

## STUDY OF VITAMIN-C AND MALONDIALDEHYDE IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE PATIENTS

Vamsi Krishna Chittimoju<sup>1</sup>, Kotikala Prabhakara Rao<sup>2</sup>, Sujatha Pasula<sup>3</sup>

<sup>1</sup>Post graduate, HOD& Professor, Assistant Professor, Department of Biochemistry,  
Katuri Medical college, Guntur, A.P

\*Corresponding Author Email: [drsujathapasula@gmail.com](mailto:drsujathapasula@gmail.com)

### ABSTRACT

**Background:** Chronic obstructive pulmonary disease (COPD) is associated with high morbidity and mortality. COPD is usually associated with a history of tobacco smoking. Free radicals in the smoke are responsible for the tissue damage seen in COPD. A strong association between oxidative stress and COPD was evidenced by several studies. Decrease in antioxidants also contributes to oxidative stress, because antioxidants not only protect against the direct injurious effects of oxidants, but also alter the inflammatory events that play an important role in the pathogenesis of COPD. **Methods:** Total number of 100 subjects were studied, comprising of 50 healthy controls and 50 COPD cases. Out of 50 COPD cases, 25 were chronic bronchitis patients and 25 were emphysema patients. Oxidant levels were measured in terms of malondialdehyde and antioxidant levels were measured in terms of vitamin C. Serum vitamin C and malondialdehyde were analysed in both cases and controls. **Results:** The levels of serum vitamin C was significantly decreased and Serum MDA was significantly increased in COPD cases when compared to controls and was significantly increased in emphysema patients when compared to chronic bronchitis patients **Conclusion:** The present study suggest that the increased MDA levels in COPD patients are due to increased lipid peroxidation mediated by toxic free radicals and decreased levels of serum vitamin C as a result of increased oxidative stress. Further studies, to evaluate the molecular mechanisms by which antioxidants modulate their protective role and also to identify new antioxidant molecules which may well prove to be better preventive factors or additional protective factors, should be done.

### KEY WORDS

Oxidative stress, Antioxidants; COPD, Vitamin C, malondialdehyde.

### INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is the fourth leading cause of death globally. The prevalence of COPD is higher in countries where smoking is highly prevalent. A frequent respiratory disorder affecting millions of people in India is COPD. In India, there is an increasing tendency to abuse tobacco and COPD is emerging to be a major public health problem.(1) Cigarette smoking is the most important risk factor for COPD. It is estimated that 80% of COPD patients have significant exposure to tobacco smoke. The remaining 20% have a combination of exposure to environmental tobacco smoke, occupational dusts and chemicals, indoor air pollution from biomass fuel used for cooking in poorly ventilated buildings, outdoor air pollution, airway infection, familial and hereditary factors have been implicated in the development of COPD(2). American Thoracic Society defines "Chronic obstructive pulmonary disease as a disease state characterized by the presence of air flow obstruction due to chronic bronchitis or emphysema; the airflow obstruction is generally progressive, may be accompanied by airway hyper-reactivity, and may be partially reversible "(2). Chronic bronchitis is a clinical diagnosis defined by

excessive secretion of bronchial mucus and is manifested by daily productive cough for 3 months or more in at least 2 consecutive years. Emphysema is a pathologic diagnosis that denotes abnormal permanent enlargement of air spaces distal to the terminal bronchiole, with destruction of their walls without obvious fibrosis (2). A relationship between passive smoking and development of chronic airflow obstruction is also expected. A current hypothesis in the pathogenesis of COPD is that the increased oxidant burden both directly as a result of smoking and indirectly by the release of reactive oxygen species from airspace leukocytes may not be adequately counter balanced by the lung antioxidant systems, resulting in oxidative stress. An excess of oxidants may then lead to enhanced pro-inflammatory gene expression and oxidative tissue injury leading to COPD (3).

