Short Communication

Investigation of peripheral blood mononuclear cells phagocytosis in allergic asthma mice model

Faride Afshari[1], Bahram Yavari[2], Asie Eftekhari[3], Kiyan Musaie[4], Seyyed Shamsadin Athari[5*]

[1]Department of Immunology, Faculty of Medical Sciences, Tarbiat Modares University, Tehran, Iran
[2]Department of Genetic and Molecular Medicine, Hamadan University of Medical Sciences, Hamadan, Iran
[3]Department of Psychology, Zanjan Branch, Islamic Azad University, Zanjan, Iran
[4]Faculty of Pharmacy, Zanjan University of Medical Sciences, Zanjan, Iran
[5]Department of Immunology, Faculty of Medicine, Zanjan University of Medical Sciences, Zanjan, Iran
Received: 1 January , 2018; Accepted: 6 April, 2018

Abstract

Background: The respiratory system is exposed to the potentially harmful environment agents. More importantly, respiratory system infection is an important risk factor for inflammation and some pathogens can be main responsible of asthma. Phagocytosis is a main mechanism to eliminate of microbial infection. Phagocytic clearance may control asthma pathogenesis. In asthma, cytokines balance may be changed, therefore we investigated possible change in phagocytes in the present study.

Materials and Methods: 14 male Balb/c mice were divided into two control and asthmatic group. Asthma model in mice was produced by ovalbumin. Peripheral blood mononuclear cells were separated and reduction nitro blue tetrazolium and latex bead florescence phagocytosis tests were done.

Results: There was no significant difference in phagocytosis and NBT reduction test between asthmatic and control groups ($P \leq 0.05$).Airway inflammation and unbalancing of cytokines in asthma might modulate phagocytosis function.

Conclusion: Therefore, asthmatic patient might be more susceptible to airway infection but there was not any notable changes in phagocytosis

Keywords: Infection, PBMC, Allergy, Asthma, hygiene.

***Corresponding Author:** Seyyed Shamsadin Athari, Email: SS.Athari@zums.ac.ir; SS.Athari@gmail.com.

Please cite this article as: Afshari F, Yavari B, Eftekhari A, Musaie K, Athari A Sh. Investigation of peripheral blood mononuclear cells phagocytosis in allergic asthma mice model. Arch Med Lab Sci. 2018;4(2):36-39.

Introduction

Respiratory system infection with bacteria and viruses is an important risk factor for inflammation (1). According to hygiene theory, when infectious disease has the high prevalence, allergic disease would be in the lowest amount of prevalence in population (2). But some pathogens can be main responsible of asthma with cough, whizzing and breathlessness symptoms (3, 4). Alveolar macrophages are responsible for phagocytosis of respiratory pathogens (3). Phagocytosis is a main mechanism to eliminate of microbial infection. Monocytes are produced in the bone marrow and enter the peripheral blood. Then passing into the tissues and converting into macrophages. The main tasks of this cells are based on removing microorganisms, dead cells, or their residues and harmful particles in the process of phagocytosis (5-7). Macrophages as the professional phagocytes cells, recognize, engulf and eliminate pathogens (8, 9). The respiratory system is exposed to the potentially harmful environment agents through the inhalation (particles, suspended toxins, allergens, and pathogens). Resident macrophages defense against inhaled

pathogens (10, 11). Pro-inflammatory cytokines orchestrate the infiltration of immune cells to sites (12, 13).

Eosinophils which mediate inflammation of airway and hyper-responsiveness are the main problem in asthma. Therefore, removal of eosinophils can be an important mechanism to protect the tissue from allergic inflammation. Apoptotic eosinophils can be engulfed by alveolar macrophages. Phagocytic clearance of apoptotic cells may control asthma pathogenesis. In asthma, cytokines balance may change, therefore the possible alteration in phagocytes (4, 14-16) was investigated in this study.

Methods

In this study, 14 male Balb/c mice were selected and divided into two groups: negative control group (control group) and asthmatic group. Asthma model in mice was produced according to standard protocol with ovalbumin (17). blood samples were taken and peripheral blood mononuclear cells (PBMC) were separated then reduction nitro blue tetrazolium (NBT) and latex bead florescence phagocytosis tests were done according to previous study (18).

Results

There was no significant difference in phagocytosis between asthmatic and healthy groups .Moreover, NBT reduction in two groups has no meaningful change ($P \leq 0.05$). In phagocytosis latex bead florescence test, phagocytosis index (the number of cells that had phagocytosis) and phagocytosis speed (the number of latex bead florescence that had been phagocytized by cells) had no significant difference ($P \leq 0.05$) (fig. 1).

