Forced alkaline diuresis for lithium intoxication

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Summary

A case of lithium intoxication treated with forced alkaline diuresis is described. Although clearance of lithium from the plasma by this method is less efficient than by haemodialysis it is as effective as peritoneal dialysis, is easier for nursing and medical staff to undertake and carries less risk of complications. In the absence of facilities for haemodialysis forced alkaline diuresis is the treatment of choice for lithium intoxication.

Introduction

Lithium is being used more frequently in the treatment of recurrent manic depressive disorders (Hullen, McDonald and Allsopp, 1972; Prien, Caffey and Klett, 1973) and recurrent depressions of the endogenous type (Baastrup *et al.*, 1970; Schou, Amdisen and Baastrup, 1971). This in addition to the narrow margin between therapeutic levels of less than 1.3 mEq/l (Schou *et al.*, 1971) and toxic levels of greater than 1.6 mEq/l (Schou, Amdisen and Trap-Jensen, 1968; Zall, Per-Olaf and Myers, 1968) will increase the frequency of lithium intoxication.

There is no specific antidote for lithium intoxication, hence treatment is mainly supportive. However, methods of increasing the rate of elimination of lithium from the body may be necessary. Although haemodialysis will lower the lithium level most efficiently, rebound phenomenon has been noted (Amdisen and Skjolkborg, 1969; Hawkins and Dorken, 1969; von Hartitzsch *et al.*, 1972). Prolonged peritoneal dialysis (Wilson *et al.*, 1971) significantly increases lithium elimination and prevents rebound. Although in human volunteers alkalinization of the urine by oral sodium bicarbonate increases urinary lithium excretion (Thomsen and Schou, 1968), there has been no published accurate assessment of the efficacy of forced alkaline diuresis alone in the treatment of lithium poisoning. Horowitz and Fisher (1969) treated such a case with oral acetazolamide and intravenous mannitol in addition to intravenous sodium bicarbonate. This article reports a case of lithium intoxication treated with forced alkaline

line diuresis and compares its efficacy with that of haemodialysis and peritoneal dialysis.

Case report

A 49-year-old male with manic depressive psychosis was started on lithium carbonate 750 mg t.i.d. in addition to stelazine (trifluoperazine) 5 mg t.i.d. and disipal (orphenadrine) 100 mg t.i.d. 6 weeks before his admission to the Regional Poisoning Treatment Centre, Royal Infirmary, Edinburgh. The day before admission he became drowsy, had an epileptiform seizure and by the day of admission had become comatose: lithium poisoning was suspected and he was admitted to this Centre.

FIG. 1. Serum lithium concentration following forced alkaline diuresis.

On admission he was exhibiting the classical picture of lithium intoxication, with tremor, myoclonic contractions and an impaired level of consciousness. Although his eyes would open when stimulated he did not respond to questions, his state being that of a 'coma vigil'. He was dehydrated, febrile and extremely restless, especially when stimulated. Muscle tone was generally increased, fasciculations were present, reflexes were exaggerated and his plantar responses were extensor although Hoffman's sign was negative. He had intermittent

attacks of limb hyperextension accompanied by vacantly staring open eyes. The blood pressure was 140/60 mmHg, pulse regular at 110/min and temperature 101.2°F. There were inspiratory crepitations at his left base but no signs of cardiac failure. His urea was 77 mg% and his electrolytes were normal.

Forced alkaline diuresis was started 4 hr after admission when the serum lithium level (as estimated by flame photometry) was 4.0 mEq/l (normal therapeutic range 0.7–1.3 mEq/l). Five hundred ml of fluid—either as 1/6 molar lactate, 1.26% sodium bicarbonate or 5% laevulose, with potassium supplements were given intravenously each hour keeping the urinary pH higher than 7.0. The patient's myoclonic contractions were slow to respond to parenteral phenobarbitone and repeated doses were needed to achieve sedation. Ampicillin 500 mg intramuscularly q.i.d. was given for his chest infection, in addition to careful nursing including regular suction of pharyngeal secretions.

The serum lithium levels during and after the diuresis are shown in the figure. The diuresis was stopped after 48 hr at which time, although the serum lithium level had fallen to 0.7 mEq/l, limb spasticity was still present. Some rebound was observed during the first 24 hr of the diuresis. The patient started to respond to questions 68 hr after treatment was started but did not fully recover until the fifth day. At no time did he show signs of congestive cardiac failure. Electrolytes were estimated twice daily during the diuresis and the only abnormalities noted were a transient rise in serum sodium to 153 mEq/l and bicarbonate to 35 mEq/l. His arterial pH remained normal during this period.

Discussion

Several deaths have been reported following severe lithium intoxication (Corcoran, Taylor and Page, 1949; Hanlon *et al.*, 1949; Schou *et al.*, 1968; Hawkins and Dorken, 1969), usually as a result of pulmonary complications. Permanent neurological sequelae despite haemodialysis have also been reported (von Hartitzsch *et al.*, 1972). This patient showed the classical features of lithium intoxication (Schou *et al.*, 1968) with drowsiness, dysarthria and tremor, being followed by coma, hyperextension of the limbs, muscle fasciculation, epileptiform seizures and staring open eyes.

Forced alkaline diuresis was preferred to haemodialysis or peritoneal dialysis because of this Centre's experience with this form of treatment and because of the known rebound phenomenon that occurs with haemodialysis. This is secondary to the concentration and subsequent release of lithium from certain tissues (especially bone and muscle) (Schou *et al.*, 1968) and to its slow passage across cell membranes (Ljungberg and Paalzow, 1969). The serum

lithium half-life was approximately 13 hr during the period before the 20% rebound and 18 hr thereafter. These half-lives compare very favourably with values of 14, approximately 7.5 and approximately 33 hr reported in three cases treated with peritoneal dialysis (Wilson *et al.*, 1971; von Hartitzsch *et al.*, 1972). In this patient the renal clearance of lithium varied from 16.5 to 40.5 ml/min (mean 31.9 ml/min) which is in excess of the sum of both renal and peritoneal dialysis clearance in the case treated by Wilson *et al.* (1971) with peritoneal dialysis alone.

Although haemodialysis is the most efficient method of removing lithium from the body, 30, 40 and even 100% rebound has been noted (Amdisen and Skjoldborg, 1969; von Hartitzsch *et al.*, 1972; Hawkins and Dorken, 1969). This can be prevented by longer haemodialysis (12–16 hr) or by repeating the dialysis after a few hours. Facilities for haemodialysis are not always available and this report shows that when renal function is not impaired, forced alkaline diuresis is as effective as prolonged peritoneal dialysis in lowering lithium levels. Forced alkaline diuresis is much easier for nursing and medical staff to undertake and carries less risk of complications than the two alternative methods. Whether the rebound seen will be a constant feature of cases treated with forced alkaline diuresis remains to be evaluated.

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