ORIGINAL ARTICLE

# Effect of Single Acute Dose of Intravenous Lithium Chloride on Rabbit Electrocardiogram

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**Abstract**

Effect of single acute dose of lithium chloride on rabbit's heart was investigated by injecting it intravenously and recording limb lead II electrocardiography. This resulted in transient disappearance of P-wave, reduction in QRS complex amplitude, ST-segment elevation and long tented T-wave, suggesting a need for cardiovascular monitoring of population which is exposed to environmental or occupational lithium hazards.

**Key words**

Lithium chloride, Electrocardiogram

## Introduction

Cardiovascular effects of lithium when used as a therapeutic salt are reported (1,2). But recently environmental lithium has also been implicated in genesis of cardiovascular diseases (3). Lithium occurs not only in all sea water, but also in the soil over wide areas of terrestrial contents (4,5). The salts of this lightest alkali metal are frequently used in pharmaceutical works, air conditioning plants, ceramics, lubricant and battery industries (6,7) Lithium is also inhaled from atmosphere specially in the form of combustion aerosole (8). Due to this, monitoring of its environmental and occupational hazards has become necessary. Electrocardiogram of rabbit resembles with that of man in essential details (9). In the present study chronological changes induced in electrocardiographic tracings of rabbits by single acute dose of intravenous lithium chloride have been investigated.

## Material and Methods

Twenty healthy male albino rabbits weighing 2-2.5 kg each, were procured and housed in steel cages. They were provided a diet of commercial rabbit pellets and water ad-libitum. The rabbits were observed for two weeks before the study began to allow adaptation to the vivarium environment and to eliminate sick animals. The rabbits were divided into two groups of ten each. Before ECG recording, the rabbits of the first group were anaesthetized with intraperitoneal injection of pentobarbitone sodium (35mg/kg of body weight). The ECG recordings were obtained with standard limb lead II using fine needle electrodes placed subcutaneously and attached to ECG amplifier adjusted for recorder deflection of 1cm/1mV for 15 minutes. After this intravenous injection of lithium chloride (100mg/Kg) dissolved in pyrogen free, distilled water was given in the ear vein of every rabbit. Electro-cardiogram was again recorded for half an hour. The rabbits were then kept under observation from seven days. No rabbit developed apparent morbidity or mortality.

The above procedure was repeated for second group of rabbits except for the treatment which was pyrogen free distilled water. Electrocardiograms were analysed for R-R interval calculations and thereby heart rate changes. Amplitude and topographic changes were analysed for individual rabbit separately. Maximum ECG changes from a single rabbit were recorded. Genesis of these chronological changes was tabulated. The number

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of rabbits showing the changes at respective time interval has been given in brackets.

**Results**

It was seen that effect of intravenous lithium started just after 0.25 minutes and lasted for 15 minutes. Lithium affected the atrial activity of the heart immediately which was clear from the disappearance of P-wave and coinciding of this with the isoelectric line. But by the end of 10 and 15 mintues P-wave reappeared in some of the ECG segments, i.e. 2 and 7 rabbits respectively. The control amplitude of QRS-complex varied from 0.6-0.5mV. Lithium decreased the amplitude of this complex, which ranged from 0.15-0.5mV, the minimum being at 5 minutes interval (Fig. 1). The ST segment elevation was distinct just after 0.25 minute in six rabbits (Table 1). ST segment elevation ranged from 0.05-0.2mV, maximum being at 2nd and 5th minute (Figure 1). This elevation started receding after 10 minutes and ST segment was isolectric at the end of 15 minutes. The amplitude of T-wave also increased. The range of T-wave amplitude in control rabbits was 0.3-0.45mV. During first five minutes of lithium treatment T-wave amplitude varied from 0.45-0.85mV, maximum at 2nd and 5th minute. After this the amplitude of T-wave receded and was in the range of 0.3-0.4mV. R-R interval before and after lithium treatment ranged from 0.20-0.24 second thereby heart rate ranged from 300 to 250 beats/min. No topographic change was observed after intravenous distilled water treatment.

