ABNORMAL CARDIOVASCULAR AND ELECTROCARDIOGRAPHIC PROFILES AND CARDIAC GLYCOGEN CONTENT IN RABBITS INJECTED WITH SCORPION VENOM

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(Received on March 23, 1981)

Summary : Cardiovascular and ECG abnormalities were studied following injection of venom of Buthus tamulus, a common scorpion found in South India. Venom was administered in doses of 2 and 4 *mg/kg* body weight. Subsequent estimation of glycogen content of different chambers of the heart, showed a significant reduction in tissue glycogen levels in both atria and ventricles in animals treated with a venom dose of 2 *mg/kg*. However, a significant reduction occured only in atria with a higher venom dose of 4 *mg/kg*.

Key words : scorpion venom, ECG abnormalities, tissue glycogen, atria and ventricles

INTRODUCTION

Various cardiovascular and ECG abnormalities are seen in children and adults dying of scorpion stings (5, 10). There are also several reports to show the effects to be dose-dependent (3, 4, 11). These manifestations are probably due to the neurovegetative effects of the venom on the sympathetic system with subsequent catecholamine overdosage (3, 5). These findings were supported by estimation of catecholamines and their degradation products in urine (5) as well as by the effects of blockers (3).

Earlier reports indicate that glycogen protects the heart against hypoxia (13) and that it disappears rapidly from the hypoxic heart (7) suggesting a high level of glycolysis. The catecholamines released from the sympathetic system by the venom in turn causes relative myocardial hypoxia resulting from their ionotropic effects on the myocardium, or by directly enhancing oxygen consumption to the point of causing myocardial hypoxia (5). It would then be logical to assume that, as a consequence of this relative hypoxia, the glycogen content of the heart would decrease on injection of the venom. McDonald *et al.* (8) have shown a greater atrial glycolytic capacity, than that of ventricles. This conflicts

with the findings of Dhalla *et al.* (1) who have shown a higher total enzyme phosphorylase (a glycolytic enzyme) in ventricles, than in atria. The present report correlates the decrease or otherwise in tissue glycogen in atria and ventricles with the cardiovascular E.C.G. manifestation as a result of injection of scorpion venom in two doses of different strengths.

MATERIALS AND METHODS

Rabbits (1-1.5 *kg* wt.) were anaesthetized with Pentobarbitone sodium (30 *mg/kg* iv) and then one group of rabbits were injected intramuscularly with venom of Buthus. Tamulus in dose of 2 *mg/kg* whereas another group received 4 *mg/kg*. Control animals received injection of normal saline only.

ECG was recorded with Standard Limb lead II before and after venom injection. All rabbits were kept fasting overnight (6) prior to killing. Then the animals were sacrificed by cervical dislocation. The heart was removed, the atria and ventricles weighed separately, and their glycogen content estimated (9), after first extracting glycogen by digestion with hot potassium hydroxide. All estimations were done in triplicate, and values were obtained by comparing with predrawn standard curve with glucose and expressed as equivalent of glucose in *mg/g* wet tissue.

RESULTS

ECG in control animals as well as in animals administered scorpion venom are shown in Figs. 1 and 2. Tissue glycogen content of atria and ventricles in control animals was compared with experimental animals as shown in Table I.

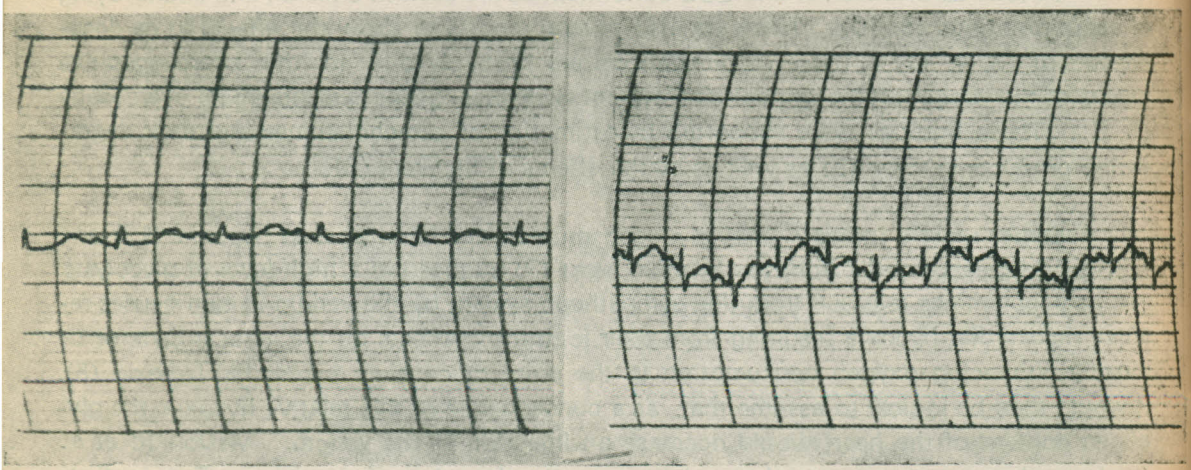

Fig. 1 (a) : ECG showing normal sinus rhythm (Rabbit).

