkey. 25200 Erzurum, Turkey
Phone: *90 5337785676*
E-mail: *demirnoro@gmail.com*

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a major public health problem and, the fourth leading cause of death worldwide (1). A further increase in prevalence, mortality of the disease, is predicted for the coming decades. Peripheral neuropathy is a failure of the nerves that carry information to and from the brain and spinal cord. There are numerous reasons for peripheral neuropathy; chronic respiratory insufficiency has been implicated as one of the factors in previous studies (2). Hypoxemia, a reduction in partial oxygen tension (PO_2), can be observed in practically every known pulmonary disease entity. Consequently, hypoxemia is an indicator of abnormal pulmonary gas exchange, and the arterial PO_2 can also serve as a test of pulmonary function. Hypoxia, a decrease in tissue oxygen tension, is a consequence of hypoxemia (3). The aim of our study was to investigate the possible effects of COPD on the peripheral nervous system and characteristics of neuropathy with prospective clinical and electrophysiological study, and its correlation with the degree of hypoxemia.

MATERIALS AND METHODS

The study was conducted at the Neurology Department of Ataturk University Faculty of Medicine Yakutiye Research Hospital. The diagnosis of COPD was based on modified criteria defined in the Global initiative for chronic Obstructive Lung Disease (GOLD) guidelines (4). We enrolled 31 patients (16 women and 15 men), mean age 66.12, with COPD into the study. PaO_2> or = 65 mmHg was considered as the cut-off value designating tissue hypoxia. According to this cut-off value, the subjects were divided into two groups: Group I (n:16), PaO_2 <65 mmHg and Group II (n:15), PaO_2 > or = 65 mmHg. Patients experiencing poorly-reversible airflow limitation observable in bronchiectasis, cystic fibrosis, tuberculosis, or asthma were not included. Patients with other causes of polyneuropathy were excluded from the study. In all patients and controls the standard motor (median, ulnar, peroneal, tibial) and orthodromic sensory nerve (median, ulnar, sural) conductions were studied in the upper and lower both limbs using conventional techniques with an electromyogram (EMG) equipment (KEYPOINT, DANTEC, DENMARK). Conduction velocity, amplitudes, and amplitude delay with distal and proximal stimulation were quantified. Two motor and sensory nerve (median and ulnar nerve) conduction studies in upper extremities, 2 motor (peroneal and tibial nerves), one sensory (right and left sural nerve) nerve conduction studies in the lower extremities were performed to all patients. The sural SNAPs were recorded behind the lateral malleolus, with stimulation applied 14 cm proximal to the recording electrode. Distal stimulations were made 7 cm. proximal to the active electrode for nerves in the upper limbs and 10 cm. proximal in the lower limbs. Proximal stimulation was made at the elbow for median and ulnar nerve, at the neck of fibula for common peroneal nerve, at the popliteal fossa for the tibial nerve. If a response was abnormal for any of the explored nerves, nerve conduction study was repeated. The diagnosis of polyneuropathy was based on electrophysiologic criteria defined as two or more electrophysiologic abnormalities at nonentrapment sites. Mononeuropathy was diagnosed when one nerve was

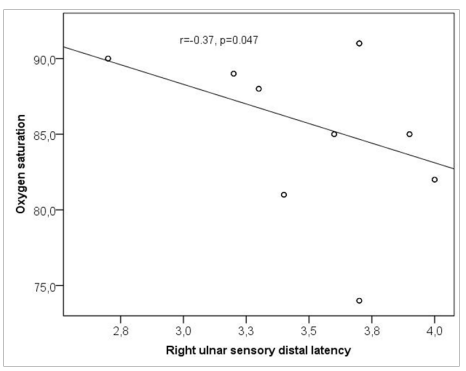

***Figure 1**. Correlation between Oxygen Saturation with Right Ulnar Duysal Nerve*

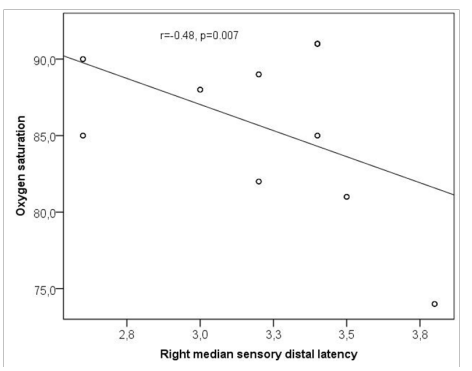

***Figure 2**. Correlation between Oxygen Saturation with Right Median Duysal Nerve*

affected. Arterial blood gas analysis was performed by using ABL 330 blood gas analyzer, and PaO_2, oxygen (O_2) saturation, $PaCO_2$, pH and HCO_3 were evaluated.

Statistical methods

Data are expressed as mean±standard deviation (mean±SD). Differences between the means of groups were determined using the unpaired t-test. The correlation of two parameters was tested using a linear regression analysis. In the analysis of the data, SPSS 20.0 (SPSS, Inc., Chicago, Illinois) software was used. Statistical hypotheses were tested using <0.05 as the level of statistical significance.

RESULTS

We detected neuropathy in 93,5% of the study patients on EMG. Abnormalities of sensory nerve conduction were most common, affecting the sural nerve (29 subjects), median nerve (28), ulnar nerve (26) and motor nerve peroneal (seven), median nerve (two), tibial and ulnar nerve (one). In the Group I, severity of neuropathy was correlated with the degree of hypoxemia, but no correlation was observed in the Group II (Figure 1, Figure 2). In our study, there was no significant difference male and female nerve conduction studies.

