



12.2 The Results of Medical Surveillance of Beryllium Production Personnel

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The report presents results of surveillance of 1836 workers of beryllium production of Ulba Metallurgical Plant JSC with the acute and chronic forms of occupation diseases for 52 years of its operation.

The dependence of acute and chronic occupation lesions on the protection degree is shown. It has been found out that, the risk of getting an occupation disease increases sharply at the moments of experimental works and at the time of reconstruction and some other extreme conditions in the production, that is supported by fixed lesions of eye mucous coat, skin and lung lesions. In this case, the readiness of people for their work in deleterious conditions and their personal responsibility for following the regulations of safety occupational standards plays a definite role.

Therefore, the issues of protection are of paramount importance in prophylaxis both of acute and chronic exposure to beryllium. An influence of duration of service and occupation on chronic beryllium diseases is shown. A parallel between the lung beryllium disease and skin lesions by insoluble beryllium compounds is drawn for the first time.

The problem of beryllium and its compounds intoxication is attracting attention of scientists, doctors and hygienists within already several decade of years.

However many aspects of these investigations are still little studied.

It is well known at present that beryllium is an extremely dangerous material, required not only specific protective measures when operating it, but a continual medical observation of the staff handling this material as well.

This report includes a review of medical observations of beryllium production Table 1

staff which have being carried out at JSC “UMZ” within the last fifty-two years.

As everybody knows, there are three main kinds of illnesses related to beryllium.

Among them are conjunctivitis, dermatitis and lungs injury.

They can have either acute or chronic form.

It was registered total 1836 occupational diseases within 52 years of beryllium production operation at UMZ.

Diseases structure and form are given in the Table 1

Number of Patients by Kinds and Forms of Diseases

Disease	Acute	Chronic	Total
Occupational lungs disease	252	484	730
Occupational dermatitis	602	43	645
Occupational conjunctivitis	432	23	455
TOTAL	1286	550	1836

The most of occupational diseases, basically of acute forms fall on the period since 1954 up to 1965 (10 years).

It was a period of beryllium production putting into operation.

During these years it were registered about 1156 acute and 72 chronic forms of berylliosis (total 1228 cases) which comprised to 66% of total beryllium injuries within the whole period of beryllium production operation.

The most of injuries were acute beryllium injuries (95,1%) due to the lack of reliable individual protective measures, as well as poor production technology, technique

and industrial engineering.

Besides, toxic properties of beryllium were insufficiently studied that caused the quick increase of acute occupational diseases within the period of beryllium production start-up and reconstruction.

Chronic berylliosis has an eclipse period of development from 3 up to 5 years and more; therefore the first case of chronic berylliosis was registered only in 1956.

Since 1970 acute diseases began to decline and on the contrary, chronic diseases began to increase due to the previous negative impact of beryllium on the staff of production.

Table 2
Forms and occupational diseases be periods

Years	Acute berylliosis		Chronic berylliosis		Total
	Number	%	Number	%	
1951-1955	96	100	-	-	96
1956-1960	264	85,4	45	14,6	309
1961-1965	796	96,7	27	3,3	823
1966-1970	77	68,7	35	31,3	112
1971-1975	26	23,6	84	76,4	110
1976-1980	19	19,2	80	80,8	99
1981-1985	7	5,3	124	94,7	131
1986-1990	1	0,9	83	99,1	84
1991-1995	-	-	51	100,0	51
1996-2000	-	-	15	100,0	15
2001-2002	-	-	6	100,0	6
1952-1953	- beryllium production putting into operation		1955 - 1956	- beryllium hydroxide and acetate beryllium	

oxide production
workshop putting in
operation
1959-1962 - beryllium production
modernization

The high level of occupational morbidity within the starting period of beryllium production operation predetermined the necessity to improve working conditions at this UMZ production area.

To reduce the risk of berylliosis incidence various actions were taken at UMZ including:

- the division of production sites in areas by dust content;
- the development and introduction in practice norms and rules for work in these areas;
- the establishment of a specific laboratory for a continuous control and monitoring of beryllium content in the air of production sites, facility area and outside the production territory;
- the obligatory providing of all personnel handling beryllium with clean overalls provided it changing without fail during each entrance-exit to the production area;
- the obligatory usage of individual protection means in the production areas even when beryllium content in air is lower than permissible limits;
- the introduction of a specific diet therapy, a half-day (36-hours workweek), prolonged annual leave (30-56 working days);
- the introduction of obligatory annual and preliminary (during giving an employment) medical survey.