**Figure 1. Showing effect of intravenous lithium chloride on electrocardiogram of rabbit at different intervals.**

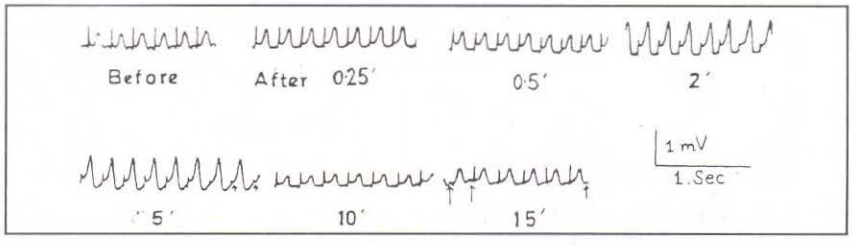


**Table 1**

| ECG Parameter | Time (Minutes) 0.25 | 0.5 | 2 | 5 | 10 | 15 |
|---|---|---|---|---|---|---|
| P-Wave | Disappears | Disappears | Disappears | Disappears | Remains | Reappear in some of the ECG segments |
| | Minor decrease | Minor decrease | Remnants of P-wave | | Reappears in some of the ECG segment | Remains indist-tinct |
| QRS complex | Minor decrease in amplitude | Further decrease | Further decrease | Remants of QRS complex left in some of ECG segments | QRS complex recovers back to good extent | Recovery is maintained |
| | Remains as in control | Remains as in control | | | | |
| T-wave | T-wave reaches upto R-wave | Remains there | Surpasses T-wave the R-wave | Higher height of T-wave is main-tained | T-wave comes back to R-level | T-wave upto R-wave |
| | T-wave remains as in control | T-wave remains as in control | T-wave rises upto the level of R-wave | | T-wave below the R-wave | T-wave below the R-wave |
| ST segment | Begins to rise above the isoelectric line | Rises further | ST-segment reaches near the R-wave | Remains at earlier position | Begins to come back to isoelectric line | Returns to isoelectric line |
| | Remains at isoelectric line | Remains at isoelectric line isoelectric line | ST-segment rises above R-wave | St-segment reaches near | Remains near R-wave line | Begins to return to isoelectric |

## Discussion

The present findings throw light on some new findings and at the same time support the theory of ionic disturbances which are caused by lithium(10). Electrocardiographic changes have been used for diagnosis(11) and in the present experiment depicted alterations in P-wave, QRS-complex alongwith ST-segment and T-wave, The disappearance of atrial activity is most likely due to the effect of lithium on atrial myocardium. The fall in amplitude of QRS complex might be due to transient effusion from myocardial cells(12). ST segment and T-wave changes following application of lithium lactate to the surface of heart have been reported(13). T-wave depression is most consistently reported finding in the case of patients receiving oral lithium carbonate for long time (2). ST-segment elevation alongwith long peaky T-wave, which is recorded in the present experiment is a uncommon clinical finding and is generally not reported in lithium receiving patients (12). ST-segment elevation is probably due to entrance of lithium and leakage of potassium from myocardial cells. Baer *et al* (14) suggested that lithium resembled potassium more than sodium and might, therefore have readily replaced the former. This has probably caused the local pooling of potassium in the interstitial fluid thereby resulting in hyperkalemia and hence long tented T-wave. Similar results have been earlier been shown in animals receiving lithium chloride (15). Though T-wave depression is often reported but there are reports of T-wave inversion and amplification as a cardiovascular side effect of lithium (16). Generally, slender tented T-wave suggest hyperkaelemia, but it is not absolutely diagnostic since patients with posterior wall infarction and even normal individual may show a similar pattern (12). Above discrepancies in ECG alterations induced by lithium are probably due to difference in mode of injection, animal species, dose and salt of lithium used.

## Conclusion

Effect of single acute dose of lithium chloride on rabbit's heart was investigated by injecting it intravenously and recording limb lead II electrocardiography. This resulted in transient disappearance of P-wave, reduction in QRS complex amplitude, ST-segment elevation and long tented T-wave, suggesting a need for cardiovascular monitoring of population which is exposed to environmental or occupational lithium hazards.

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