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Psychopharmacologia (Berl.) 40, 177—184 (1974)

Short Reports

The Effect of Lysergic Acid Di-Ethylamide on Serum Creatine Kinase Levels

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Received August 19, 1974

Abstract. Serum creatine kinase levels were estimated in 7 patients following LSD ingestion. All patients showed a transient rise in serum level, and this was greatest in those patients who became psychotic.

Key words: Creatine Kinase — Lysergic Acid Di-Ethylamide — Enzymes — Psychoses — Abreaction.

Introduction

Creatine kinase (CK) is an enzyme found predominantly in striated muscle. Estimation of serum CK levels is a useful index of certain kinds of skeletal muscle disease (Ebashi and Toyokura, 1959) and has been used in the diagnosis of suspected myocardial infarction (Smith, 1967). Elevated levels also occur in patients with acute cerebral disease, meningitis and other conditions with acute disturbance of cerebral function (Schiavone and Kaldor, 1965). There have also been reports of raised levels in patients with acute psychosis (Meltzer *et al.*, 1969). This study reports observations on serum CK in subjects who had ingested lysergic acid di-ethylamide (LSD), a "psychotomimetic" drug.

Methods

Efforts were made to identify all patients admitted to a psychiatric hospital who had ingested LSD during the previous 24 hrs. Venous blood samples were taken on admission (prior to any drug treatment) and sequential samples were obtained at two day intervals until the sixth day or until serum CK levels fell below 100 I.U./l whichever was longer. Thereafter samples were taken at 5-day intervals until discharge from hospital. In addition two inpatients who received LSD therapeutically were included in the study. Venous blood samples were taken immediately before oral administration of 0.05 mg LSD and sequentially thereafter over a period of 69 hrs and 75 hrs respectively.

Serum CK levels were determined using the procedure introduced by Rosalki (1967) with a minor modification described by Smith (1967).

Results

The results from newly admitted patients who had taken LSD are shown in Fig. 1—5, which includes data on clinical condition and drug therapy. Brief résumés of each patient are given below:

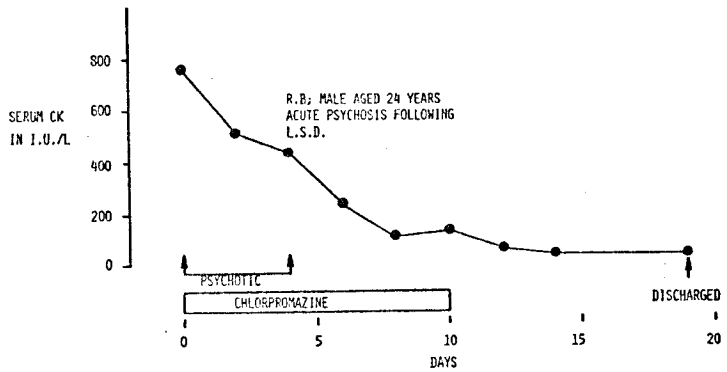

Fig. 1

1. R. B.—a 24 year-old man, admitted in an acutely disturbed state with auditory and visual hallucinations. He was in a state of fear, pacing continuously, with paranoid delusions and ideas of reference. The patient was a bank clerk who had taken LSD in powder form, for the first time 14 hrs before admission. He was treated with oral chlorpromazine and improved steadily over 5 days and was discharged from hospital after $2^1/_2$ weeks. Serum CK level on admission was 760 I.U./l and subsequent levels are shown on Fig. 1.

2. C. M.—an 18 year old male student, who had frequently smoked marihuana during the previous year and had taken LSD on three occasions with transient, pleasurable effects. 30 hrs before admission he had taken "3 LSD tablets" (3 times his "normal dose"). For 6 hrs he had experienced visual hallucinations and other pleasant perceptual experiences in the company of friends. He had then been left alone for several hours and when his friends returned, they found him talking at great speed and with no apparent sense. On admission to hospital he exhibited pressure of talk, flight of ideas, paranoid delusions and was experiencing vivid hallucinations. His behaviour was very disturbed and he constantly tried to leave the room by the doors or windows. He was treated with a single intramuscular injection of chlorpromazine followed by oral thioridazine and quietened over a period of 36 hrs. He then became withdrawn and profoundly depressed, with sleep disturbance. Phenothiazines were stopped and his depression improved gradually over 3 weeks. He was then discharged and was able to return to his studies. Serum CK level on admission was 350 I.U./l and subsequent levels are shown in Fig. 2.

