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Detection of Cell Homeostasis Imbalance in Subjects Exposed to Traffic Related Air Pollution

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Air-pollution promotes ROS generation and oxidative stress, causing imbalance of the antioxidant endogenous system.

The aim of this study has been to evaluate the role of thiol analysis by HPLC – cysteine (Cys), cysteinylglycine (CG), homocysteine (Hcy) and glutathione (GSH), which are redox balance parameters – for the early recognition of a risk-subject in a population exposed to environmental pollution. In a heavy polluted city, such as Milan, Italy, a group of subjects (n=38, age 82±9) living in hospices for retired people was enrolled and compared to a control population (n=42, age 70±8), living in Aprica, a remote alpine site, (1118 m a.s.l), with low traffic volume, in order to evaluate adverse health effects of traffic related air-pollution.

Daily levels of PM10, PM2,5 and PM1 were measured both by OPC detectors and low volume gravimetric detectors. Information on previous clinical history was collected. Spirometry and HPLC analysis on blood samples were performed for the evaluation of thiols (plasma total and reduced forms PT, PR respectively; erythrocytes total and reduced forms ET, ER respectively).

Results must be considered preliminary, because of the limited number of collected samples.

Table 1. Significantly different parameters. [mean±standard deviations (unpaired data T-test)].

	Milan µM	Aprica µM	p
PR Cys	10,7±4,4	8,0±2,1	0,01
PT Cys	459,8±155,2	286,3±74,8	<0,001
PT Hcy	27,7±19,9	14,5±10,6	0,001
ET Cys	62,2±45,4	33,7±20,5	0,013
ER Cys	2,5±0,8	1,5±0,6	< 0.001
ET CG	6,6±3,0	4,7±2,5	0.005

In order to match the population by age, we excluded patients over the age of 90 and under the age of 70 (table 2). After that, (*) significance increased in comparison with previous statistical analysis.

Table 2. Significant data in populations matched by age (Milan n=21, age 78±7; Aprica n=23, age 77±4). [mean±standard deviations (unpaired data T-test)].

	Milan µM	Aprica µM	p
PR Cys	13,6±3,4	7,7±2,0	0,001*
PT Cys	427,1±152,2	280,4±74,9	<0,001
PT Hcy	28,3±23,6	13,8±7,5	0,012
PR CG	2,4±0,6	1,7±0,6	0,007
PR GSH	2,2±1,0	1,4±0,8	0,025
ET Cys	73,1±31,5	45,8±23,4	0,003*
ER Cys	2,8±0,8	1,4±0,5	< 0.001
ET CG	7,7±3,5	4,9±2,8	0.006
ER CG	2,0±0,9	1,5±0,7	0,047

There was no evident difference in the GSH levels between the two populations. In fact, GSH alteration is a late event, occurring in severe imbalances and no subject in both groups had clinically evident pulmonary diseases. The increase in PT and PR Cys (a pro-oxidant) is likely caused by a lower intake into the erythrocyte. Moreover, the higher concentrations of E-Cys suggest that in the cell there is an obstacle to the condensation of Cys with glutammic acid in the $\tilde{\gamma}$-glutamil cycle. In the Milan's group high Hcy levels indicate that it is not being used for cystationine synthesis. Moreover, the excessive presence of P Hcy and P Cys promote the production of ROS, altering redox state and cell homeostasis. At the same time, lower levels of PR GSH show an increase of $\tilde{\gamma}$-GT activity and, consequently, of plasmatic GSH peroxidase.

Inhabitants of areas with different traffic volumes show significantly different Cys CG and Hcy levels even if GSH remains unchanged, suggesting a greater- pro-oxidant effect in more exposed populations, affecting Cys CG and Hcy levels, before GSH alterations. Therefore, analysis of thiol redox balance in plasma and erythrocytes is able to distinguish between more and less exposed subjects and could be a useful diagnostic tool for early detection of subjects at higher risk of health effects from environmental pollution.

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