Journal of Obesity and Overweight
Volume 7 | Issue 1
ISSN: 2455-7633

Research Article Open Access

Fractional Exhaled Nitric Oxide (FeNO) in Healthy Obese Adults

Rouatbi S[*123], Anane I[1], Sellami S[1], Mahmoudi K[1], Ghannouchi I[123]

[1]Department of Physiology and Functional Explorations, University Hospital of Farhat Hached, Sousse, Tunisia
[2]Laboratory of Physiology, Faculty of Medicine of Sousse, University of Sousse, Sousse, Tunisia
[3]Heart Failure (LR12SP09) Research Laboratory, University Hospital of Farhat Hached, Sousse, Tunisia

[*]**Corresponding author:** Sonia Rouatbi, Department Service of Physiology and Functional Explorations, Farhat Hached Hospital, Sousse, Tunisia, Tel: (+216) 97644064, E-mail: Sonia.rouatbi@gmail.com

Citation: Rouatbi S, Anane I, Sellami S, Mahmoudi K, Ghannouchi I (2021) Fractional Exhaled Nitric Oxide (FeNO) in Healthy Obese Adults. J Obes Overweig 7(1): 103

Abstract

Introduction: This study aimed to assess the relationship between obesity and airway inflammation evaluated by FeNO levels in healthy obese subjects.

Patients and methods: It was a cross-sectional study including 434 apparently healthy subjects (194 males) divided into two groups: i) obese (BMI ≥ 30 Kg/m^2) and ii) non-obese (BMI < 30 Kg/m^2). Exclusion criteria were: current smokers, asthma, medicine intake interfering with FeNO levels, and abnormal lung function tests. The FeNO measurements were performed before spirometry. Student t test was performed to compare between the two groups. The Spearman correlation between BMI and FeNO levels was evaluated. The Piecewise linear regression with breakpoint was assessed to define the breakpoint of inflammation related to obesity.

Results: Lower pulmonary volumes in obese patients compared to non-obese ones in favor of a restrictive defect are noted. Obese subjects had significantly higher levels of FeNO when compared to non obese patients. The breakpoint of inflammation (FeNO value) related to obesity is fixed at 13.65ppb.

Conclusions: Added to the systemic inflammatory response, obesity may associate airway inflammation assessed by increased FeNO levels >13.65ppb.

Keywords: Obesity; Inflammation; FeNO; Oxidative stress

Introduction

Obesity, vascular dysfunction and obstructive sleep apnea-hypopnea syndrome (OSAS) are commonly associated disorders. Obesity is associated with a chronic inflammatory response that exceeds the adipose tissue and reaches the general circulation via adipocytokines. The role of adipo(cyto)kines in systemic inflammation and vascular dysfunction has been proved by many studies [1]. The main source of pro-inflammatory cytokines in obesity is the adipose tissue. The main cytokines responsible of chronic inflammation are tumor necrosis factor-α (TNFα), interleukin-6 (IL-6), and the inflammasome-activated IL-1β [2]. Fractional exhaled nitric oxide (FeNO) is a non-invasive airway inflammation assessment test which reflects airway inflammation at high levels [3]. This study aimed to assess the relationship between obesity and airway inflammation evaluated by FeNO levels in healthy obese subjects.

Patients and methods

Study design

It was a cross-sectional study including 434 apparently healthy subjects (194 males) divided into two groups: i) obese (BMI ≥ 30 Kg/m^2) and ii) non-obese (BMI < 30 Kg/m^2). Exclusion criteria were: current smokers, asthma, medicine intake interfering with FeNO levels, and abnormal lung function tests. The FeNO measurements were performed before spirometry.

Total body plethysmography

It is performed for all patients and subjects in the study using "ZAN 500" equipment (Messgeraete GmbH2000, Germany). Ventilatory variables are interpreted according to international recommendations [4]. The total body plethysmography allows the realization of a flow-volume curve and the measurement of ventilatory flows and pulmonary volumes.

The measured parameters are the following: forced expiratory volume at the first second (FEV1, %), forced vital capacity (%), FEV1/VC ratio (%), median maximum expiratory flow (MEF25-75, %), totals lung capacity (TLC, %) and Thoracic gas volume (TGV, %). These parameters are considered diminished when they are below the lower limit of normal (LLN). The LLN is determined from the specific reference values of the Tunisian population.

Measurement of exhaled nitric oxide

Exhaled fraction of nitric oxide (FeNO) is measured by the MedisoftHypAir method using an electrochemical analyzer (Medisoft, Sorinnes, Belgium). It is based on the electrochemical NO analyzer method [5]. The instrument has been calibrated and used according to the manufacturer's instructions. The measurement of FeNO is made following the international recommendations. Three acceptable measurements are taken at a flow rate of 50 ml/s at 15 minutes as recommended by the ATS / ERS. The average of the three values is used. FeNOis expressed in parts per billion (ppb), which is the equivalent of nanoliter per liter [5].

