ACTA MEDICA IRANICA
Vol. XIX. 1976, P. 82-88

Determination of Serum Lithium by Flame Emission Spectroscopy

R. Nafissy*

Summary

Lithum can be determined both by atomic absorption spectroscopy and flame emission spectroscopy. We have used the later method with a Zeiss Model PMQII spectrophotometer fitted with ante-chamber atomizer and a potensiometric line recorder. Accurate analysis for the element was accomplished due to a sophistacated measuring instrument.

Introduction

In the periodic table of Mendeleev the elements are listed in order of their atomic numbers and arranged in such a way that similarities become apparent. Elements with similar properties are called groups; group 1 contains highly reactive alkali metals, lithium, sodium and potassium. Lithium is the lightest of the alkali metals and compounds containing this element are more covalent than those of the other elements of group 1.

Laboratory of Chemical Pathology, Teheran Univesity Medical School.

In 1949, John F. J. Cade (2) in Australia tested the effect of oral lithium on a number of human psychotic patients and noticed a marked improvement. Following Cade's report, lithium salts and particulary lithium carbonate have been used by other psychotherapists as an effective sedative for patients with acute psychotic excitement (5).

The biochemical basis and the mode of action of the lithium on patients is still far from clear (6). However, lithium treatment is well stabilished and its specific efficacy makes it one of the first order drugs against manic episodes.

The typical treatment in an average sized adult is an initial daily dosage of 1.5 to 2 g of lithium carbonate, usually taken orally and after 5 to 10 adys the dosage is reduced in order to maintain the lithium concentration in the blood at 0.5 to 1 milliequivalent (mEq) per liter. Above 1.5 mEq various side effects such as abdominal cramps, nausea, diarrhoea, termor, sleepness have been observed. In excessive amount, when the lithium concentration rises above 2.5 mEq per liter in blood serum, poisonning and semiconsciousness or coma and in certain cases death from renal failure or heart attacks may occur.

For the above mentioned reasons, lithium therapy requires close individual observation and determination of lithium concentration in the blood serum must be repeated continuously.

Methods and Materials

Instrumental

Analyses were performed with a Zeiss atomic absorption and flame emission spectrophotometer consisting of the following units: Monochromator M4QIII, indicator with two photoelectric detectors, flame attachment FA2 fed with acetylene and compressed air, power supply unit, potensiometric line recorder Servogor fitted with scale expansion unit.

The wavelength was set at 670.78 nm, the most sensitive line for lithium. The air: acetylene ratio was 9:9 relative units. The slit width

was set at 0.05 mm.

Glassware

Pipets and test tubes were soaked for 24hr in 50% nitric acid and then rinsed throughly in deionized water.

Reagent

A stock standard containing 1 mEq lithium was made by weighing accurately 37 mg of lithium carbonate, previously dried for 24hr at 100°. This was transferred to a 1-l flask and made up to 1l mark with deionized water.

Specimen

Blood was collected in disposible syringes and transferred to washed glass tubes. Sera were separated from red cells within 4hr.

Procedure

In order to avoid interference with other elements of the serum, sera obtained from normal subjects that have no detectable lithium, were added to all the working standards as shown in table 1.

Table 1.

Working standards.	ml of stock.	ml of lithium-free serum.	Diluted to ml.	Lithium mEq/1.
I	3	1	10	3
II	2	1	10	2
III	1	1	10	1
IV	0.5	1	10	0.5

Sera from patients were diluted 1 to 10 (v/v) in deionized water. After calibration of the instrument with a solution of 1 to 10 dilution of lithium-free serum in deionized water, working standards and samples were aspirated and the results recorded.

Results and discussion

Typical recorder graph for flame emission analysis of serum lithium is shown in Fig. 1. Calibration curves were linear over the entire range of working standards from 0.5 to 3 mEq/1. (Fig. 2)

To determine whether lithium was correctly measured, 15 sera obtained from lithium-treated patients were analysed by the actual method and after trichloracetic acid treatment according to the method described by Blijenberg (1), the results of two sets of analysis are shown in table 2.

