CERTAIN OBSERVATIONS IN ELECTROCARDIOGRAM AND ENZYME VARIATION IN DOGS, FOLLOWING SCORPION VENOM INJECTION

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Summary: The effect of scorpion venom of *Buthus Tamulus* species on blood pressure, ECG, enzyme and electrolytes were studied in dogs. Venom was given in doses of 2 and 4 *mg/kg* body weight. Hypotension and tachycardia were observed with low dose and bradycardia was significant with high dose. ST segment depression, T wave changes, shortening of PR interval were the important ECG changes apart from ventricular extrasystoles. With high dose, QRS amplitude was reduced and duration prolonged. QTC interval was also significantly prolonged. Significant increase in SGOT, SGPT and LDH levels were observed but no change in serum electrolytes was seen.

Key words: scorpion venom blood pressure ECG enzymes

INTRODUCTION

Bizarre cardiovascular effects were observed in cases of scorpion sting both in adults and children. The present ECG and enzyme studies were undertaken in order to correlete and investigate fully the cardiovascular changes produced by the toxin of *Buthus tamulus* (commonly found in South India) in laboratory dogs. In an earlier study on the effects of scorpion venom on animals especially dogs, the important cardiovascular manifestations observed were hypotension and tachycardia (1,2). Several studies and observations have been related with regard to effect of scorpion venom both in animals (3) and in human beings from different geographical areas (4,5, 6). The present study relates to the electrocardiographic and enzymatic changes as observed following scorpion venom injection in dogs.

MATERIALS AND METHODS

The normal laboratory dogs of mongrel breed and wieghing 7.5 ± 1.5 *kg* were taken for study. The animals were anaesthetised with alpha chloralose 80 *mg/kg* body weight given intravenously. Blood pressure was measured by a simple modification of the ausculatory method used in man (7) and ECG was taken with Cardiart in the supine position. The normal ECG of a dog was established by recording 3 tracings taken at different times, in 3 dogs. The body position of the dogs particularly the chest position was carefully controlled during recording of ECG. Venom was collected from the *Buthus tamulus* species, after passing an electrical stimulus of 6 volts through the scorpion's telson (8). The venom was weighed and diluted with normal saline to produce a concentration of 1 *mg* in 1 *ml*. The venom was given in a dose of 2 *mg/kg* body weight, intravennously. The study was repeated in 6 dogs. Serial 12 lead electrocardiograms were recorded after 15 min, 30 min, 1 hr, 2 hrs on the same day, after 24 hrs, 48 hrs and after the disappearance of changes. Blood was drawn from these animals before and 2 hrs after the scorpion venom

injection and the serum was estimated for LDH by King's method (9) and SGOT and SGPT by the methods described by S. Reitnam and S. Frankel (10) and serum electrolyte by flame photometry. Two dogs were injected with 4 *mg/kg* body weight and the same procedure as above adopted till the animal died.

RESULTS

Blood pressure:

In all the 8 dogs, hypotension was an immediate finding following venom administration. In the 6 dogs where venom was given at 2 *mg/kg* body weight, associated tachycardia was observed. In the 2 dogs where venom of 4 *mg/kg* body weight was administered, it was noticed that hypotension was sudden and severe, associated with bradycardia followed by fatal cardiac arrest within 20-30 min.

Electrocardiogram:

In 6 dogs on 2 *mg/kg* venom, P-R interval was reduced in 4 recordings (0.08 to 0.06 sec.). Changes in QRS duration were found to be insignificant. ST segment depression was observed in 3 ECG recordings (50%). T-wave changes were observed in 5 (83%)-notched in 2 (33%), inverted in 2 (33%) and rudimentary in 1 (16%). Extrasystoles were observed in 2 recordings (33%). All the 6 animals from this group survived. The ECG changes were transient, returned to normal in 2 to 3 days in all 5 animals and on the 10th day, in one animal (Fig.1.).

In 2 dogs on 4 *mg/kg*, sinus bradycardia and prolonged PR interval were observed following venom infusion. QRS amplitude was reduced and duration prolonged (0.041 sec. to 0.06 sec.). S.T. segment showed marked depression. QTC was significantly prolonged at 10 min interval from 0.27 sec to 0.34 sec (Fig.2). Both the animals died.

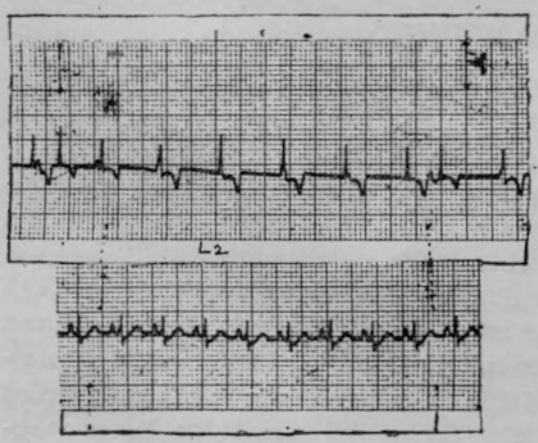

Fig. 1: Upper tracing shows inversion of T-wave and extrasystole. Lower tracing shows ST depression and tachycardia.

