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A CONTRIBUTION TO THE LABORATORY DIAGNOSTICS OF EARLY SATURNISM*

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With regard to the difficulties encountered in the diagnosis of early saturnism the authors have developed a diagnostic test consisting of the peroral administration of 3 g of Ca_2EDTA (3 × 1 g per day). If urinary lead excretion is after that found to amount to more than 0.340 mg Pb/24 h, it can be considered as indicating the possibility of saturnism.

It is known that certain difficulties are encountered in the diagnostic of saturnism regardless of the stage of poisoning – yet greater if an early stage of poisoning is in question. If the clinical symptoms and subjective complaints (loss of appetite, exhaustion, palour, blue line, constipation, asthenia, etc) are present, as well as a positive occupational history, we are in most cases able to ascertain the stage of poisoning and remove the worker from dangerous exposition. Laboratory results are an additional evidence confirming the degree of exposition in these cases. We have to consider the laboratory results in each case regardless of the fact that there is no saturnism without clinical symptoms. If latent saturnism, presaturnism or an early saturnism are in question, laboratory analysis and results are the only help and indicator to a correct diagnosis and undertaking of adequate measures of prevention.

The present knowledge of laboratory test values applied in suspected cases of saturnism it not definite. Some normatives are nevertheless accepted in everyday work.

Stippled cells as non-specific signs may be considered if they outnumber 1000 per million erithrocytes.

Blood lead does not reflect the real quantity of lead in the organism. It is normally considered that its upper limit is 0.060 mg%.

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Coproporphyrin in the urine is, according to many authors, one of the first symptoms of lead poisoning, especially in the cases of early saturnism. It is normally considered that the upper limit of coproporphyrin in the urine amounts to 0.120 mg/24h.

Urinary lead is found in each exposed person. The normal concentration is cca 0.120 mg/24h.

Very useful data for an evaluation of the exposition, early diagnosis and assessment of working environment may be obtained by pathophysiological facts (through laboratory tests), circulation of lead through the blood and its deposition in soft tissues and bones. This is possible if lead is mobilized from the stores and if urinary lead concentrations are established, as certain investigators have already tried to do 1, 2, 3, 4, 5, 6, 7, 8).

We have used Mosatil tabloids (each tabloid contains 0.5 g of Ca_2EDTA) to mobilize the stores and to work out a »diagnostic test« primarily for the purpose of outpatient work (9).

The resorption of the perorally applied EDTA is considerably lower, although effective (10, 11, 12, 13, 14, 15). In addition, Ca_2EDTA tabloids are very convenient for outpatient practice. Table 1 contains various data on the resorption of EDTA by peroral application.

Table 1

Author	Year	% resorption of Edta
White	1953	1.5–4,5
Foreman, Trujillo	1954	4.2±2
Hecht, Eiken	1956	4.0
Srbova, Teisinger	1957	2.6
Pagnototto	1958	0.3
Stanković, Petrović, Poleti	1960	3.0–4.0

In this study urinary lead was determined by the polarographic method (16). Coproporphyrin was extracted by aether extraction from the acidified urine. The content of coproporphyrin was obtained by measuring the absorption of coproporphyrin by the spectrophomotometer (17).

The urinary lead excretion is usually increased after the administration of EDTA to healthy persons not exposed to lead, as EDTA mobilizes even the smallest lead quantities from the organism. We administered 3 g of Ca_2EDTA to 8 healthy persons – employees, and noted that the mean excretion amounted to 0.117 ± 0.043 mg/24h. Table 2 contains our results found in healthy persons compared with results of some foreign authors who also administered EDTA (1, 2, 3, 4, 5, 6, 7, 8). It

can also be observed that our results slightly differ from the results of other authors, probably because the dosages and ways of taking the drug were different.

Table 2

Author	Year	Edta	Excretion in normal persons
Hardy et al.	1954	I. V. inf.	0.09–0.65 mg/24h
Riedcrs, Briegcr	1955	I. V. Infus.	1.00 mg/lit.
Salvini	1955	I. V., 1 g.	0.50 mg/24h
Desoille et al.	1957	I. V. Inf. 2. g.	0.80–1.00 mg/lit.
Desoille et al.	1957	Per os, 4 g.	0.50 mg/lit.
Bastenier et al.	1957	12 mg/kg.	0.30 mg/lit.
Unseld	1958	I. V., 1.2 g.	0.30 mg/lit.
Albahary et al.	1958	Per os, 4 g.	0.40 mg/lit.
Albahary et al.	1958	I. V 0.5 g	0.80 mg/lit.
Teisinger, Srbova	1959	I. V., 3 g.	0.35 mg/24h
Stanković et al.	1960	Per os, 3 g.	0.062–0.189 mg/24h

In order to determine the diagnostic test in persons with positive occupational history and to establish definite lead exposition in the limits of MAC to 0.150 mg/m^3, we administered perorally 3 g (3 × 1 g of Ca_2EDTA in the course of one day) to a group of 29 printers. The group was observed in order to establish the maximum urinary lead excretion in persons without clinical manifestations of saturnism. The laboratory results were also negative.

The second group consisted of 18 lead smelters to whom the same dosages of Ca_2EDTA were administered and who had established symptoms of lead poisoning.

Table 3

Group	Number of cases						
		Range	Mean	Stand devi-ation	Range	Mean	Stand devi-ation
I	29	0.040–0.088	0.058	0.016	0.110–0.445	0.236	0.101
II	18	0.132–0.515	0.322	0.115	0.782–5.820	2.476	1.233

Note: I Group: Printers without clinical signs of saturnism
II Group: Lead exposed workers with the signs of presaturnism

Equation of standard deviation: $s = \frac{\Sigma x^2}{n} - \bar{X}^2$

Table 3 contains the results of investigation obtained in these two groups, with all the necessary statistical data. The first group had an average urinary excretion of 0.236 mg lead in 24 hours ± 0.101 mg/24h. The conclusion is, for the outpatient practice, that every person with urinary excretion of over 0.340 mg Pb/24h (after the peroral treatment with 3 g of Ca_2EDTA) may be considered as suspected of saturnism.

