

Treatment of Lead Intoxication

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TREATMENT OF LEAD INTOXICATION

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The method of treating the acute phase of lead intoxication has been well established and its rational universally accepted. However, the type of treatment that should be instituted after the subsidence of the acute symptoms is a controversial issue. While the approved treatment of the acute stage will be reviewed, this paper will deal primarily with the theories versus practicality of storing and deleading.

It would seem obvious that the entire therapeutic regimen should be directed toward (1) overcoming the intestinal colic, (2) correcting the anemia, (3) making the patient symptom free with no disability and (4) returning the patient to a remunerative job as soon as possible.

The following procedures are prescribed for the acute stage:

1. Hospitalization or ambulatory, depending on symptoms
2. If hospitalized, bed rest or ambulatory, depending on colic
3. High calcium diet
4. Warm water bag or electric pad for abdominal discomfort
5. One half to 1 ounce (16 to 31 Gm.) magnesium sulfate every morning on arising
6. Antispasmodics, such as tincture belladonna, phenobarbital mixture, every four hours, or amprotropine phosphate (syntropan®) tablets or hydrochloride of diphenylacetyl diethylaminoethanol (trasentine hydrochloride®) and phenobarbital tablets for abdominal discomfort
7. Ten cubic centimeters of 20 per cent calcium gluconogalactogluconate solution (neo-calglucon®) intravenously every four hours
8. No narcotics advised
9. Complete blood cell count and stippling determination, followed by red blood cell count and stipple cell counts taken every three days

10. Estimation of lead in urine (twenty-four hour specimen) and urinalysis

This routine therapy is predicated on the original contention of Aub¹ and his associates that the direction of the lead stream is similar to that of the calcium stream, that when calcium is being deposited in the bones, circulating lead is being deposited in the bones and that when calcium is being pulled from the bones, some stored lead is also liberated.

Deleading appears to be the method advocated by most authorities, but this does not tell the whole story, because it is unusual to find physicians who actually utilize this procedure: as a matter of fact, recently a questionnaire was sent to twelve actively practicing industrial physicians engaged in this work, and their answers showed that only one physician was using deleading, two physicians formerly used deleading, but had given it up, and the remaining nine had never utilized deleading in any shape or form.

METHODS OF DELEADING ADVOCATED

1. *High Calcium Diet*.—This method was claimed by Lederer and Bing² to be the optimum diet for deleading. Taeger³ arrived at the same conclusion. Schilling and Hopper⁴ expressed the belief that the use of calcium did not induce superior calcification, but rather had the opposite effect. Gray and Greenfield⁵ reported that prolonged high calcium diet and regimen was the best means of deleading. On the other hand, Litzner, Weyrauch and Barth⁶ claimed that a high calcium diet reduces lead excretion.

2. *High Phosphorus and High Vitamin Diet*.—Gray and Greenfield⁵ found the use of an optimal calcium diet with a high phosphorus and high vitamin diet

1. Aub, J. C.: The Biochemical Behavior of Lead in the Body, J. A. M. A. 104:37 (Jan. 12) 1935.

2. Lederer, L. G., and Bing, F. C.: Effect of Calcium and Phosphorus on Retention of Lead by Growing Organism, J. A. M. A. 114: 207 (June 22) 1940.

3. Taeger, H.: Calcium Therapy of Lead Poisoning, Klin. Wchnschr. 16:1613, 1937.

4. Schilling, H. D., and Hopper, K. B.: Calcium and Phosphorus Studies, Bull. Johns Hopkins Hosp. 35:196, 1946.

5. Gray, K., and Greenfield, L.: New Concepts in the Treatment of Lead Poisoning, New York State J. Med. 28:1513, 1938.

6. Litzner, S.; Weyrauch, F., and Barth, E.: Untersuchungen über Bleiauscheidung durch die Nieren und ihre Beeinflussung durch bestimmte Kostformen und Arzneimittel beim Menschen, Arch. f. Gewerbepath. u. Gewerhyg. 2:330, 1931.

(vitamin D particularly) the best treatment in these cases. Gray,⁷ interestingly enough, observed a few years previously that a low calcium and high phosphorus diet (ration 1:4) was ideal in deleading; on the other hand, Lederer and Bing⁸ disagreed with this statement and expressed the opinion that the addition of phosphate has no beneficial effect.

3. *Low Calcium Diet.*—As stated previously, Gray⁷ recommended a diet low in calcium.