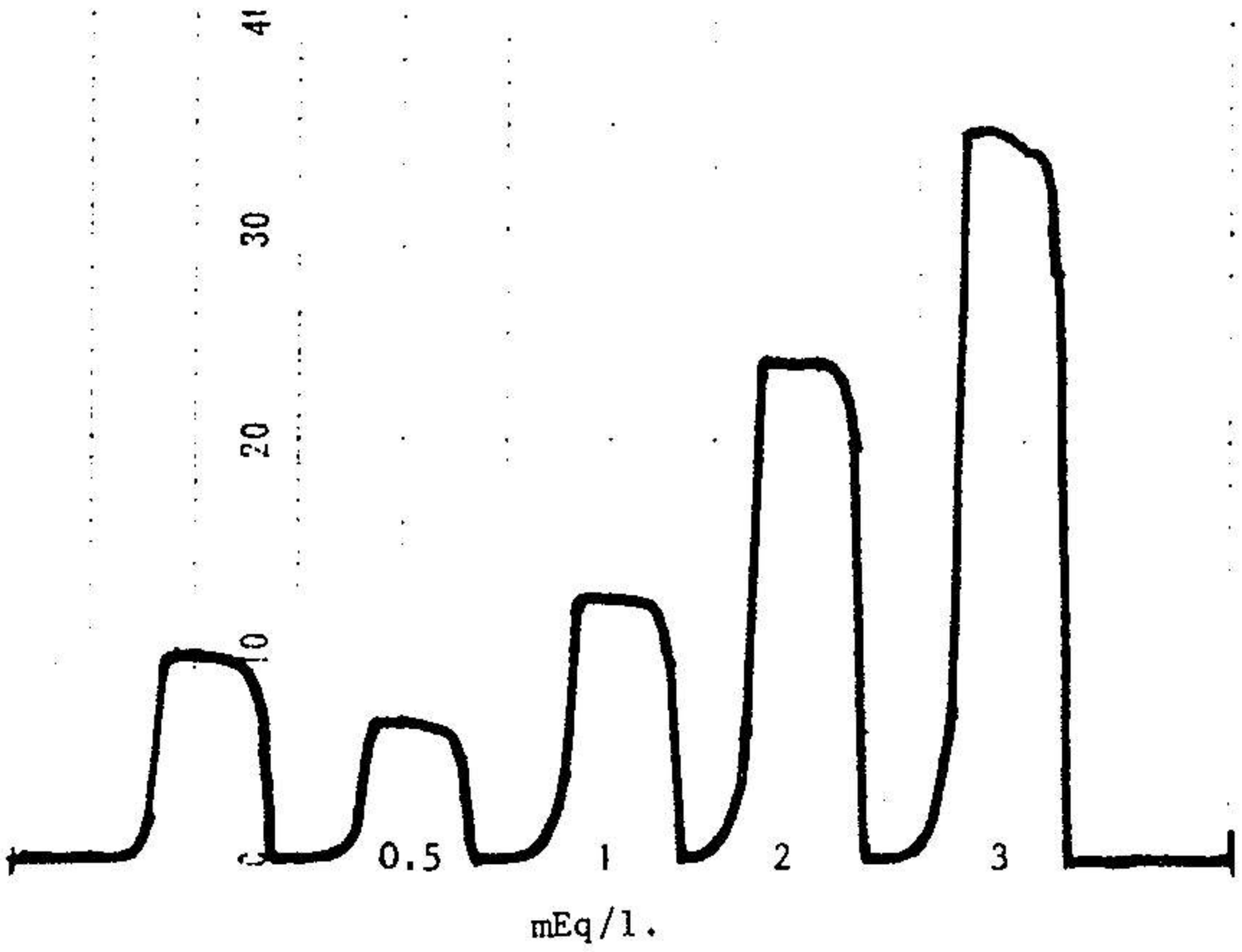

Fig 1. Recorder chart tracing showing four working standards and one serum sample from a lithium-treated patient.