The made improvements of the "know-how", improvement of working conditions and means of protection have

lowered a level of incidence and have changed a structure of occupational pathology aside prevalence of chronic diseases. So, since 1982 acute occupational diseases of lungs, since 1987 - acute dermatitis and since 1988 - acute conjunctivitis are not registered at all.

Speaking about acute skin injuries, it have been noticed, that they arise usually within the first 3 months and less often after 1 year from the beginning of contacting with beryllium compounds. As well as many authors, we are inclined to think of the allergic nature of these injuries, first of all.

The most aggressive are fluorine compounds - beryllium fluoride and ammonium fluoroberyllate, and less aggressive are beryllium sulfate and beryllium hydroxide.

It would be desirable to draw attention to the insufficiently studied form of skin injury - beryllium granulomas. They arise when contacting with insoluble beryllium compounds (rough and distilled beryllium metal, beryllium oxide). A condition for their occurrence is skin damages, more often - microtraumas that are disregarded at all. Therefore, the factor of skin protection plays an important role in prophylaxis of beryllium injuries.

Starting from 1951 up to 2002 it were registered 25 cases of skin beryllium granulomas at Ulba plant, confirmed by histological (microscopic) methods of research.

It was noted, that the overwhelming quantity of beryllium granulomas of skin falls to persons with the experience of work of 11-15 years and more (60 %), i.e. the duration of contact with beryllium increases the rate of probability of traumatic skin damages and penetration of insoluble beryllium through it.

Table 3
Occurrence of beryllium granulomas of skin depending on the experience

Total injuries	Contact with beryllium				Total
	Up to 5 years	6-10 years	11-15 years	More than 15 years	
Absolute number	4	6	8	7	25
%	16	24	32	28	100

Table 4
Occurrence of beryllium granulomas of skin depending on the profession

Occupation	Number of people	%
Operator	22	88
Other operating personnel	3	12

Table 5
The period of development of lungs berylliosis after appearance of skin beryllium granulomas

The period of development of lungs berylliosis after appearance of skin beryllium granulomas	Number of people	%
Up to 1 year	4	16
1-3 years	9	36
More than 5 years	4	16
Berylliosis has not developed	8	32
Total	25	100

There are no specific distinctions by sexual attribute: men - 12 (48 %), women - 13 (52 %) (tab. 3).

Depending on occupation, foremost are operators (tab.4).

The special item of these researches is the problem of beryllium granulomas transformation to lungs berylliosis.

Apparently, at 1/3 of total patient's lungs berylliosis has not developed during the years, which followed, and at 2/3 of patients (68 %) it has developed, basically, in the first 3 years after occurrence of skin granulomas.

Granulomas progressing on skin and pulmonary tissue of berylliosis diseased patients have the same histopathologic features.

An increase of chronic occupational berylliosis (lungs granulomatosis) and the continued up to now cases of its detection under the improved working conditions testify to the allergic nature of this disease.

Basically, these diseases are connected with technological processes, which are characterized by presence of vapor-phase, aerosol or dust insoluble beryllium compounds in air (metallurgical production of beryllium, production of beryllium powders and beryllium oxides, beryllium metal machining, repair of the equipment, etc.). At that, technological and maintenance personnel take the risks of their health first of all. (tab. 6)

Table 6
The quantity of occupational patients by occupation

Occupation	Quantity, %
Instrument control man	48,6
Maintenance man	13,6
Experts (engineering and administrative staff)	11,6
The other personnel (electricians, turners, laboratory assistants, cleaners and others)	26,2

Table 7
Quantity of professional patients by length of contact with Be

Duration of contact with beryllium	Quantity, %
Up to 5 years	15,1
6-10 years	19,0
11-15 years	24,1
16 years and more	41,8

Table 8
Quantity of professional patients by scale of age

Duration of contact with Beryllium	Quantity, %
23-40 years	5,0
41-50 years	57,8
51 and upward	37,2

The risk to get chronic lungs berylliosis grows with the increase of beryllium contacting period, that is an evidence of host defenses reduction with respect to beryllium impact during the long period of work at beryllium production (tab.7)

The probability to fall ill of chronic berylliosis grows with age.