Malondialdehyde (MDA) a lipid peroxidation product is an indicator of oxidative stress has correlated inversely with pulmonary function (4). Antioxidants depletion or deficiency may contribute to oxidative stress. Antioxidants not only protect against the direct injurious effects of oxidants, but also alter the inflammatory events that play an important role in the pathogenesis of COPD (5). Vitamin C is a major antioxidant in respiratory epithelial lining fluid which forms first line of defence against exposure to smoke. Vitamin C is a water soluble free radical scavenger, can directly scavenge  $O_2^-$  and  $OH^-$  radicals and helps to neutralize physiological oxidant burden created by both exogenous and endogenous sources (6).

Present study was done to evaluate serum vitamin C and malondialdehyde in controls and in chronic obstructive pulmonary disease cases.

## METHOD

A study of serum vitamin C and malondialdehyde in chronic obstructive pulmonary disease patients was carried out. Informed consent was taken from controls and chronic obstructive pulmonary disease cases and this study was approved by the ethical and research committee.

### Inclusion criteria:

- i) Cases: Clinically and radiologically diagnosed cases of chronic obstructive pulmonary disease were included. Total 50 cases of COPD patients were divided into 25 cases of emphysema and 25 cases of chronic bronchitis.
- ii) Controls: 50 normal healthy individuals without any history of smoking and chronic lung disease were included.

**Exclusion criteria :** Patients with other pulmonary diseases where FEV1 is reduced, history of cardiac failure or history of any surgical intervention, diabetes mellitus, hepatic disease, renal disease.

In these patients serum vitamin C was analyzed by simple colorimetric method by YEKYAW and serum malondialdehyde by TBA method.

## RESULTS

TABLE-1: COMPARISON OF SERUM VITAMIN C AND MALONDIALDEHYDE IN CONTROLS AND COPD CASES

GROUPS		VITAMIN-C (mg/dl)	MDA(nmol/ml)
CONTROLS	MEAN±S.D	1.09±0.16	2.64±0.52
CASES	MEAN±S.D	0.54±0.12	5.43±0.74
CONTROLS	p-value	<0.001	<0.001
Vs			
CASES			

TABLE-2: COMPARISON OF SERUM VITAMIN -C AND MDA IN CONTROLS AND CHRONIC BRONCHITIS CASES

GROUPS		VITAMIN-C (mg/dl)	MDA(nmol/ml)
CONTROLS	MEAN±S.D	1.09±0.16	2.64±0.52
CHRONIC BRONCHITIS	MEAN±S.D	0.63±0.09	4.91±0.51
CONTROLS	p-value	<0.001	<0.001
Vs			
CHRONIC BRONCHITIS			

TABLE-3: COMPARISON OF SERUM VITAMIN C AND MDA IN CONTROLS AND EMPHYSEMA CASES

GROUPS		VITAMIN-C (mg/dl)	MDA(nmol/ml)
CONTROLS	MEAN±S.D	1.09±0.16	2.64±0.52
EMPHYSEMA	MEAN±S.D	0.45±0.08	5.96±0.52
CONTROLS	p-value	<0.001	<0.001
Vs			
EMPHYSEMA			

TABLE-4: COMPARISON OF SERUM VITAMIN C AND MDA IN CHRONIC BRONCHITIS AND EMPHYSEMA CASES

	VITAMIN-C (mg/dl)	MDA(nmol/ml)
CHRONIC BRONCHITIS	0.63±0.09	4.91±0.51
EMPHYSEMA	0.45±0.08	5.96±0.52
p-value	<0.001	<0.001