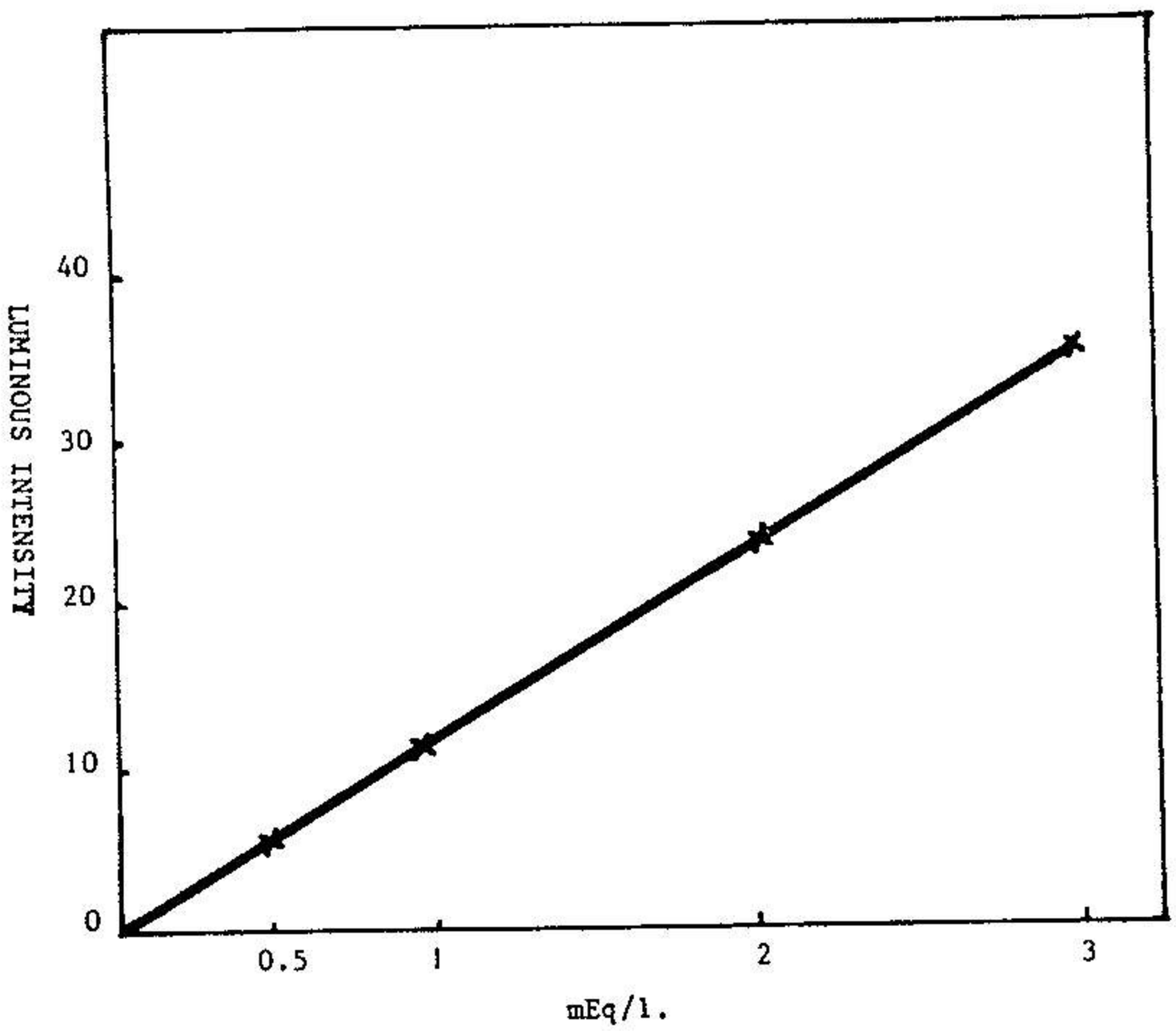

Fig 2. Calibration curve for lithium in flame emission spectroscopy.

Table 2. Comparison of the results of two different methods for estimation of lithium in serum (mEq/1.).

Serum No:	Actual method.	Blijenberg,s method.
1	0.75	0.80
2	0.85	0.80
3	0.44	0.50
4	0.64	0.68
5	0.60	0.58
6	0.72	0.81
7	0.94	0.89
8	0.56	0.61
9	1.22	1.19
10	0.38	0.40
11	0.57	0.53
12	0.84	0.86
13	0.99	0.88
14	0.75	0.77
15	1.11	1.08

The correlation coefficient of the two sets of analysis was 0.98, there was no significant difference between the two sets of measurements.

The advantage of this flame emission spectrophotometric procedure over previously described (1, 3, 4), is the elemination of protein precipitation step; it also eleminates several known interferences.

References

1. Blijenberg, B. G. and Leijnse, B., (1968), The determination of lithium in serum by atomic absorption spectroscopy and flame emission spectroscopy, Clin. Chim. Acta, 19, 97-99
2. Cade, F. G., (1949), Lithium salts in treatment of psychotic excitement, M. J. Australia, 2, 349-352
3. Helm, H. J. van der., and Andriess, D., (1961), The determination of lithium in serum during therapy with lithium salts, Clin. Chim. Acta, 6, 747-8
4. Lang, W., and Hermann, R., (1965), Eine methode zur flammenspektrophotometrischen lithimbestimmung im serum, Z. Ges. Explt. Med. 139, 200-212
5. Mendels, J., and Secunda, S. K., (1972), A controlled study of the antidepressant effects of lithium carbonate, Arch. Gen. Psychiatry, 26, 154-157
6. Samuel, D., and Gottesfeld, Z., (1973), Lithium, manic-depression, and the chemistry of the brain, Endeavour, 32, 122-129