4. *Ascorbic Acid Therapy.*—Holmes, Campbell and Amberg⁹ observed much benefit from ascorbic acid

TABLE 1.—Age Factors

Total Number Intoxication Cases.....	63
Age groups	
39 cases between 21-29 years	
21 cases between 30-39 years	
11 cases between 40-47 years	
1 case 54 years	
Average age, intoxication case (years).....	31
Average exposure (weeks).....	12
Average time lost from work (days).....	23
Age of youngest patient (years).....	21
Age of oldest patient (years).....	54
Exposure of youngest case (weeks).....	4
Exposure of oldest case (weeks).....	8
Shortest exposure case (days).....	12
Longest exposure case (days).....	37

therapy in cases of lead intoxication; others have had no success with this form of therapy.

5. *Other Substances.*—Ammonium chloride, potassium iodide (Belknap⁹), sodium bicarbonate, sodium citrate (Kety and Letonoff¹⁰), parathyroid hormone and 2,3-dimercaptopropanol (BAL) antilewisite have been used.

7. Gray, I.: Recent Progress in the Treatment of Plumbism, *J. A. M. A.* 104:200 (Jan. 19) 1935.

8. Holmes, H. W.; Campbell, K., and Amberg, E. J.: The Administration of Vitamin C in the Treatment of Lead Poisoning, *J. Lab. & Clin. Med.* 24:1119, 1939.

9. Belknap, E. L.: Control of Lead Poisoning in the Worker, *J. A. M. A.* 104:203 (Jan. 19) 1935.

10. Kety, S., and Letonoff, T. V.: The Treatment of Lead Poisoning by Sodium Citrate, *Am. J. M. Sc.* 205:404, 1943.

Do these procedures actually delead? Kehoe¹¹ stated, "... there are grave doubts whether or not the elimination of the toxic agent can be materially accelerated by artificial means" and further added, "... this elimination can only be accomplished spontaneously over a considerable length of time." Aub¹ and his associates concluded that complete deleading cannot be done. Oliver¹² and many others have confirmed this observation. It is most interesting that practically all the advocates of deleading admit that the procedure is dangerous and must be attempted

TABLE 2.—Hospital and Nonhospital Studies

Total Number Cases 1920-1948.....	62
Hospital cases.....	35
Nonhospital cases.....	27
Hospital Cases	
Average age.....	33 years (21-54)
Average length of exposure.....	10 weeks (1-34)
Shortest hospital stay.....	5 days
Longest hospital stay.....	34 days
Average hospital stay.....	14 days
Average loss of time.....	21 days (7-33)
Nonhospital Cases	
Average age.....	30 years (21-47)
Average length of exposure.....	14 weeks (1-25)
Average loss of time.....	13 days (1-47)

only in specific circumstances. Johnstone¹³ stated, "... this procedure (deleading) has been discarded due to the belief that lead is excreted from the body by normal physiologic processes."

It is admitted by its advocates that rapid deleading is to be avoided, and, therefore, it is advisable to immobilize the lead in the bony structure during the acute toxic episode. It is also stated that deleading is then advisable, since the liberation of this store of lead is an obvious factor in the onset of toxic lead

11. Kehoe, R. A.; Cholak, J.; Hubbard, D. M.; Bambach, K. and McNary, R. R.: Experimental Studies on Lead Absorption of Excretion and Their Relation to the Diagnosis and Treatment of Lead Poisoning, *J. Indust. Hyg. & Toxicol.* 23:71, 1943.
12. Oliver, T.: Lead Poisoning from the Industrial, Medical and Social Points of View, New York, Paul B. Hoeber, 1914.
13. Johnstone, R. T.: Occupational Medicine and Industrial Hygiene, St. Louis, C. V. Mosby Company, 1948.

episodes during metabolic upsets. It is this latter statement which apparently is the principal argument used by the advocates of deleading. It sounds almost convincing, but in my experience, in treating over 60 patients with lead intoxication and hundreds with absorption, not one patient had any such metabolic

TABLE 3.—Blood Studies

Period of Greatest Changes in Counts and Smears— 7-14 days after acute symptoms arise		
Period When Blood Cell Counts and Smears Return to Normal (according to whether or not hospitalized)		
Hospital cases.....	4½ months	
Ambulatory cases.....	5 months	
Period When Blood Cell Counts and Smears Return to Normal (according to age)		
Short exposure case group (below 10 weeks)	4.4 months	
Long exposure case group (beyond 10 weeks)	4.3 months	
Range of Red Blood Cells *		
Lowest count.....	(H) 2,950,000	
	(A) 3,720,000	
Highest count.....	(H) 4,150,000	
	(H) 4,750,000	
Average count.....	(H) 3,573,000	
	(A) 4,004,000	
Range of Hemoglobin Counts		
Lowest count.....	(H) 56%	
	(A) 66%	
Highest count.....	(H) 73%	
	(A) 70%	
Average count.....	(H) 66%	
	(A) 71%	
Range of Stipple Counts (per 30 fields)		
Lowest count.....	(H) 27	
	(A) 30	
Highest count.....	(H) 300	
	(A) 134	
Average count.....	(H) 113	
	(A) 73	

* (H), hospital cases; (A), ambulatory cases.

upset, liberating stored lead to such a degree as to be incapacitated. I admit that some conditions can produce some free circulating lead into the blood stream, but the results are negligible and the persons are symptom free as far as lead is concerned.