FIGURE-1: BAR DIAGRAM SHOWING VITAMIN -C IN THREE GROUPS

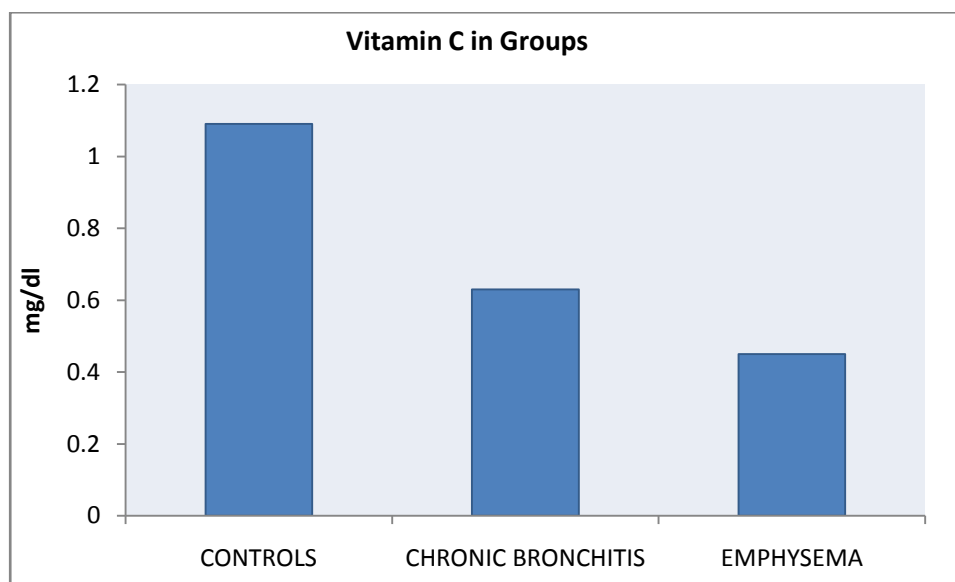
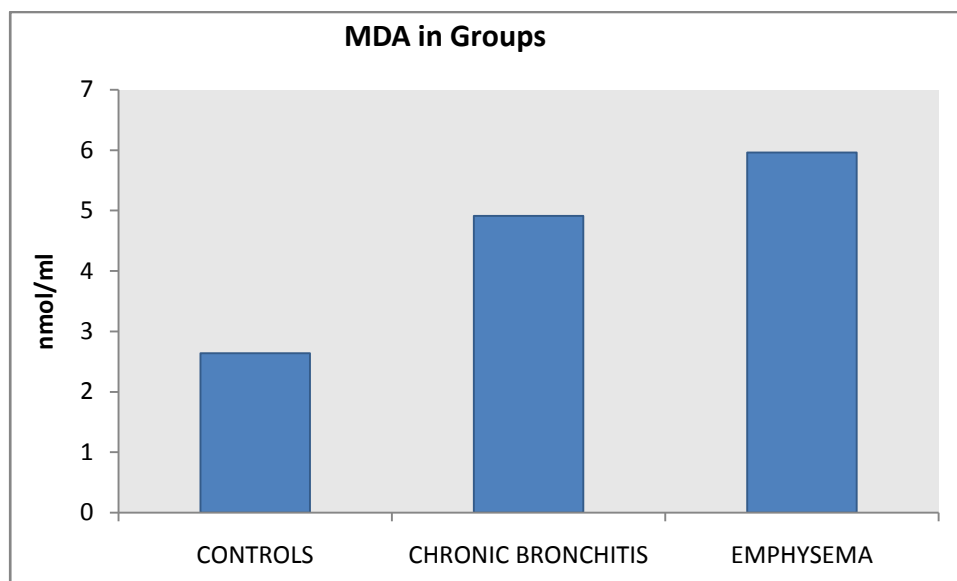


FIGURE-2: BAR DIAGRAM SHOWING MDA IN THREE GROUPS



## DISCUSSION

Chronic obstructive pulmonary disease is the fourth leading cause of death globally. The prevalence of COPD is higher in countries where smoking is highly prevalent. In India, there is an increasing tendency to abuse tobacco and COPD is emerging to be a major public health problem (1). Oxidative stress plays an important role in the pathogenesis of COPD; oxidative stress is caused by an imbalance between the production of oxidants and the presence of antioxidants (7).

The main aim of this study is to know the alterations in serum vitamin C and MDA in controls and chronic obstructive pulmonary disease patients. The present study includes 100 subjects of which 50 were chronic obstructive pulmonary disease patients and 50 were normal healthy individuals. Out of 50 COPD patients, 25 were chronic bronchitis patients and 25 were emphysema patients.