3. D. S.—a 24 year-old man with a history of two previous admissions to psychiatric hospital with a diagnosis of personality disorder. On the

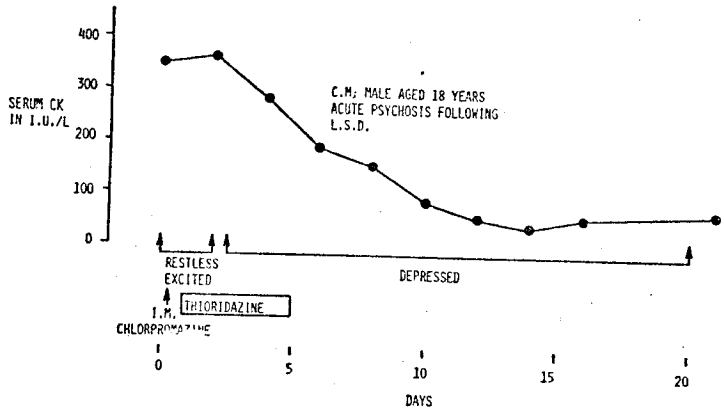

Fig. 2

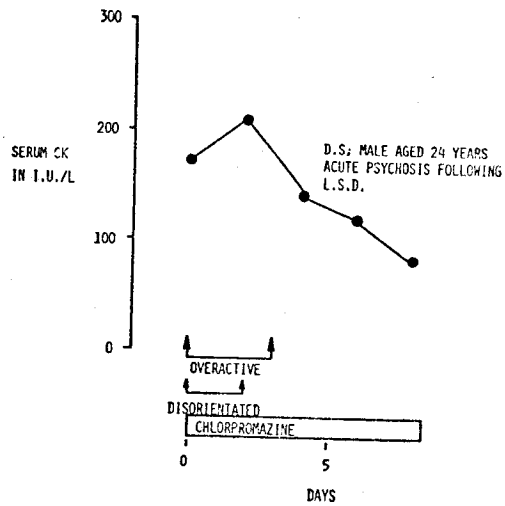

Fig. 3

day prior to admission he took LSD in powder form and within 2 hrs he became disturbed and distressed. On admission he was overactive, auditorily hallucinated and paranoid. He was disorientated in time and place. Serum CK level was 171 I.U./l on admission and rose to 210 I.U./l 2 days later. He was treated with oral chlorpromazine and his symptoms subsided. He remained rather suspicious and intermittently paranoid. A week after admission he discharged himself, by which time serum CK level had fallen to 76 I.U./l. He had not been seen as an out-patient 6 months later, Serial serum CK levels are shown in Fig. 3.