It may be noted, from the results obtained in the second group, that the values are much higher and amount to 2.476 ± 1.233 mg Pb/24h. The excretion differences here are much higher. This is understandable, since the persons treated had clinical manifestations of saturnism with rich lead stores. In practice for such cases the diagnostic test is not needed.

Lead provocation may be obtained by the administration of the Ca_2EDTA in the case of the persons who had an established lead exposition and stopped working with lead, in order that their return to the old job may be decided upon.

The same quantities of Ca_2EDTA were administered to the group of 8 workers considered as medically rehabilitated (especially as the blood lead, urinary lead and coproporphyrin were below allowed concentrations) and fit to return to their jobs with lead exposure after an average break of 5 years. Table 4 contains the results obtained after the administration and submission to a diagnostic test. It may be noted that fairly high concentrations of urinary lead were excreted and that the stores in the organism were rich in lead. This indicates that these

Table 4

Cases	Contact with lead (year)	Before treatment with Ca_2EDTA		24h after first dose		48h after first dose	
		Urinary lead mg/24h	Urinary coproporphyrin mg/24h	Urinary lead mg/24h	Urinary coproporphyrin mg/24h	Urinary lead mg/24h	Urinary coproporphyrin mg/24h
O. S.	4	0.085	0.051	0.401	0.058	0.285	0.063
I. R.	5½	0.093	0.057	0.249	0.040	0.500	0.060
J. DŽ.	8½	0.112	0.070	0.659	0.084	0.458	0.079
M. L.	7	0.108	0.078	0.843	0.085	0.654	0.061
M. M.	5½	0.064	0.069	0.491	0.052	0.543	0.051
S. S.	3½	0.108	0.082	0.412	0.049	0.480	0.055
S. M.	5	0.085	0.079	0.336	0.074	0.446	0.051
R. R.	5½	0.110	0.096	0.462	0.060	0.456	0.091
Mean	5½	0.095	0.073	0.482	0.063	0.478	0.064

workers were not fit to return to their previous jobs. In addition to differences in the urinary lead excretion before and after the administration of 3 g of Ca_2EDTA, coproporphyrin decreased in this group as well.

The control group consisted of 5 laboratory technicians who were submitted to the same analysis and treated in the same way. Table 5 contains the results of this group. It may be observed that urinary lead excretion is considerably lower than in the group examined, and below 0.340 mg/24h, due to normal stores of lead in the organism, that is to the lack of lead exposition in the past.

Table 5

Cases	Contact with lead (year)	Before treatment with Ca_2EDTA		24h after first dose		48h after first dose	
		Urinary lead mg/24h	Urinary coproporphyrin mg/24h	Urinary lead mg/24h	Urinary coproporphyrin mg/24h	Urinary lead mg/24h	Urinary coproporphyrin mg/24h
S. S.	—	0.027	0.068	0.189	0.069	0.115	—
L. S.	—	0.052	0.069	0.168	0.070	0.074	—
J. D.	—	0.069	0.062	0.185	0.061	0.093	—
R. V.	—	0.068	0.056	0.243	0.059	0.270	—
M. M.	—	0.087	0.068	0.317	0.065	0.252	—
Mean	—	0.061	0.065	0.220	0.065		—

CONCLUSION

1. For an early diagnosis and prevention of saturnism the control in fixed intervals (of approximately 6 months) is required in the cases of all exposed workers, with a laboratory analysis of biological material (blood count, blood lead, urinary lead and coproporphyrin). If no clinical symptoms are found and if the results of the laboratory analysis are atypical, being on the upper limit of allowed values, in such suspected cases a diagnostic test by peroral administration of 3 g of Ca_2EDTA (3 × 1 g per day) is recommended. If urinary lead excretion amounts to more than 0.340 mg Pb/24h, this may reasonably indicate the possibility of saturnism.

2. The diagnostic test may be applied in the cases of the workers who had a positive occupational history in the past and were removed from their jobs to avoid exposure to lead. If by applying the diagnostic test it is established that the urinary lead excretion is not high – not over 0.340 mg/24^h – and confirming that no lead stores exist, such workers may be allowed to return to their jobs with lead exposure if they comply with other health conditions.

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Sadržaj

PRILOG LABORATORIJSKOJ DIJAGNOSTICI RANOG SATURNIZMA

Autori iznose teškoće koje se u praksi susreću kod dijagnosticiranja ranog saturnizma. Da bi olakšali postavljanje dijagnoze, naročito u slučajevima kad nedostaju klinički znaci trovanja i kad su rezultati laboratorijskih analiza atipični, autori su izradili jedan dijagnostički test oralnom primenom 3 g Ca_2EDTA (3×1 g u toku jednog dana). Ukoliko se posle davanja ove količine Ca_2EDTA izluči urinom više od 0,340 mg Pb/24^h, postoji opravdana sumnja da u organizmu postoje depoi olova, bez obzira na dužinu ekspozicije radnika olovu.

Do ovih zaključaka se došlo posle ispitivanja dejstva EDTA na zdravim osobama, grafičkim radnicima i topioničarima olova, a ovaj test je dobio svoju punu potvrdu na jednoj grupi bivših topioničara olova koji već prosečno pet godina nisu imali nikakvog kontakta s olovom.

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