DISCUSSION

In COPD, changes occur in peripheral nerves that are chronically subjected to hypoxaemia resulting from less than normal blood oxygen concentration (1). Studies that included patients having clinical evidence of peripheral neuropathy, reported a higher prevalence of peripheral neuropathy upon neurophysiological investigation. Similarly, studies involving patients with severe hypoxaemia and/or hypercapnia, observed a higher prevalence of peripheral neuropathy upon neurophysiological analysis (5, 1). Stoebner et al., also observed that the microangiopathy in peripheral nerves in patients with COPD appears to be diffuse and essentially related to hypoxia (6). Hypoxic neuropathies are associated with nerve capillary endothelial cell hyperplasia and hypertrophy, predisposing to luminal occlusion. this may impede the transport of nutrients and oxygen. These mechanisms seem to be applicable to peripheral nerve dysfunction and lesions, resulting from impaired axonal transport and causing axonal degeneration (7). In our study, arterial oxygen tension (PaO_2)> or = 65 mmHg was considered as the cut-off value designating tissue hypoxia. According to this cut-off value, the subjects were divided into two groups: Group I, PaO_2< 65 mmHg and Group II, PaO_2> or = 65 mmHg. In the Group I, severity of neuropathy was correlated with the degree of hypoxemia, but no correlation was observed in the Group II.

In animal models, chronic hypoxaemia causes a deceleration in nerve conduction velocity. Studies of the oxygen consumption in the microenvironment of the peripheral nerve under conditions of nerve oedema and experimental diabetic neuropathy show that the peripheral nerve function is oxygen dependent. Axonal transport is an energy requiring process and its impairment by hypoxaemia can enhance axonal degeneration (8,9).

In a study, the group data analysis of COPD patients revealed no motor nerve impairment. However, individual data analysis of the five patients with electrophysiological evidence of peripheral neuropathy suggests a predominantly sensory, and axonal polyneuropathy. A possible explanation may be that the slight motor abnormalities in the five patients are masked by the normal values of the remaining 25 patients (10). Some studies showed corrrelation between the degree of hypoxemia and severity of neuropathy. All previous studies observed peripheral neuropathy involving the sensory nerves in these patients (2,11). Jann et al. had found low amplitude compound muscle action potential, and sensory nerve action potential, with only slight reduction of nerve conduction velocity in affected patients. The data confirmed an axonal polyneuropathy (12).

In a study, the electrophysiologically diagnosed neuropathy was detected in 15% of the patients with COPD. Fifty percent had distal sensorial polyneuropathy and 50% had peroneal motor neuropathy. Furthermore, in patients with severe COPD group; right and left sural nerve amplitude and conduction velocity were found significantly lower than in patients with moderate COPD (13).

To conclude, the incidence of neuropathy, particularly sensorial, was more than expected, the rate of axonal neuropathy was significantly higher in the group I than group II and the severity of neuropathy was correlated with the degree of hypoxemia in group I. Our study showed significant corrrelation between the degree of hypoxemia and severity of neuropathy. Also COPD pa-

tients may have severity peripheral nerve involvements. From these data we suggest that electrophysiological studies may be useful in assessing the peripheral neuropathy in patients with COPD.

REFERENCES

1. *Gupta PP and Agarwal D. Chronic obstructive pulmonary disease and peripheral neuropathy. Lung India 2006; 23:25-33.*
2. *Kayacan O, Beder S, Deda G, Karnak D. Neurophysiological changes in COPD patients with chronic respiratory insufficiency. Acta Neurol Belg 2001; 101: 160-5.*
3. *Klocke RA, Arterial blood gases, Baum GL, Wolinsky E, Editors; Textbook of Pulmonary Diseases, Little, Brown and Company, Boston/Toronto (1989), p. 147 (Chapter 8).*
4. *Jindal SK, Gupta D, Aggarwal AN; WHO-Government of India Biennium (2002-2003) Programme. Guidelines for the management of chronic obstructive pulmonary disease (COPD) in India: a guide for physicians (2003). Indian J Chest Dis Allied Sci 2004; 46:137-53.*
5. *Poza JJ and Martí-Massó JF. Peripheral neuropathy associated with chronic obstructive pulmonary disease. Neurologia 1997; 12: 389-94.*
6. *Stoebner P, Mezin P, Vila A, et al. Microangiopathy of endoneurial vessels in hypoxemic chronic obstructive pulmonary disease (COPD). A quantitative ultrastructural study. Acta Neuropathol (Berl) 1989; 78: 388-95.*
7. *Mayer P, Dematteis M, Pépin JL, et al. Peripheral neuropathy in sleep apnea. A tissue marker of the severity of nocturnal desaturation. Am J Respir Crit Care Med 1999; 159: 213-9.*
8. *Ludemann P, Dziewas R, Soros P, Happe S, Frese A. Axonal polyneuropathy in obstructive sleep apnoea. J Neurol Neurosurg Psych 2001; 70(5):685-7.*
9. *Low PA, Schmelzer JD, Ward KK, et al. Experimental chronic hypoxic neuropathy: relevance to diabetic neuropathy. Am J Physiol 1986; 250: 94-9.*
10. *Agrawal D, Vohra R, Gupta PP, Sood S. Subclinical peripheral neuropathy in stable middle-aged patients with chronic obstructive pulmonary disease. Singapore Med J 2007; 48 (10) : 887.*
11. *Ozge A, Atis S, SevimS. Subclinical peripheral neuropathy associated with chronic obstructive pulmonary disease. Electromyogr Clin Neurophysiol 2001; 41(3): 185-91.*
12. *Jann S, Gatti A, Crespi S, Rolo J, Beretta S. Peripheral neuropathy in chronic respiratory insufficiency. J Peripher Nerv Syst 1998; 3: 69-74.*
13. *Öncel C, Baser S, Çam M, et al. Peripheral Neuropathy in Chronic Obstructıve Pulmonary Disease. COPD 2010; 7:11-6.*