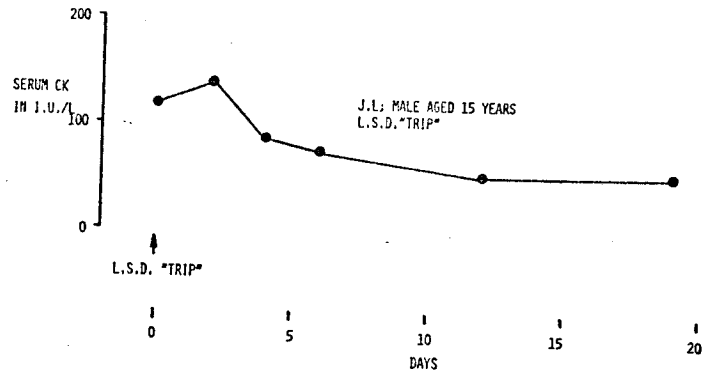

Fig. 4

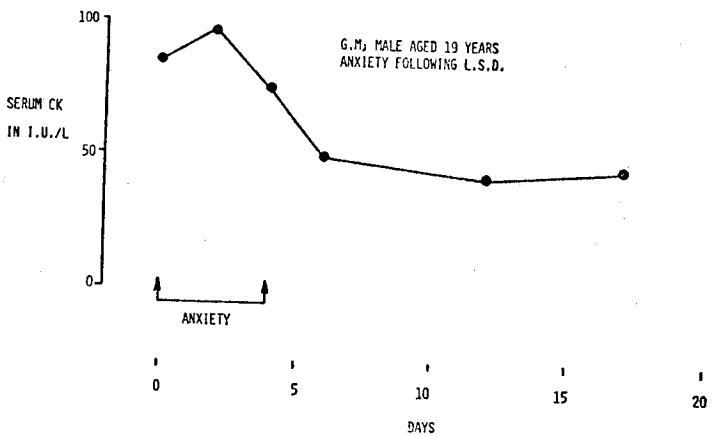

Fig. 5

4. J. L.—a 15 year-old patient under long term treatment by the adolescent unit for a severe personality disorder, associated with disturbed family relationships. During one weekend he obtained LSD illicitly and took it by mouth. He experienced a typical "trip". On returning to the hospital serum CK level was 120 I.U./l and subsequent levels are shown in Fig. 4, the highest level being 140 I.U./l.

5. G. M.—a 19 year-old student was admitted to hospital with symptoms of acute anxiety following LSD ingestion 12 hrs previously. He experienced only minimal, transient perceptual disturbance. Serum CK level on admission was 85 I.U./l and subsequent levels are shown in Fig. 5.

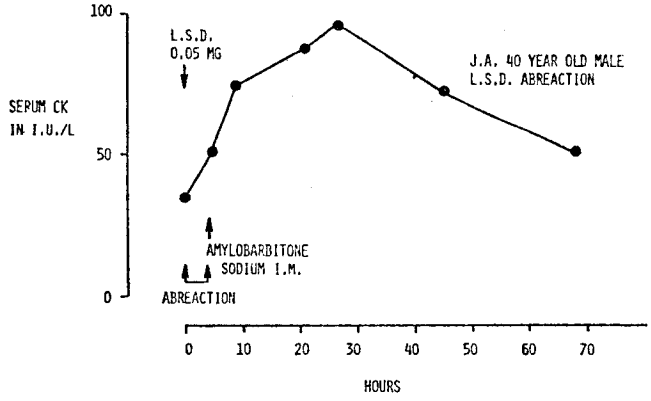

Fig. 6

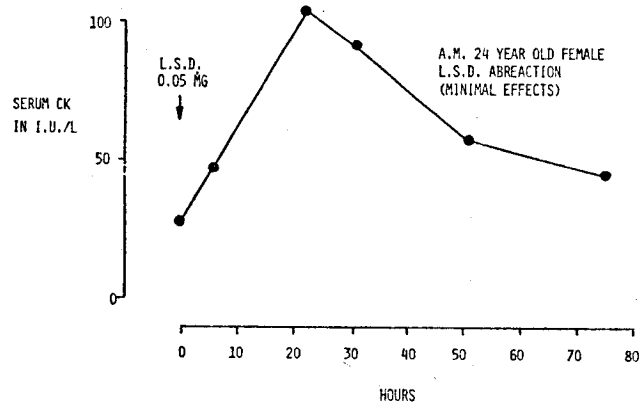

Fig. 7

The results from the 2 patients given LSD therapeutically are shown in Figs. 6 and 7. The first patient (J. A., Fig. 6) was a 40 year-old man with a long-standing severe anxiety psychoneurosis. He had a striking and productive abreaction following 0.05 mg LSD and the abreaction was terminated by an intramuscular injection of amylobarbitone sodium. The second patient (A.M) was a 24 year-old woman with a personality disorder of schizoid type. Little abreaction took place following 0.05 mg LSD orally, the patient experiencing only rather unpleasant visual perdeptions. The abreaction was not therefore terminated by a drug.

