

Effect of respirable silica dust levels toward interferon- γ in Sandblasting workers

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Abstract- Sandblasting is a metal working process by way of firing a silica sand of high pressure to the surface of the ship. These jobs produce a silica dust can cause inflammation of the respiratory tract, decrease lung function and affect serum levels of interferon- γ . The purpose of the study was to analyze the Effect of respirable silica dust exposure toward interferon- γ in Sandblasting workers. The study was conducted in 2016. Researchers study design using analytic observational with cross sectional design. Population in this study were all sandblasting workers and comparison group is administrative staff. The study sample consisted of 8 sandblasting workers and 8 administration staff. Data analysis using multiple linear. Result showed there effect of personal respirable silica dust levels on levels of serum interferon- γ ($\beta = 2,567$; $p = 0,035$), that meaning the direction is a positive correlation means higher levels of respirable silica dust, it can lead to an increase in interferon- γ levels in blood serum. The result showed, personal respirable silica dust levels affect the increased interferon- γ levels in blood serum.

Keywords- Silica Dust1, Interferon gamma2, Sandblasting workers3

1. INTRODUCTION

Silica particles are ubiquitous in the environment, even constituting a portion of the small particulate fraction of air Pollution. Respirable silica dust mean is that portion of airborne crystalline silica that is capable of entering the gas-exchange regions of the lungs if inhaled. Excessive exposure to respirable particles of crystalline silica is an occupational health problem in developing countries and can cause a variety of pulmonary diseases, such as silicosis, chronic obstructive pulmonary disease (COPD), and malignancy, in susceptible hosts. In addition to the well-documented role of pulmonary macrophages, lymphocytes occasionally have been suggested to influence the pneumoconiotic process, but their potential role is not clearly understood. Interferon gamma (IFN- γ), a lymphocyte cytokine, is recognized as the most important cytokine in converting macrophages from a resting to an activated state

Dust particles of silica dust which included one of the risk of causing lung disease. Silica dust can be found in rocks and metal processing, in the ceramic industry, in coal mines, iron and steel as well as in the process of sandblasting (NIOSH, 2002). Sandblasting is a process in which metal working metal surface made rough and flat with the degree of roughness and specific erosion rate according to the needs by firing abrasive to a metal surface with a certain pressure. Sandblasting jobs in Indonesia still use manual that workers hold high-pressure hose to spray silica sand. This job risks include wound on the surface of the skin or eyes, and silica dust buildup in the lungs called silicosis (Susanto, 2015). Based on Presidential

Decree 22 in 1993, mentioned various diseases arising from work, one of which is pneumoconiosis. Silicosis include a Pneumoconiosis diseases.

Silica dust is a fine dust (solid) with a diameter of 0.02 to 0.08 μm with a density of 2.65 g / cm^3 at 0 ° C. Pollution respirable dust containing silica will settle in the bronchioles and alveoli. This dust is Fibrogenic and can cause restrictive lung disorders. The main reactions due to exposure silica dust in the lungs is fibrosis (Susanto, 2011).

One of the body's defensive reaction caused by dust inhaled by workers is the dust phagocytosis by macrophages. Dust particles will stimulate alveolar macrophages to release products that are mediators of the inflammatory response and initiate a process of fibroblast proliferation and collagen deposition. According to Migliaccio et al (2005) Interferon- γ and tumor growth factor also plays a role in macrophage phagocytosis. The mediator is very important to the process of fibrogenesis. Failure Phagocytic macrophages by IFN- γ , can lead to fibrosis which in turn will lower the working efficiency of the lung (Isa servant, 2006).

The purpose of this study was to analyze the effect of silica dust exposure toward interferon- γ levels in Sandblasting workers.

2. METHODS

This Researchers was study design using analytic observational with cross sectional design. Population in this study were all sandblasting workers (exposure group) PT. Dock and Shipping Surabaya.

As a comparison group is administration staff. The study sample consisted of 8 sandblasting workers and 8 administration staff. Technique of data collection was done by conducting interviews, personal dust measurement and workers took blood samples. Blood serum taken aims to determine the level of interferon- γ measured aim to determine the condition of the lungs workers. Examination of IFN- γ in blood serum using human interferon gamma ELISA kit with ELISA high sensitivity methods and measurement Personal dust using PDS (Personal Dust Samplers). Technique data collecting by interview using a questionnaire about age, years of smoking, and the use of Personal protective equipment.

Interferon- γ level is dependent variable. Meanwhile, respirable silica dust as independent variables. Age, duration of work activity, smoking habit and used of personal protective equipment as a confounding variable. The multiple regression was used for determination of the association between silica dust exposure, age, period of work, smoking habit and used of personal protective equipment with the interferon gamma levels. Result were considered to be statistically significant at $p < 0,05$.