Vitamin C is a water soluble free radical scavenger, can directly scavenge  $O_2^-$  and  $OH^-$  radicals and helps to neutralize physiological oxidant burden created by both exogenous and endogenous sources (6). The mean value of serum vitamin C is  $1.09 \pm 0.16$  mg/dl in controls and  $0.54 \pm 0.12$  mg/dl in COPD cases. When compared to controls, COPD patients have significantly ( $p$  value  $< 0.001$ ) decreased level of vitamin C. This is in accordance with studies of Raghunath R. Rai et al,(6) L.A. Sargeant et al(8) and Mukadder cali koglu et al(9). The mean value of serum vitamin C is  $0.63 \pm 0.09$  mg/dl in chronic bronchitis patients and  $0.45 \pm 0.08$  mg/dl in emphysema patients. Vitamin C is significantly decreased ( $p$  value  $< 0.001$ ) in emphysema patients when compared to chronic bronchitis patients. This is in accordance with the study of Papaioannou AI et al(10).

Vitamin C functions as an important free radical scavenger. The mechanism involved in the reduction of vitamin C level in COPD is due to rapid oxidation of ascorbic acid by free radicals. The negative relationship between vitamin C and MDA may be due to the depletion of vitamin C when the oxidant burden is increased (9). Vitamin C functions as an antioxidant. By donating its electrons, it prevents other compounds from being oxidized in the process. The species formed after the loss of one electron is a free radical i.e., ascorbyl radical. As compared to other free radicals, ascorbyl radical is relatively stable with half life of  $10^{-5}$  seconds and is fairly unreactive which explains the antioxidant nature of vitamin C and its preference. Reduction of a reactive free radical with formation of a less reactive compound is sometimes called free radical scavenging or quenching (11).

MDA is a lipid peroxidation product which is formed during oxidative process of PUFA by reactive oxygen species. MDA is the sensitive marker of lipid peroxidation. COPD patients are subjected to enhanced oxidative stress and

increased level of MDA. The mean value of serum MDA is  $2.64 \pm 0.52$  nmol/ml in controls and  $5.43 \pm 0.74$  nmol/ml in COPD cases. When compared to controls, COPD patients have significantly ( $p$  value  $< 0.001$ ) increased level of MDA. This is in accordance with the study of M.K. Daga et al,(12) Birgul Isik et al,(13) and Gamze kirkil et al.(14) The mean value of serum MDA is  $4.91 \pm 0.51$  nmol/ml in chronic bronchitis and  $5.96 \pm 0.52$  nmol/ml in emphysema patients. MDA level is significantly elevated ( $p$  value  $< 0.001$ ) in emphysema patients when compared to chronic bronchitis patients. This is in accordance with the study of J. Gea et al(15). Oxidative stress has been implicated in the pathogenesis of tobacco smoke induced chronic obstructive pulmonary disease. Reactive oxygen species present in the tobacco smoke may cause damage to human alveolar epithelial cells by lipid peroxidation of cell membranes. Increased MDA concentration in patients with COPD is due to increased production of reactive oxygen species and hence more lipoxidation products (12). Increased MDA level in emphysema patients indicates more oxidative stress compared to chronic bronchitis patients. This may be due to patients with emphysema having more severe lung function impairment, lower body mass index, poor quality of life and more serious systemic dysfunction (10, 16)

## CONCLUSION

Present study demonstrates that there is increased oxidative stress in patients with COPD when compared to controls and it is higher in emphysema patients when compared to chronic bronchitis patients. Antioxidants are particularly decreased in emphysema patients when compared to chronic bronchitis patients. This study demonstrates that tobacco smoke induces oxidative stress in smokers which results in chronic obstructive pulmonary disease. Hence discontinuance of smoking by public awareness and by advising diet rich in antioxidants or supplementation of antioxidants may prevent the further oxidative damage in COPD patients.