In Fig. 8 serum CK levels are plotted for each patient in two conditions:

"Basal" level. This is taken as an indication of serum CK level when the direct or indirect effects of LSD are likely to be minimal or absent. In the

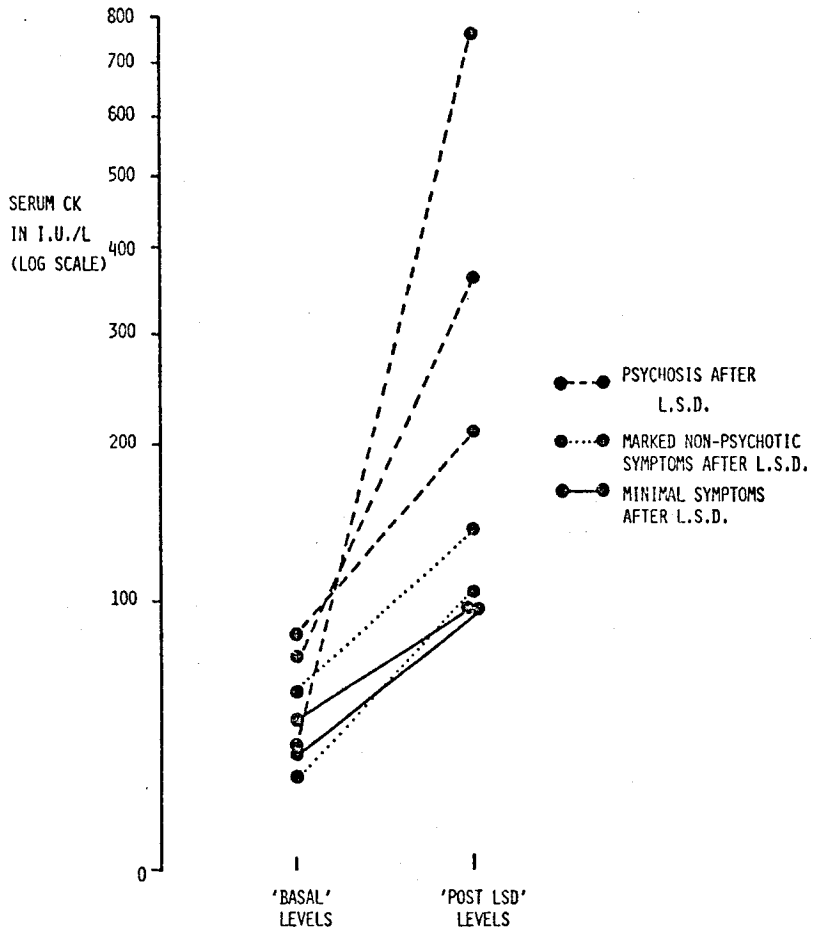

Fig. 8

case of the two abreacted patients the "basal" level is taken as that recorded immediately before LSD administration. In the case of the 5 patients admitted following LSD ingestion, in whom a pre-LSD level was not available, the basal level is taken as the highest serum CK level recorded more than 12 days after LSD ingestion. (In one patient, who discharged himself prematurely, the discharge level is taken.)

"*Post LSD*" *level.* This is the serum CK level recorded when the possible effect of LSD in raising serum CK levels is likely to be optimal. In the case of the two abreacted patients it is taken as the highest level recorded during 48 hrs following LSD administration; in the case of other patients it is taken as the highest serum CK level recorded during

Table 1. Mean "basal" and "post LSD" levels in patients with and without psychosis following LSD