3. RESULT

Particles of silica dust samples taken using Personal Dust Sampler (PDS) by using the silica glass fiber micro filter, so that it can be seen that respirable silica dust by sandblasting workers during work. Based on Minister of Manpower and Transmigration No.Per.13 / Men / X / 2011 on the value of the threshold levels of dust (respirable particulate matter) in the workplace is 3 mg/m^3 . Table 1 shows that the average personal exposure to the dust exposure group was 3.96 greater than the unexposed group was 0.12 and this value exceeds the threshold value ($> 3 \text{ mg/m}^3$).

Tabel.1 Distribution of Responding According to Respirable Dust 2016

Respirable Silica Dust Levels	Mean \pm SD	Min	Max
Exposed	3,96 (0,64)	3.0441	4.8465
Unexposed	0,12 (0,02)	0,1	0,16

Source : Primary Data

Levels of IFN- γ (Interferon Gamma) serum was analyzed using ELISA method. The measurement results of IFN- γ levels in blood serum of exposed and unexposed groups can be seen in Table 2. Table 2 shows that the average levels of interferon gamma in the exposed group was 231.37, the value was greater than the unexposed group was 66.25. This means that value exceeds the treshold value of IFN- γ serum levels in the blood serum (0-188.9 pg / ml).

Tabel.2 Distribution of Responding According to Interferon Gamma Levels 2016

Source : Primary Data

Based on the frequency distribution of respirable silica dust and the levels of IFN- γ serum

IFN- γ levels in blood serum	Mean \pm SD	Min	Max
Exposed	231 (177,6)	87	634
Unexposed	66,25 (69,90)	0	217

showed that the respirable silica dust in sandblasting workers exceed the threshold value, which was in line with increased levels of IFN- γ on sandblasting workers significantly different with administration staff.

Effect of respirable silica dust levels on levels of IFN- γ in blood serum were analyzed using multiple regression test with the following results.

Tabel.3 Analysis Effect of Respirable Silica Dust Toward Interferon Gamma Levels in Sandblasting Workers 2016

Variable	IFN- γ levels	
	B	p
Respirable Dust	2,622	0,016
Age	-0,223	0,715
Period of work	0,163	0,771
Smoking Habit	-0,227	0,297
Personal protective equipment	2,000	0,062

$p < 0,05$ (Significant)*

Table 3 showed that there are significant silica dust exposure on the levels of IFN- γ in blood serum ($\beta = 2.567$; $p = 0.035$). So we can say that the higher the levels of respirable silica dust in person, the higher the levels of interferon gamma in blood serum of respondents. Meanwhile, other variables such as age, years of smoking and the use of masks has no effect on levels of interferon gamma in blood serum.

This is in line with research conducted by Polatli et al., (2008) states that the average levels of IFN- γ serum increases in workers exposed to silica dust ($10.22 \pm 22.68 \text{ pg / mL}$). Free of silica dust entry into the respiratory tract activates macrophages (activated alveolar machropage), so phagocytosis by macrophages, but the macrophages die or damaged thus increasing the activity of APC (antigen-presenting cells) and cell T indirectly thereby increasing levels of interferon gamma serum , IL-13

and IL-4 (Hamilton et al., 2008). Baratawidjaja (2010) also states that the failure to issue phagocytosis by macrophages CD4⁺, natural killer and CD8⁺. Silica dust will stimulate increased IFN- γ in blood serum. IFN- γ will activates macrophages, endothelial and epithelial. For the body's defense system, the epithelium release Th1 and Th2 immunity. Interferon gamma produced by Th1 immunity. Because IFN- γ failed to reduce silica dust, then an increase in matrix metalloproteinase and increase collagen production.

According to the forman (2004) states that the silica dust that enters the lungs will stimulate alveolar macrophages to secrete inflammatory mediators (cytokines), thereby increasing the activity of PMN (polymorphonuclear) and when the levels of free radicals (dust particles) is too high then the ability of inadequate endogenous antioxidants to neutralize free radicals therefore is unequal between free radicals with antioxidants, in this situation there fibrosis.

4. DISCUSSION

Production of chemokines, inflammatory cytokines, and growth factors is believed to be a key event in the initiation and progression of silica-induced lung disease.