Discussion

In the current study, there was no differences in phagocytosis power between asthma and control groups. Some studies demonstrated that phagocytosis in the moderate and severe asthma of pediatric was decreased compared with in adults. Therefore, innate immune response with phagocytosis might be impaired in asthmatic children that might be response to respiratory system infection in mentioned population (19, 20). This no difference in our study that may be related to age of mice, because our study groups were adult normal mice.

Innate immune system is important for clearance of respiratory infections. Phagocytosis is one of these mechanism. In this study phagocytosis was investigated in the presence of larger particles and there was not significant differences between asthma and healthy groups. Probably pinocytosis as the nonspecific uptake of fluid and solutes or endocytosis as the specific process of small particles (21, 22) might be different in asthmatic patients in specific conditions .

Other studies demonstrated that phagocytosis has reduced in patients with chronic obstructive pulmonary disease (COPD) and cystic fibrosis similar asthma in children. They had reduced phagocytosis process against bacteria and apoptotic cells (23-25). Phagocytosis dysfunction can be influenced with disease states (phagocytes phenotype) and our findings suggest that inflammation might have an important effect on phagocytosis in the human airway. They had reported no data about adults and phase of diseases.

Recently, it was observed no phagocytic differences

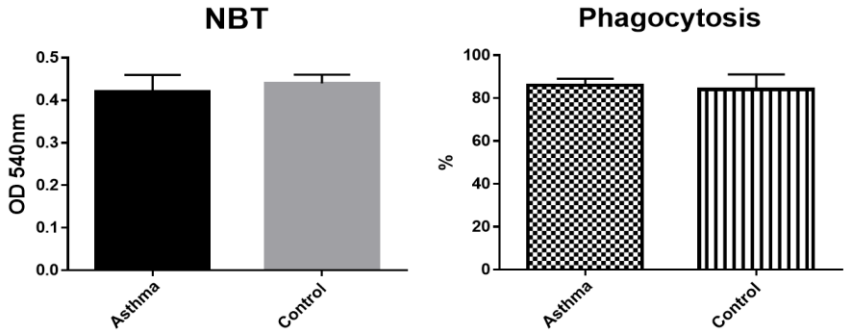

Figure 1. NBT reduction and latex bead florescence phagocytosis tests in healthy and asthmatic groups.

between adults with mild-moderate asthma and healthy people and in one study phagocytosis did not differ between control group and mild intermittent asthma patients (26).

Airway inflammation and unbalancing of cytokines in asthma might modulate phagocytosis function. Therefore, asthmatic patient with mucus hyper-secretion (as suitable environment for infectious agents localization) might be more susceptible to secondary airway infection and other problems but this hypothesis is not approved and in our study, there was not any notable changes. However, the relationship between viral and bacterial infection of respiratory system in asthmatic children is not clear.

Conflict of Interest

There is no conflict of interest among authors.

Acknowledgement

This study was supported by a grant from Zanjan University of Medical Sciences, Zanjan, Iran.

References

1. Anne M. Fitzpatrick, Fernando Holguin, W. Gerald Teague and Lou Ann S. Brown. Alveolar macrophage phagocytosis is impaired in children with poorly controlled asthma. J Allergy Clin Immunol 2008;121:1372-8

2. Sheikh A, Strachan DP. The hygiene theory: fact or fiction? Curr Opin Otolaryngol Head Neck Surg. 2004; 12(3):232-6.

3. Heymann PW, Carper HT, Murphy DD, Platts-Mills TA, Patrie J, McLaughlin AP, et al. Viral infections in relation to age, atopy, and season of admission among children hospitalized for wheezing. J Allergy Clin Immunol 2004; 114:239-47.

4. Seyyede Masoume Athari, Faride Afshari, Asie Eftekhari, Seyyed Shamsadin Athari. The surveillance system, diagnosis and treatment challenges of asthma and health policy orientation of main challenges. J Pain Manage Ther. 2017; 1(2):1-5

5. Baughn, R.; Bonventre, P.F. Phagocytosis and intracellular killing of Staphylococcus aureus by normal mouse peritoneal macrophages. Infect. Immun. 1975, 12, 346–352.

6. Przerwa, A.; Zimecki, M.; S´witała-Jelen´ , K.; Da˛browsk, K.; Krawczyk, E.; Łuczak, M.; Weber-Da˛browska, B.; Syper, D.; Mi˛edzybrodzki, R.; Górski, A. Effects of bacteriophages on free radical production and phagocytic functions. Med. Microbiol. Immunol. 2006, 195, 143–150.

7. Bocian, K.; Borysowski, J.; Zarzycki, M.; Wierzbicki, P.; Kłosowska, D.; Weber-Da˛browska, B.; Korczak-Kowalska, G.; Górski, A. LPS-activated monocytes are unresponsive to T4 phage and T4-generated Escherichia coli lysate. Front. Microbiol. 2016, 7, 1356.