Statistical analysis

The statistical analysis is performed using the Statistica software (StatisticaKamel version 6.0, Stat Soft, France). In a first step and after checking the normal distribution of the studied parameters, we determine the means and the standard deviations of all the quantitative variables (anthropometric and ventilatory) for both G1 and G2 groups of the study.

Student t test was performed to compare between the two groups. The Spearman correlation between BMI and FeNO levels was evaluated. The Piecewise linear regression with breakpoint was assessed to define the breakpoint of inflammation related to obesity. The degree of significance is set at p lower than 0.05.

Results

Anthropometric and respiratory functional characteristics of the two groups are presented in Table 1. The sex ratio M/F of the sample is 0.80 with no significant difference of pulmonary function parameters between males and females. The comparison of BMI of the two groups showed a statistically significant difference. In addition lower pulmonary volumes (FVC, TLC and TGV) in obese patients compared to non-obese in favor of a restrictive defect are noted. Obese subjects had significantly higher levels of FeNO when compared to non-obese patients (Figure 1). A linear and significant correlation between Body mass index (BMI) values and FeNO was found (Figure 2).

	Non Obese (n=128)	Obese (n=306)
Age (years)	43,53±9,60	46,61±9,92
BMI (Kg/m²)	20,34±2,81	32,33±1.91*
FEV1%	95.92±12.20	93.82±15.23
MEF25-75%	94,94±23,97	82,63±25.20*
FVC%	98,83±14.05	94,59±11.96*
TGV%	109,29±22.79	91.24±19.08*
TLC%	95.02±11.31	90.80±10.88*

*p<0.05 by Student test

BMI: Body mass index; FEV1%: Forced expiratory volume at the first second, as a percentage of the theoretical Value; MEF25-75%: Median maximum expiratory flow, as a percentage of the theoretical value; FVC: Forced vital capacity, as a percentage of the theoretical value; TGV%: Thoracic gas volume, as a percentage of the theoretical value; TLC%: Total lung capacity, as a percentage of the theoretical value

Table 1: Anthropometric and pulmonary function characteristics of the two groups of the study

*: p<0.05 by Student test

Figure 1: Comparison of FeNO levels (ppb) between obese and non-obese patients

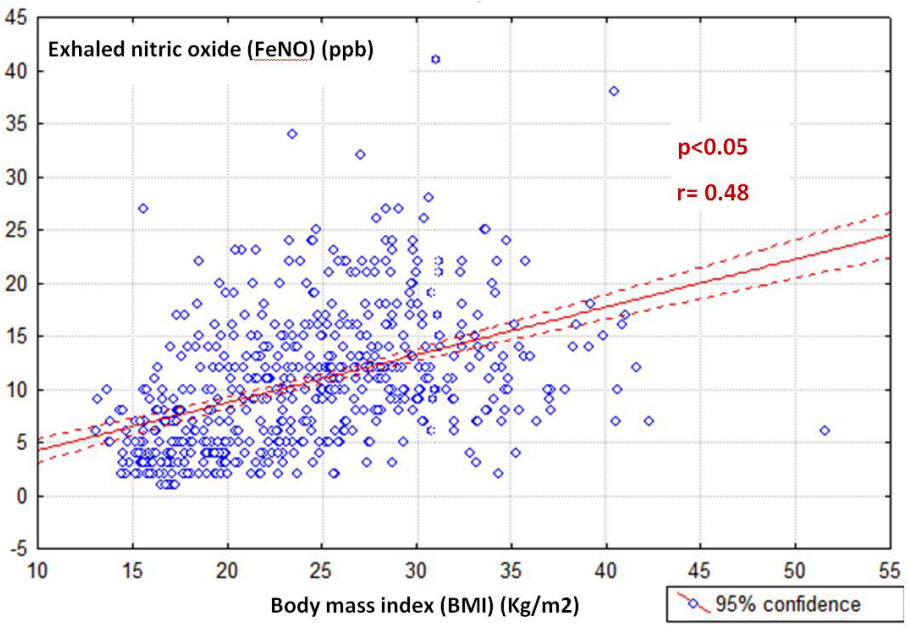

Figure 2: Correlation between Body mass index (BMI) and exhaled nitric oxide levels (FeNO)

The breakpoint of inflammation (FeNO value) related to obesity is fixed at 13.65ppb.This value is the upper limit of normality of FeNO in obese patients.

Discussion

The main result of this study is the significant airway inflammation related to obesity. Indeed, obesity is associated with a chronic inflammatory response that exceeds the adipose tissue and reaches the general circulation [6]. Adipose tissue produces and releases a variety of adipokines (cytokines) (leptin, adiponectin, resistin, and visfatin), as well as pro-inflammatory cytokines (tumor necrosis factor-α (TNFα), interferon-γ (IFNγ), interleukin [IL]-1, IL-6, and others) [2,7]. This inflammation of adipose tissue in obese patients plays a critical role in the pathogenesis of obesity-related complications (metabolic syndrome, Type 2 Diabetes Mellitus, hypertension, cardiovascular diseases…) [8]. Oxidative stress (OS) and pro-inflammatory processes are strongly related. Several mechanisms are involved in generating oxydative stress (OS) in obesity. In physiological and, even more, in pathological conditions, adipokines induce the production of reactive oxygen species (ROS), generating OS and, in turn, a major, irregular production of other adipokines [9,10].

