

Serum Adenosine Deaminase in Tobacco Factory Workers

B. Uma Devi, K.S.D. Kumar, S. Ramesh Babu, M. Swarna and P.P. Reddy

INTRODUCTION

Tobacco industry is one of the major industries in the world and over 5 million workers are employed in this industry. Workers employed in processing of tobacco are likely to be exposed to tobacco dust, volatile components and flakes via nasopharyngeal and cutaneous routes (Bagwe and Bhisey, 1991). The health hazards of tobacco are well established (Viegi et al., 1986). Besides, cytogenetic (Mahimkar and Bhisey, 1995) and genetic effects (Bagwe and Bhisey, 1993) and a high incidence of cancer in the tobacco factory workers were observed (Settimi et al., 1999).

Bagwe and Bhisey (1995) have reported increased absorption of tobacco constituents in tobacco processors due to occupational exposure and they have also demonstrated elevated cotinine levels in urine samples. Ghosh et al. (1985) have shown an increase in nicotine and cotinine levels in the body fluids of tobacco workers.

Adenosine deaminase (ADA) is an ubiquitous enzyme of purine salvage pathway that catalyses the irreversible deamination of adenosine to inosine and ammonia. ADA is widely distributed in human tissues and its principal biological activity is detected in T- lymphocytes. It is required for lymphocyte proliferation and differentiation (Sullivan et al., 1977).

The ADA activity increases during antigenic and mitogenic responses of lymphocytes and it is considered as important immunoenzyme marker for assessing cell mediated immunity (CMI) (Mishra et al., 1997).

Since the relationship between ADA activity and the cell mediated immune response is well established, the study was taken up to evaluate ADA activity in factory workers chronically exposed to tobacco dust.

MATERIALS AND METHODS

110 male tobacco factory workers with the

mean age of 37.64 ± 7.82 (Range 22 – 55 years), who were exposed to tobacco dust for the past 5 to 25 years were investigated. Detailed clinical histories and information pertaining to age, habits, previous illness, present health status were recorded using a standard questionnaire. All the subjects underwent lung function tests and tests to rule out low grade infections. Among 110 males, 70 were included in the study because they had no previous illness and were clinically normal during sample collection. The majority among the study group 48 were non-smokers and 22 were smokers. 70 age matched healthy males with the mean age of 37.42 ± 7.68 were selected for comparison.

Due care was taken during selection of the subjects because past or present infections is well able to give similar elevated serum ADA activity. None among the study group and controls had previous illness, cold or cough during sample collection and hence were included in the study.

For ADA estimation, 2ml of blood sample was collected into the serum separation tubes from both control and exposed subjects. The blood samples were centrifuged at 3000 rpm for 10 minutes and the serum was assayed immediately for ADA activity as described by Guisti and Galanti (1984).

50 μ l of serum was incubated for 1 hour at 37°C in 1ml of adenosine solution (20 mmol/l) buffered with phosphate (50mmol/l), pH 6.5. For determination of ammonia, 3ml of phenol nitroprusside and 3 ml of alkaline hypochlorite were added. Ammonium sulphate solution served as standard. The absorbance was measured at 630 nm in a shimadzu UV – 240 spectrophotometer. The activity of ADA is expressed in units/litre ie 1 μ l mol of ammonia released from substrate in 1minute at 37°C in 1 litre of assay material (μ mol/min/litre = units/litre). Serum albumin and total protein concentration were analysed by kit method supplied by Reddy laboratories, private limited, Hyderabad. Statistical analysis was carried out by 't' test.

RESULTS

Serum albumin and total protein concentration were also measured in exposed and control groups. In the exposed group the mean $\pm$ SD serum albumin levels were 4.34 ± 0.48 g/100ml and in the control group it was 4.27 ± 0.36 . The serum total protein concentration was estimated as 6.70 ± 0.54 g/100 ml in exposed and 6.78 ± 0.55 in controls. There was no difference in the serum albumin and total protein concentrations between the exposed and control groups.

The serum ADA levels in the tobacco factory workers and control subjects are shown in table 1. While the mean ADA activity was 16.22 ± 4.48 units/litre in the controls it has increased to 20.17 ± 6.30 units/litre in the factory workers. The increase in the ADA activity was statistically significant at 5% level.

Table 1: Serum ADA levels in tobacco factory workers and in healthy control subjects

Group		Serum ADA Mean $\pm$ SD	Serum ADA range
Tobacco factory workers	70	$20.17 \pm 6.30^*$	7.06 to 40.2
Healthy workers	70	16.22 ± 4.48	7.79 to 27.89

* $p < 0.05$

DISCUSSION

This is probably the first study on estimation of ADA levels in tobacco factory workers and no data are available in other occupationally exposed workers at risk for comparison. It is well established that the ADA levels reflect the activity of stimulated T-lymphocytes and its levels are raised whenever cell mediated immunity is stimulated. The increase in the mean activity of ADA levels can be attributed to the mitogenic responses of lymphocytes, due to tobacco exposure.