8. Spencer A. Freeman and Sergio Grinstein. Phagocytosis: How Macrophages Tune Their Non-professional Counterparts. Current Biology 26, R1272–R1296, December 19, 2016

9. Flannagan, R.S., Cosio, G., and Grinstein, S. (2009). Antimicrobial mechanisms of phagocytes and bacterial evasion strategies. Nat. Rev. Microbiol. 7, 355–366.

10. Monks, J., Rosner, D., Geske, F.J., Lehman, L., Hanson, L., Neville, M.C., and Fadok, V.A. (2005). Epithelial cells as phagocytes: apoptotic epithelial cells are engulfed by mammary alveolar epithelial cells and repress inflammatory mediator release. Cell Death Differ. 12, 107–114.

11. Ichimura, T., Asseldonk, E.J., Humphreys, B.D., Gunaratnam, L., Duffield, J.S., and Bonventre, J.V. (2008). Kidney injury molecule-1 is a phosphatidylserine receptor that confers a phagocytic phenotype on epithelial cells. J. Clin. Invest. 118, 1657–1668.

12. Elliott, M.R., and Ravichandran, K.S. (2010). Clearance of apoptotic cells: implications in health and disease. J.CellBiol. 189, 1059–1070.

13. Ravichandran, K.S., and Lorenz, U. (2007). Engulfment of apoptotic cells: signals for a good meal. Nat. Rev. Immunol. 7, 964–974

14. Henson PM, Tuder RM. Apoptosis in the lung: induction, clearance and detection. Am J Physiol Lung Cell Mol Physiol. 2008; 294(4):L601–L611.

15. Jeong H Yun, Peter M Henson, Rubin M Tuder. Phagocytic clearance of apoptotic cells: role in lung disease. Expert Rev Respir Med. 2008; 2(6): 753–765.

16. Maderna P, Godson C. Phagocytosis of apoptotic cells and the resolution of inflammation. Biochim Biophys Acta. 2003; 1639(3):141–151.

17. Seyyed Shamsadin Athari, Zahra Pourpak, Gert Folkerts, Johan Garssen, Mostafa Moin, Ian M. Adcock, Masoud Movassaghi, Mehdi Shafiee Ardestani, Seyed Mohammad Moazzeni, Esmaeil Mortaz. Conjugated Alpha-Alumina nanoparticle with vasoactive intestinal peptide as a Nano-drug in treatment of allergic asthma in mice. European Journal of Pharmacology 2016; 791:811–820

18. Nowruz Delirejh, Ahmad Morshedi and Seyyed Shamsadin Athari. Survey of the Effect of Powder Nigella Sativa (Black Seed) in Increscent of Monocyte Phagocytosis in Quinea Pig. Ofogh-e-Danesh. GMUHS Journal. 2010; 16(4):55-64 [In Persian]

19. Corne JM, Marshall C, Smith S, Schreibner J, Sanderson G, Holgate ST, et al. Frequency, severity, and duration of rhinovirus infections in asthmatic and nonasthmatic individuals: a longitudinal cohort study. Lancet 2002; 359:831-4.

20. Jartti T, Lehtinen P, Vuorinen T, Koskenvuo M, Ruuskanen O. Persistence of rhinovirus and enterovirus RNA after acute respiratory illness in children. J Med Virol 2004; 72:695-9.

21. Alderen A, Underhill DM. Mechanisms of phagocytosis in macrophages. Ann Rev Immunol 1999; 17:593-623.

22. Gordon S. Alternative activation of macrophages. Nature Rev 2003; 3:23-35.

23. Vandivier RW, Fadok VA, Hoffman PR, Bratton DL, Penvari C, Brown KK, et al. Elastase-mediated phosphatidylserine receptor cleavage impairs apoptotic cell clearance in cystic fibrosis and bronchiectasis. J Clin Invest 2002; 109:661-70.

24. Berenson CS, Garlipp MA, Grove LJ, Maloney J, Sethi S. Impaired phagocytosis of nontypeable Haemophilus influenzae by

human alveolar macrophages in chronic obstructive pulmonary disease. J Infect Dis 2006; 194:1375-84.
25. Kei Yamasaki and Stephan F. van Eeden. Lung Macrophage Phenotypes and Functional Responses: Role in the Pathogenesis of COPD. Int. J. Mol. Sci. 2018, 19, 582; doi:10.3390/ijms19020582
26. Alexis NE, Soukup J, Nierkens S, Becker S. Association between airway hyperreactivity and bronchial macrophage dysfunction in individuals with mild asthma. Am J Physiol Lung Cell Mol Physiol 2001; 280:L369-75.