Silica (SiO₂) is quite cytotoxic, leading to both necrosis and apoptosis (Leigh et al., 1997; Iyer et al., 1996), but it seems unlikely that cytotoxicity alone would lead to a loss of tolerance since the ingestion of apoptotic bodies by phagocytes normally down-regulates production of inflammatory cytokines (Fadok et al.,1998). One of Inflammatory cytokines is

Interferon gamma. Davis et al. describes a cycle that could possibly ensue once the lung lymphocytes are activated. This would involve the release of IFN- γ and other mediators attracting and activating a secondary population of macrophages, creating a cycle or loop of inflammation. Silica particles may simply increase overall macrophage functions indiscriminately, or alter specific components directly involved in T cell activation. Cell T produce of interferon gamma in blood serum in figure 1 (Hamilton et al., 2008).

Schematic of figure.1 of the potential sources of autoimmune dysfunction with regard to silica (SiO₂) processing and the alveolar macrophage (AM). Excessive cell death and apoptosis can lead to a source of auto antigens (apoptotic bodies, self-protein, DNA). The AM/Tcell interaction after silica exposure in vitro has been characterized by enhanced T cell activity determined by excessive IL-4 (human only), IFN- γ , and IL-13 release. The free silica particle is indicative of the fact that SiO₂ can be internalized more than once by different AM due to its capacity to kill the engulfing cell (Hamilton et al., 2008).

Silica dust is toxicity, resulting in lung incubation period of about 2-4 years (wardhana, 2001). The absorption silica dust through the respiratory channel speed dependent pulmonary blood flow, the nature of the polarity of gas and particle size. The thinness of the walls of the lung (alveoli cell layer) facing the walls of blood capillaries and the extent of the surface of the lungs through the pulmonary absorption walk quickly (Tualeka, 2013). This dust is Fibrogenic so in activities affecting the levels of interferon gamma. Due to Interferon gamma is one of the endogenous cytokine that has a

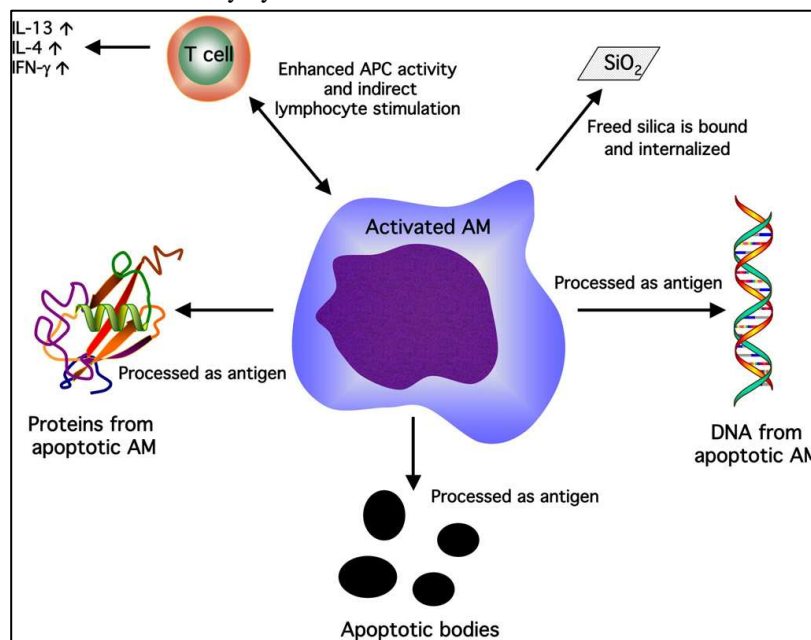


Fig. 1. Macrophage Activation Process by SiO₂ (Silica Dust)
Source : Hamilton et al.,2008

multifunctional one is as an anti-fibrotic (Zaidi and Merlino, 2011).

Silica dust into the lungs can increase the activity levels of interferon gamma in the blood serum of respondents. As research conducted by Palabiyik et al., (2013) states that there is an increased IFN- γ on sandblasting workers in turkey.

5. CONCLUSION

Based on the results obtained from this study, it can be concluded that average levels of silica dust personally by sandblasting workers have exceeded the threshold limit value (3.96 mg / m³), while the levels of respirable dust administrative employee still under NAB (0.12 mg / m³). The mean serum levels of interferon gamma in blood sandblasting workers increased (231.37 pg / ml), whereas serum gamma interferon administration officials are still in the normal range (66.25 pg / ml). and based on analysis of data obtained personal exposure to silica dust increases levels of interferon gamma in blood serum sandblasting workers.

6. SUGGESTION

Required the use of personal protective equipment such as mask type N95 (Particulate Respirator) for the protection of silica dust with a concentration of <3 microns. Periodic health examination is required to maintain the health of the workforce after being on the job, as well as assessing the possible effects of the work as early as possible need to be controlled by prevention efforts. Periodic health examinations for workers at least 1 year. Periodic Health Examination includes a complete physical examination, physical fitness, lung x-rays (if possible) and routine laboratory and other examinations deemed necessary.

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