## ACKNOWLEDGEMENT

Authors take this opportunity to express gratitude and deep regards to Dr .K.Sameera (Assistant Professor, Katuri Medical College, Guntur) for her continuous support and constant encouragement throughout the research.

## BIBLIOGRAPHY

1. Premanand R, Santhoshkumar PH, Mohan A. Study of thiobarbituric reactive substances and total reduced glutathione as indices of oxidative stress in chronic smokers with and without chronic obstructive pulmonary disease. *J Chest Dis Allied Sci* 2007;49:9 -12
2. Mephie SJ, Papadakis MA, Lawrence MT. Current medical diagnosis and treatment. 47th edition, McGraw Hill Medical Publisher, New Delhi, 2008;216-221.
3. Drost EM, Skwarski KM, Saulea J, Soler N, Roca J, Agusti A et al. Oxidative stress and airway inflammation in severe exacerbations of COPD. *Thorax* 2005; 60:293-300.
4. Kluchova Z, Petrasova D, Joppa P, Dorkova Z, Tkacova R. The association between oxidative stress and obstructive lung impairment in patients with COPD. *Physiol Res*. 2007; 56:51-56.
5. MacNee W. Oxidants / Antioxidants and COPD. *Chest* 2000; 117:303S -317S.
6. Rai RR, Phadke MS. Plasma oxidant -antioxidant status in different respiratory disorders. *Indian J Clin Biochem* 2006;21(2):161-164.
7. Gerritsen WBM, Asin J, Zanen P, van den Bosch JMM; Markers of inflammation and oxidative stress in exacerbated chronic obstructive pulmonary disease patients. *Respir Med* 2005;99:84-90
8. Sargeant LA, Jaeckel A, Wareham NJ. Interaction of vitamin C with the relation between smoking and obstructive airways disease in EPIC Norfolk. *Eur Respir J* 2000;16:397-403.
9. Calikoglu M, Tamer L, Calikoglu I, Atis S, Ulubas B, Ercan B. Oxidative stress and products of nitric oxide metabolism in chronic obstructive pulmonary disease and in healthy smokers. *Turkish Respir J* 2002;3(1):24-27
10. Papaioannou AI, Mazioti A, Kiropoulos T, Tsilioni I, Koutsokera A, Tanou K et al. Systemic and airway inflammation and the presence of emphysema in patients with COPD. *Respir Med* 2010;104:275-282.

11. Padayatty SJ, Katz A, Wang Y, Eck P, Kwon O, Lee Je-Hyuk et al. Vitamin C as an Antioxidant : Evaluation of its role in disease prevention. J Am Coll Nutr 2003; 22(1):18-35.
12. Daga MK, Chhabra R, Sharma B, Mishra TK. Effects of exogenous vitamin E supplementation on the levels of oxidants and antioxidants in chronic obstructive pulmonary disease. J Biosci 2003;28(1):7 -11.
13. Isik B, Isik SR, Yolacan H, Isik MR. Serum malondialdehyde and paraoxonase levels in chronic obstructive pulmonary disease. Turkish Respir J 2005;6(1):19 -21.
14. Kirkil G, Muz MH, Seckin D, Sahin K, Kucuk O. Antioxidant effect of zinc picolinate in patients with chronic obstructive pulmonary disease. Respir Med 2008; 102:840-844.
15. Gea J, Mas S, Balcells E, Sauleda J, Gomez F, Galdiz JB et al. Systemic oxidative stress and COPD phenotypes. Am J Respir Crit Care Med 2009; 179:A4329.
16. Boschetto P, Quintavalle S, Zeni E, Leprotti S, Potena A, Ballerin L et al. Association between markers of emphysema and more severe chronic obstructive pulmonary disease. Thorax 2006; 61:1037-1042.



**\*Corresponding Author:**

**Dr.P.Sujatha\***

Email:[drsujathapasula@gmail.com](mailto:drsujathapasula@gmail.com)