	Serum CK in I.U./l	
	Mean "basal" level	Mean "post LSD" level
Patients with psychosis	62	443
Patients without psychosis	40	106
All patients	49	251

the first 4 days of admision. The mean serum CK levels ("basal" and "post LSD") are shown in Table 1. In every case the "post LSD" level is higher than the "basal" level. The mean "basal" level for all patients was 49 I.U./l, while the mean "post LSD" level was 251 I.U./l. The difference is significant, $P < 0.01$ (statistical comparison is made by logarithmic transformation and Student's t test, since the distribution of serum CK levels in a healthy ambulant population shows a marked positive skew (Smith *et al.*, 1970). Patients who were psychotic following LSD showed the greatest rise; the mean serum CK level in 4 such patients rising from 62 I.U./l ("basal") to 443 I.U./l ("post LSD"), (significantly different, $P < 0.05$), whereas the 3 patients who did not become psychotic showed a smaller rise in mean levels from 40 I.U./l ("basal") to 106 I.U./l ("post LSD"), the difference being still significant $P < 0.05$. This difference between psychotic and non-psychotic groups of patients was considered separately and while the mean "basal" levels did not differ significantly the "post LSD" level did ($P < 0.05$).

The results of sequential estimations showed that, in patients admitted following ingestion of LSD, serum CK levels either fell progressively from time of admision or rose to a peak within 2 days and thereafter showed a progressive fall over 4—10 days. Initial values of 4 out 5 patients would be regarded as definitely raised (Smith *et al.*, 1970). The sequential estimations in the two abreacted patients showed striking similarity with a rise to a peak value of about 100 I.U./l between 20 and 30 hrs after LSD administration followed by a progressive fall.

Discussion

The results indicate that a temporary rise in serum CK level follows LSD administration, the rise being greatest in patients who develop psychosis. It is possible that the observed rise is related to LSD dose and those patients who became psychotic had ingested greater amounts. This finding contrasts with that of Meltzer and his colleagues (Meltzer

et al., 1970) who found no significant elevation of serum CK in patients given LSD orally for psychotherapeutic purposes. Meltzer and his colleagues did not include illicit LSD takers in their study and made fewer sequential estimations.

Previous studies have shown that some acutely psychotic patients display serum CK elevation and it has been suggested that this finding reflects a basic pathophysiological process common to the acute psychoses and associated with skeletal muscle abnormalities (Meltzer *et al.*, 1970). I have argued elsewhere that the observed rise is due to non-specific factors such as increased motor activity (Harding, 1974). The results of this study could be interpreted as follows: LSD itself causes a transient moderate rise in serum CK level, possibly due to a direct effect on muscle membrane. Patients who develop psychosis following LSD show more marked serum CK elevations, because of an additive effect of LSD itself and abnormal motor activity. Other interpretations are possible, but the possible direct effect of LSD on muscle membrane calls for *in vitro* studies, and, if it is confirmed, might lead to further studies on the mode of action of LSD.

References

Ebashi, S., Toyokura, Y.: High creatine phosphokinase activity of sera of progressive muscular atrophy. J. Biochem. (Tokyo) **46**, 103—107 (1959)

Harding, T.: Serum creatine kinase in acute psychosis. Brit. J. Psychiat. **125**, 280—285 (1974)

Meltzer, H. Y., Elkun, L., Moline, R. A.: Serum enzyme changes in newly admitted psychiatric patients. Arch. gen. Psychiat. **21**, 731—738 (1969)

Meltzer, H., Pahnke, W., Kurland, A., Henkin, R.: Serum CPK and aldolase activity in man following controlled administration of psychotomimetic drugs. Psychopharmacologia (Berl.) **16**, 419—425 (1970)

Rosalki, S. B.: An improved procedure for serum creatine phosphokinase determination. J. Lab. clin. Med. **69**, 696—705 (1967)

Shiavone, D. J., Kaldor, J.: Creatine phosphokinase levels and cerebral disease. Med. J. Aust. **2**, 790—792 (1965)

Smith, A. F.: Diagnostic value of serum creatine kinase in coronary care unit. Lancet **1967 II**, 178—182

Smith, A. F., Macfie, W. G., Oliver, M. F.: Clofibrate, serum enzymes and muscle pain. Brit. med. J. **1970 II**, 86—88

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