ADA shows its highest activity in lymphoid tissues, particularly in T-lymphocytes. Its activity in T-cells has been reported 5-20 folds higher than B-cells (Sullivan et al., 1977).

Hovi et al. (1976) reported increased ADA activity in lymphocytes in response to mitogen stimulation. Earlier studies have also shown elevated levels of serum ADA in tuberculosis

(Ocana et al., 1983), acute nephrotic syndrome (Mishra et al., 1997), leukemia (Smyth and Harrap, 1975) and patients with renal transplants (Yasmineti et al., 1977).

In our study some of the workers who are occupationally exposed to tobacco might have stimulated cell-mediated immune response which is an indirect indicator of T-cell activity. Further studies in this area are warranted to identify a sub group of workers with stimulated CMI response due to exposure to various toxic constituents of tobacco.

KEY WORDS Adenosine Deaminase (ADA). Cell Mediated Immunity. Tobacco Exposure.

ABSTRACT Adenosine deaminase (ADA) levels show the activity of stimulated T-lymphocytes and its levels are elevated whenever cell mediated immunity is stimulated. Serum ADA activity, a measure of CMI response was determined in 70 male tobacco factory workers in the age group of 25-55 years and 70 healthy males not exposed to any hazardous physical or chemical agents for control values. The mean ADA activity was raised in the factory workers. The increase in ADA activity in the workers was found to be statistically significant. The results clearly indicate the cell mediated immunity is impaired in factory workers as a result of exposure to toxic constituents of tobacco.

REFERENCES

- Bagwe, A.N. and Bhisey, R.A.: Mutagenicity of processed bidi tobacco: Possible relevance to bidi industry workers. *Mut. Res.*, **261**: 93-99 (1991).
- Bagwe, A.N. and Bhisey, R.A.: Occupational exposure to tobacco and resultant genotoxicity in bidi industry workers. *Mut. Res.*, **299**: 103-109 (1993).
- Bagwe A.N. and Bhisey, R.A.: Occupational exposure to unburnt bidi tobacco elevates mutagenic burden among tobacco processors. *Carcinogenesis*, **16**: 1095-1099 (1995).
- Ghosh, S.K., Parikh, J.R., Gokani, V.N., Rao, N.M. and Doctor, P.B.: Occupational health problems among tobacco processing workers: a preliminary study. *Arch. Environ. Health*, **40**: 318-321 (1985).
- Guisti, G. and Galanti, B.: Adenosine deaminase. In: *Methods of Enzymatic Analysis*. H.U. Bergmeyer. 1-3rd Edn., Verlag Chemie, Weinheim. Academic Press, New York) 315-323 (1984).
- Hovi, T., Smyth, J.E., Allison, A.C. and Williams, S.C.: Role of adenosine deaminase in lymphocytic proliferation. *Clin. Exp. Immunol.*, **23**: 395 (1976).
- Mahimkar, M.B. and Bhisey, R.A.: Occupational exposure to bidi tobacco increases chromosomal aberrations in tobacco processors. *Mut. Res.*, **334**: 139-144 (1995).
- Mishra, O.P., Rajiv, G., Ali, Z. and Usha: Adenosine deaminase activity in Nephrotic syndrome. *J. Trop. Pediatr.*, **43**: 33-37 (1997).
- Ocana, I., Jose, M., Ross, M.V., Fernandez, T. and Capdevilla, J.A.: Adenosine deaminase in pleural

- fluids, test for diagnosis of pleural fluids. *Chest*, **84**: 51-54 (1983).
- Settimi, L., Costellati, L., Naldi, M., Birsari, G., Orlando, S., Maiozzi, P.: Mortality among workers in an Italian cigarette factory. *Occup. Med. (Lond)*, **49**: 361-364 (1999).
- Smyth, J.R. and Harrap, H.R.: Adenosine deaminase in leukemia. *Br. J. Cancer*, **31**: 544-548 (1975).
- Sullivan, J.L., Oxborne, W.R.A. and Wedgwood, R.J.: Adenosine deaminase activity in lymphocytes. *Br. J. Haematol.*, **37**: 157-158 (1977).
- Viegi, G., Paggiaro, P.L., Begliomini, E., Vaghetti, E., Paoletti, P. and Guintini, C.: Respiratory effects of occupational exposure to tobacco dust. *Br. J. Indus. Med.*, **43**: 802-808 (1986).
- Yasmineti, W.G., Brynes, R.K., Lum, C.T. and Abbasnezhad, M.: Adenosine deaminase activity in lymphocytes of normal persons, leukemic patients and kidney – transplant recipients. *Clin. Chem.*, **23**: 2024-2029 (1977).

Authors' Address: B. Uma Devi, K.S.D. Kumar, S. Ramesh Babu, M. Swarna and P.P. Reddy, Institute of Genetic & Hospital for Genetic Diseases, Osmania University, Begumpet, Hyderabad 500 016, Andhra Pradesh, India

Address for Correspondence: Prof. P.P. Reddy, Institute of Genetic & Hospital for Genetic Diseases, Osmania University, Begumpet, Hyderabad 500 016, Andhra Pradesh, India

E-mail: reddypp@rediffmail.com