The most of professional patients (95%) has age from 41 years and upward (tab. 8). Tables on the experience and age supplement each other and once again testify to the increased risk to get a disease during the enlarged period of contact with beryllium.

These data are to be certainly analyzed considering the change of working conditions due to technological development.

That is, among the group of people aged 41 years and upwards having the long period of work with beryllium there are patients who started to work in the worst conditions (50-70 years) and among which there is the greatest percent of diseased people.

Among a diseased people 79,5 % are men and 20,5 % - women.

The middle age of patients diseased with lungs berylliosis is 44 years. The average duration of disease period starting from its detection up to a fatal outcome makes 8 years, and sometimes - from one year up to 3 years.

Chronic lungs berylliosis has the most serious consequences and is practically

an incurable illness.

Chronic lungs berylliosis results in the development of pulmonary and cardiac insufficiency that finally became a principal cause of patient's death.

The analysis of the causes of death of 270 professional patients has shown, that in 128 cases (47,4 %) an occupational disease (development of pulmonary and cardiac insufficiency of different extent) was mainly responsible for death, in 120 cases (50,4 %)

the prime cause was a concomitant complication.

In 43 cases (15,9 %) oncological diseases of various localization, mainly lung cancer, were responsible for death, and in 20 cases (46,5 %) - all oncological pathology. Therefore, data available at UMZ give no single-valued reasons to consider beryllium to be a carcinogenic substance.

Table 9
The reasons of mortality among occupational patients

The reason of mortality	Number
Pulmonary and cardiac insufficiency	47,4
Malignant neoplasms of different localization	15,9
Cirrhosis	1,5
Ichemic heart disease	16,3
Acute cerebral circulation disturbance	3,7
Poisonings (suicides), injury	8,2
Other reasons	7,0
Total	100,0

The most serious category of the diseased, from the medical point of view, are the patients suffering from lungs berylliosis.

The constant hypoxia due to the alveolar-capillary block makes a life of such patients intolerable, to what cases of a suicide of such people testify.

We did not observe any case of reverse development of lungs granulematosis, but two categories of sick persons with slow and fast progressing of disease to which there is no explanation yet, are precisely traced. Probably, it is connected with immunological status of an organism, but it is only our assumptions.

Corticosteroid hormones and immunomodulators used now, slow down clinical course, however, complications from application of these medications (hormonal dependence, steroid diabetes, diseases of

blood, etc.) limit their application.

Due to serious consequences of granulematosis a paramount role in it preventions, from the medical point of view, have its diagnostics and prophylaxis. Without going into medical details, it is quite possible to ascertain, that both these problems are far from resolution as of today. The most important is to identify those persons at the stage of giving the employment, who are sensitive to beryllium and to exclude their contact with it.

The second moment is the treatment of patients, which are already struck by beryllium.

Unfortunately such problems are not among primary medical problems in medical practice due to its little social significance (not many patients, considerable costs for

researches make it easier to prohibit the production and use of beryllium).

For the present time the most efficient way to depress occupational diseases rate is to prevent it by reduction of direct exposure of man to beryllium.

However, the knowledge of beryllium problem will be called for sooner or later, so as beryllium is in demand now.

There are no useless elements in the nature, and if beryllium is presented in the periodic system, it will be presented in the list of materials in use as well. In our opinion, data on occupational incidence available at UMZ, contingent for carrying out researches

on this problem, the availability of medical basis can appear to be useful for the decision of medical problems connected with berylliosis, as well as for ITER program.

At present we are observing the following patients (as of 01.01.2003)

- Patients with lungs injury by beryllium – 285 people
- Patients with chronic dermatitis and granulomas caused by beryllium impact- 25 people
- Patients with chronic conjunctivitis – 3 people

Total 313 people

CONCLUSIONS

Based on medical observations of beryllium production personnel, which were carried out within 52 years, we can make the following conclusions:

1. The level of occupational diseases directly depends on the level of production process as well as on the extent of personnel protectability.
2. Risk of lungs injury by berylliosis increases in a direct proportion with an employee age and the period of work with beryllium.
3. Acute form of berylliosis can entirely be eliminated due to the compliance to the rules and norms of beryllium handling.
4. Chronic forms of berylliosis at this point are inevitable.
5. The main efforts of beryllium medicine must be aimed at the problem of chronic berylliosis including the elaboration of true diagnosis procedures and efficient methods for lungs granulomatosis prophylaxis and treatment.

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