Belknap¹⁴ stated, "... after an absence from lead exposure of one to two years, lead intoxication

14. Belknap, E. L.: Lead Poisoning: Criteria for Diagnosis, Indust. Med. 9: 505, 1940.

practically never develops." Aub¹ stated, "... from a theoretical standpoint, deleading is advisable, but from a practical point of view, the answer is dependent on which procedure will advance most promptly to a

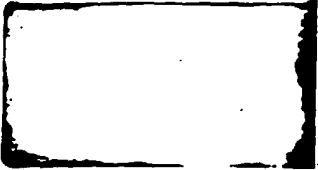
TABLE 4.—Disability Studies

Nonhospital Cases (27)	
Average loss time.....	15 days (1-47)
Number cases with no loss time.....	8
Number cases with loss time.....	19
Number cases with permanent disability award	3
Average award.....	5% (3-17)
Hospital Cases (38)	
Average loss time.....	31 days (7-58)
Number cases with permanent disability award	4
Average award.....	7.5%

TABLE 5.—Résumé of Permanent Disability Cases

Patient	Age, Yr.	Ex- posure, Weeks	Loss of Time, Days	Days Observed After Acute Phase	Cell Counts Re- turned to Normal, Months	Disability Award, Per- centage
Nonhospital						
A. A.....	27	16	12	441	7	7.0
J. A.....	23	4	60	60	5	8.0
S. B.....	36	20	67	150	2	3.0
Average.....						5%
Hospital						
E. H.....	30	4	30	450	3	7.5
S. W.....	40	8	20	87	3	7.5
W. O.....	34	22	39	61	2	7.5
J. H.....	28	22	22	69	2	7.5
Average.....						7.5%

recovery of health." I agree wholeheartedly with this declaration, but one can hardly miss the implication in this statement that deleading is not advisable from a practical point of view. In other words, it does not appear to be the method of choice.



It has also been stated that circulatory lead may cause tissue damage but stored lead in the bones produces no deleterious effects. If this is so, and, so far as is known, it has been accepted by most men in this work, then what is the justification for employing a method as therapy which is acknowledged by its advocates as dangerous and uncertain as to its ultimate results? No method is available for the complete removal of lead from the body, and I can see no reason for deleading when it is well recognized and accepted that there is a normal metabolism governing the intake and output of lead from the body. It is my opinion that no remedy has been found to justify the dangers inherent in deleading. It is my contention that it is more advisable not to employ deleading procedures, in view of the fact that simple immobilization of lead within the skeletal structures of the body is the most rapid and safe method of bringing about a state of well-being.

My method of treatment during the convalescent (subacute) and chronic phases of this disease is purely symptomatic (associated with observations of the blood). This is simple, direct and productive of excellent results.

In the subacute or convalescent stage, I prescribe as follows:

1. Regular diet
2. Mild laxatives
3. Calcium wafers
4. Iron and vitamin B complex therapy for anemia and as a tonic
5. Monthly red blood cell counts and determination of stippling and hemoglobin
6. No further lead exposure

During the chronic phase, I use the following routine:

1. Permanent removal from exposure
 2. Fresh air occupation (yard gang)
 3. Adequate diet
 4. Multiple vitamin therapy for fatigue, malaise and the like
 5. Laxatives for constipation
 6. Calcium, oral therapy, if indicated
- 

COMMENT

Intravenous calcium therapy must be continued for at least three to four days after all symptoms of colic have disappeared, and withdrawal must be gradual—otherwise all symptoms may return. Calcium wafers (oral therapy) are given after discontinuance of intravenous therapy. No iron or calcium (oral) should be given during the acute phase, as I do not believe that they can be absorbed and utilized. Vitamins, milk and special diets are acceptable, but their value is questionable.

Permanent removal from lead exposure is obligatory. Hospitalization is preferred in all cases except in cases of mild disease; I believe that calcium should be given intravenously around the clock for quick and best results.

CONCLUSIONS

1. Deleading is not advocated because: (1) it is dangerous, (2) it prolongs hospitalization, (3) it prolongs length of disability and (4) results are uncertain.

2. Calcium immobilization therapy is advocated because: (1) it is simple and safe, (2) it shortens hospitalization, (3) it shortens length of disability and (4) results are certain.

It is therefore my opinion that until such time as some satisfactory deleading procedure is found, which will be simple, safe and able to shorten present length and amount of disability, I shall advocate calcium therapy as the method of choice.