Fig. 1. (b) : Sinus tachycardia.

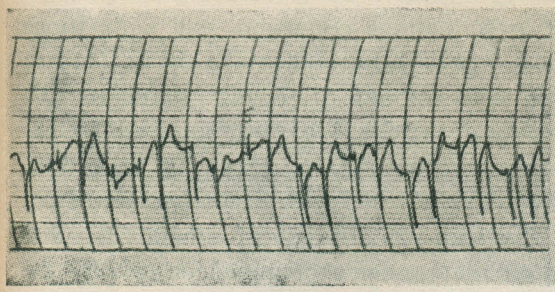

Fig. 2 (a) : Supraventricular dysrhythmia.

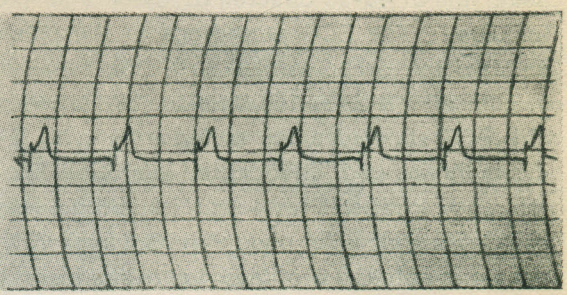

Fig. 2. (b) : Myocardial infarction–like pattern (inferior wall infarction) ST segment camel – backed.

TABLE I : Effect of scorpion venom (Buthus tamulus) on tissue glycogen content of atria and venticles of rabbits (*mg/g* wet tissue)

	Control n=10	2 *mg/kg*+ n=8	*% depletion*	4 *mg/kg*+ n=6	*% depletion*
Atria	7.3 ±0.61	3.58±0.55*	50%	3.38±0.60*	50%
Ventricles	8.86±1.19	5.47±0.98*	38%	6.80±0.10	23%

*$P < 0.05$
n = number of animals
+ = dose of venom

In control rabbits, the values for tissue glycogen was more in ventricles compared to atria. On treatment with venom (2 *mg/kg*) a significant reduction in glycogen content of atria and ventricles was observed, whereas with a higher dose (4 *mg/kg*), there was significant reduction in atrial content only, whereas glycogen content of ventricles was not significantly reduced. The percentage depletion of glycogen is greater in atria (50%) than in ventricles with either dose of venom (38% and 23%).

DISCUSSION

Scorpion stings are known to induce abnormal cardiovascular and ECG profiles in human and experimental population (3, 5, 10). Venom of Buthus tamulus is known to induce such abnormalities (11) as well as produce a defibrination syndrome in humans (2). Hospital statistics (Kurnool Medical College, Kurnool, Andhra Pradesh, India) show a yearly

death rate of 40-50 children of lower age group dying from sting of scorpion (Buthus tamulus). The ECG recordings in the present investigations compared well with those reported by earlier workers with the same venom, either in experimental animals (11) or in clinical cases (5, 10) as also by others (3) with venom of Tityus serrulatus (3). The ECG showed sinus tachycardia with 2 *mg/kg* dose (Fig. 1-b) and supra ventricular dysrhythmias and "Myocardial infarction-like pattern" with 4 *mg/kg* dose (Fig. 2a and b). Necropsy studies in fatal scorpion sting cases resembled those due to excessive circulating catecholamines as in pheochromocytoma (5). This supports the view of others (3) that the abnormal ECG profile is due to the increased circulating catecholamines induced by the neuro vegetative action of venom on sympathetic system.

Hexokinase and phosphofructokinase increase their activity during hypoxia (12). Also glycogen disappears readily from the hypoxic heart (7). In the present study, atrial glycogen was significantly reduced in experimental animals with both 2 and 4 *mg/kg* venom dose. Similarly ventricular glycogen was reduced with either dose though significant reduction was seen only with the lower dose. However, percentage depletion or lowering of glycogen was more marked in atrial tissue than in ventricular tissue.

McDonald *et al.* (8) showed that atrial tissue has a greater glycolytic capacity than ventricular tissue and is more resistant to hypoxia. Presuming that a higher dose of venom would induce a higher level of circulating catecholamines, resulting in greater myocardial abnormality and damage, this observation of McDonald would be pertinent and could explain the present observation of a greater percentage depletion in atrial glycogen content in either case, though why a higher dose does not cause significant reduction of ventricular glycogen content cannot be explained satisfactorily and could be the basis for further investigation in this field.

ACKNOWLEDGEMENTS

The authors like to thank, the Dean, Lokmanya Tilak Municipal Medical College, for providing facilities to conduct these experiments. The authors also thank Prof. N.A. Dabholkar, Department of Physiology, for his helpful suggestions.

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