As shown in other studies, FeNO an easy and non-invasive marker of airway inflammation was positively correlated to BMI [2]. Obese subjects had significantly higher levels of FeNO than underweight individuals [11]. This parameter can be used in the monitoring of obese patients on diet.

The overall impact of obesity on lung function is multi-factorial, related to mechanical aspects of obesity in addition to inflammation. In the present study obese patients had lower pulmonary volumes (TLC and FVC) than non-obese ones. It is the tendency to restrictive ventilatory deficit. The mechanical properties of the lungs and chest wall are altered significantly in obesity, largely due to fat deposits in the mediastinum and the abdominal cavities. These alterations reduce the compliance of the lungs [12], chest wall and entire respiratory system, and likely contribute to the respiratory symptoms of obesity such as wheeze, dyspnea, and orthopnea [12,13]. These mechanical changes explain the reduced values of distal flows (MEF25-75%) noted in obese patients.

The size of the sample and its distribution by sex do not represent a limitation of this work when compared to similar studies [14,15]. Therefore, this study presents some limitations: first, biological and systemic inflammatory markers are not measured. Second, physical activity and quality of life scores that may influence the degree of obesity, oxidative stress and therefore systemic inflammation have not been calculated.

Conclusion

Added to the systemic inflammatory response, obesity may associate airway inflammation assessed by increased FeNO levels > 13.65ppb.

References

1. Van de Voorde J, Pauwels B, Boydens C, Decaluwé K (2013) Adipocytokines in relation to cardiovascular disease Metabolism 62: 1513-21.

2. Gregor MF, Hotamisligil GS (2011) Inflammatory mechanisms in obesity. Annual Review of Immunology 29: 415-45.

3. Lin J, Yin K, Su N, Huang M, Qiu C, et al. (2015) Chinese expert consensus on clinical use of non-invasive airway inflammation assessment in bronchial asthma. J Thorac Dis 7: 2061-78.

4. Pellegrino R, Viegi G, Brusasco V, Crapo RO, Burgos F, et al. (2005) Interpretative strategies for lung function tests. Eur Respir J 26: 948-68.

5. American Thoracic Society/European Respiratory Society (2005) ATS/ERS recommendations for standardized procedures for the online and offline measurement of exhaled lower respiratory nitric oxide and nasal nitric oxide, 2005. Am J Respir Crit Care Med 171: 912-30.

6. Flegal KM, Kit BK, Orpana H, Graubard BI (2013) Association of all-cause mortality with overweight and obesity using standard body mass index categories. JAMA 309: 71-82.

8. Xu H, Barnes GT, Yang Q, Tan G, Yang D, et al. (2003) Chronic inflammation in fat plays a crucial role in the development of obesity-related insulin resistance. J Clin Investig 112: 1821-30.

7. De Winter–de Groot KM, van der Ent CK, Prins I, Tersmette JM, Uiterwaal CSPM (2005) Exhaled nitric oxide: The missing link between asthma and obesity? J Allerg Clin Immunol 115: 419-20.

9. Fernández-Sánchez A, Madrigal-Santillán E, Bautista M, Esquivel-Soto J, Morales-González A, et al. (2011) Inflammation, oxidative stress, and obesity. Int J Mol Sci 12: 3117-32.

10. Hensley K, Robinson KA, Gabbita SP, Salsman S, Floyd RA (2000) Reactive oxygen species, cell signaling, and cell injury. Free Radic Biol Med 28: 1456-62.

11. Al Khathlan N, Mohammed Salem A (2020) The Effect of Adiposity Markers on Fractional Exhaled Nitric Oxide (FeNO) and Pulmonary Function Measurements. Int J General Med 13: 955-62.

12. Pelosi P, Croci M, Ravagnan I (1998) The effects of body mass on lung volumes, respiratory mechanics, and gas exchange during general anesthesia. Anesth Analg 87: 654-60.

13. Sin DD, Jones RL, Man SF (2002) Obesity is a risk factor for dyspnea but not for airflow obstruction. Arch Intern Med 162: 1477-81.

14. van de Kant KDG, Paredi P, Meah S, Kalsi HS, Barnes PJ, et al. (2016) The effect of body weight on distal airway function and airway inflammation. Obes Res Clin Pract 10: 564-73.

15. Rouatbi S, Ghannouchi I, Kammoun R, Ben Saad H (2020) The Ventilatory and Diffusion Dysfunctions in Obese Patients with and without Obstructive Sleep Apnea-Hypopnea Syndrome. J Obes 2020: 8075482.