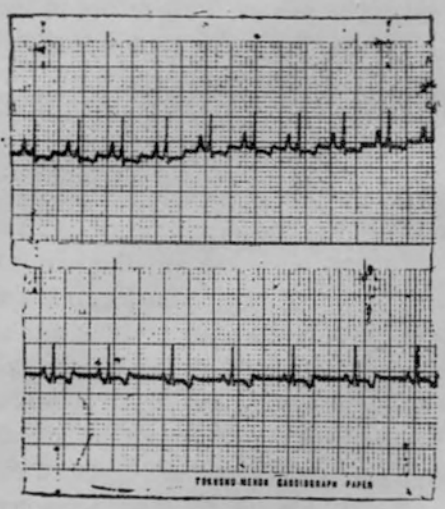

Fig. 2: Upper tracing shows biphasic T-wave and tachycardia. Lower tracing shows inversion of T-wave.

In venom administrated dogs, there was a significant increase in Lactic Dehydrogenase ($P<0.05$) and in SGOT and SGPT levels ($P<0.01$) in the serum. The enzyme changes returned to normal in 3-4 days. Serum electrolytes showed no significant changes ($P>0.01$).

TABLE I: Serum, Enzyme and Electrolyte changes in dogs.

Substance estimated	*Controls (8)*	*After venom (6) Mean ± S.E.*
L.D.H. units	97.8 ± 7.936	x 173.2 ±39.48
S.G.O.T. units	31.2 ± 1.381	* 69.8 ±12.55
S.G.P.T. units	33.4 ± 0.8513	* 52.6 ± 7.98
Sodium mEq/L	143.5 ± 1.482	' 143.5 ± 2.598
Potassium mEq/L	4.55 ± 0.5527	' 4.55 ± 0.8177

x Significantly different from control ($P<0.05$).
* Highly significant and different from control ($P<0.01$).
' Not significant ($P>0.01$).

DISCUSSION

Following scorpion venom administration marked changes in blood pressure and heart rate were observed, depending on the venom dose. In addition, striking ECG changes were seen. These ECG changes, especially T wave changes in many leads, ST depression, QTC prologation, and ventricular extrasystoles are suggestive of myocardial injury pattern (myocardiogenic). The associated rise in the levels of serum enzymes like SGOT, SGPT and LDH is strongly indicative of venom effect on the cardiac musculature. But no histopathological changes were observed in the cardiac muscle. As there was no change in the serum electrolyte pattern, the ECG changes could not be related to any electrolyte imbalance.

Recently the involvement of cardiovascular system were studied at length both in human beings (1,11,12) and experimental animals. Freira Maia *et al.* (13) in their experimental studies in rats have reported sinus techycardia with low dose and sinus bradycardia with high dose of scorpion venom and concluded that catecholamines and acetylcholine release respectively as the cause for cardiac arrhythmias. They were also of the opinion that the venom has direct action on the medullary centres as well. Devi *et al.* (14) have reported hemorrhages and histopathological changes in the heart muscle suggestive of defibrination syndrome. But no such changes were observed in our study cases.

Poon King, in his observations mostly in adults following stings of *Tityus Trinitatus*, found ECG changes typical of myocarditis persisting for 3 to 6 days. Gueron *et al.* (6) have reported ear-early "myocardial infarction" like pattern in scorpion sting cases in adults and many of them had in addition hypertension, congestive cardiac failure and pulmonary edema. These findings were observed in sting of *Quinquestriatus* species commonly seen in Isreal and they attributed these cardiovascular manifestations to the increased circulating catecholamines directly affecting the sympethetic system. In the present study none of the animals had any evidence of hypertension

to support the theory of catecholamines induced hypoxia following scorpion sting. On the other hand, hypotension was the striking feature in this study.

The observations in human beings especially in children following sting of *Buthus Tamulus* species are similar to our study. Hypotension was often an important manifestation seen within half to one hour of the sting and the symptoms of pain or local reaction was unrelated to the development of hypotension. Although we are cognizant that animal experiments are not similar to natural sting, the findings in the present study are comparable to the observations in children as reported by Santhanakrishnan *et al.* (15,16). They concluded that the cardiac complications scorpion sting, probably related to the direct effect of the venom on myocardium. However, in our earlier study (2), no obvious pathology was found in cardiac muscle following venom injection.

ACKNOWLEDGEMENTS

We are grateful to Dr. S. Ranganathan, Department of Biochemistry, Institute of Child Health & Hospital for Children, for this help in carrying out the biochemical studies and Dr. B.R. Santhanarkishnan, of the Institute of Child Health and Hospital for Children, Madras, for his valuable suggestions.

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