MYOCARDITIS FROM SCORPION STINGS

BY

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Most of the scorpions found in the West Indies are relatively innocuous, although their stings may be quite painful. However, in Trinidad the sting of *Tityus trinitatis* sometimes proves fatal. *Tityus trinitatis* is the common scorpion of Trinidad and belongs to the family Buthidae (Fig. 1). It is found in large numbers in the canefields, where most of the patients in the present series were stung. In a clinical analysis of 698 cases of scorpion sting admitted to one hospital from 1929 to 1933 Waterman (1938) found that the heart beat was generally slow but forcible and extrasystoles were comparatively frequent. Waterman (1950) published

FIG. 1.—*Tityus trinitatis* (Family Buthidae).

with electrocardiograms two cases of scorpion-poisoning characterized by convulsions. The electrocardiograms showed multiple ventricular extrasystoles, and it was concluded that in some cases of scorpion stings the convulsions might be the result of ventricular tachycardia. A survey of the literature failed to reveal any other report of electrocardiographic changes associated with scorpion stings. The present paper deals with the clinical and electrocardiographic study of 45 cases of scorpion stings.

Material and Methods

The 45 patients were between the ages of 9 and 50; 29 of them were under 25. There were 26 males and 19 females. Only patients who had actually seen the scorpion and could describe its features were investigated. They were examined soon after admission to hospital, and an electrocardiogram consisting of standard, unipolar limb, and six precordial leads were taken in the supine position.

Serial 12-lead electrocardiograms were done at approximately 24, 48, and 72 hours after the scorpion sting. If the electrocardiogram was still abnormal after 72 hours it was repeated at the end of the week. The clinical examination and the recording of the electrocardiograms were done personally in every case. The chest radiograph was taken in order to determine the size of the heart more accurately in many patients who had electrocardiographic abnormalities. Fasting blood-sugar, urinary sugar, serum amylase, serum electrolyte, and blood urea examinations were made within 24 hours of admission in all cases. The erythrocyte sedimentation

rate (Wintrobe's method) was estimated in 16 cases and the serum calcium in five cases. The serum amylase was estimated by Somogyi's method and the serum electrolytes by flame photometry.

Results

Clinical Findings.—Table I shows the clinical features of the 45 cases. Pain at the site of the sting, excessive salivation, vomiting, epigastric pain, abdominal tenderness, tachypnoea, and disturbances of the heart rate or rhythm were common. Glycosuria (42%), pyrexia

TABLE I.—Clinical Features in 45 Cases of Scorpion Sting

Clinical Features	No. of Cases	% Total
Pain at site of sting	45	100
Excessive salivation	45	100
Vomiting	42	93
Epigastric pain	32	71
Abdominal tenderness	28	62
Tachypnoea (hyperventilation) ..	22	49
Pyrexia	18	40
Profuse sweating	14	31
Tachycardia	17	38
Bradycardia	8	18
Extrasystoles	11	24
Drowsiness	13	29
Restlessness	9	20
Shock	9	20
Carpopedal spasm and twitchings	3	7
Glycosuria	19	42

(40%), and profuse sweating (31%) occurred. Nine patients were shocked on admission, and three had carpopedal spasms and muscular twitchings. Convulsions were not observed in any of the patients. Despite the pain at the site of the sting there was little local reaction. Examination of the cardiovascular system revealed tachycardia in 17 patients, bradycardia in eight, pulsus alternans in eight, and extrasystoles in 11. Triple rhythm was heard in five patients and a transient grade I to II apical systolic murmur was present in nine. Enlargement of the heart was not found clinically in any case, and the C:T ratio was normal in the patients who had chest radiographs. Nine patients were admitted in a state of shock.

Biochemical Findings (Table II).—The serum amylase was higher than 200 units (Somogyi) in 29 patients. The level was 3,000 units (Somogyi) in two patients, between 1,000 and 2,000 units in six, and between 500 and 1,000 units in seven. The fasting blood sugar was above 120 mg./100 ml. in six patients. Glycosuria was present in 19. Glycosuria was associated with a normal fasting blood sugar and a high serum amylase in 14 patients, with a high fasting blood sugar and a high serum

TABLE II.—Biochemical Findings (Patients with Glycosuria)

Case No.	Age	Urinary Sugar	Fasting Blood Sugar (mg./100 ml.)	Serum Amylase (Somogyi Units)	Serum Electrolytes (mEq/l.)			Blood Urea
					K	Na	Cl	
3	11	++++	90	800	3.4	134	105	54
6	40	+	93	266	5.1	138	103	
8	20	+	94	228	4.2	132	100	30
9	9	+	93	200	3.6	140	100	35
12	35	++	80	320	4.8	148	100	47
21	23	+++	100	533	3.9	146	104	46
22	27	++++	80	320	4.6	140	105	30
26	17	+	160	3,000				30
27	21	+	102	160	4.0	144	105	52
28	12	+	96	1,600	4.4	150	106	63
29	15	+	90	1,600	6.4	140	100	32
30	13	+	70	260	3.8	144	100	30
35	20	++++	130	400	3.8	138	98	52
36	11	+++	170	3,000	4.0	148	100	56
37	11	+++	80	1,000	3.6	136	101	44
38	41	+	80	200	4.4	140	100	32
39	14	++++	270	1,000	3.0	144	100	30
41	30	++	100	1,500	4.0	138	106	30
43	10	+	80	1,000	4.8			54
44	14	+++	90	300	4.8			45

amylase in five, and with a normal fasting blood sugar and a normal serum amylase in two. The blood sugar was less than 170 mg./100 ml. in 17 patients with glycosuria; it was over 170 mg./100 ml. in only two patients. Serum potassium levels were below 3.5 mEq/l. in four patients, between 3.6 and 3.8 mEq/l. in 12, between 3.9 and 5.5 mEq/l. in 26, and 6.4 mEq/l. in one patient. Hypochloreaemia was present in six cases and the blood urea was a little raised (40 to 60 mg.) in 12.

TABLE III.—*Abnormal Electrocardiographic Findings in 45 Cases of Scorpion Stings*

	No. of Cases	% Total
Ectopic beats	11	24
Electrical alternation (with pulsus alternans)	6	13
Abnormalities of QRS complex:		
Incomplete right bundle-branch block	4	9
Pathological Q wave	1	2
RST depression	17	38
T-wave inversion (in several leads)	31	69
Prolonged Q-Tc:		
> (0.42 sec.—males; 0.43 sec.—females)	24	53
Abnormal:		
Electrocardiograms	39	87
Myocarditis	34	76
Ectopic beats without myocarditis	5	11
Normal:		
Electrocardiograms	6	13
With sinus tachycardia	2	4
,, bradycardia	1	2

FIG. 2.—Case 12. Man aged 35. Electrocardiogram (A) 5 hours, (B) 6 days after scorpion sting. (A) P-R interval 0.24 sec., QT₀ 0.45 sec., T wave inverted in aVL, V₁, V₂, V₃, V₄, V₅, V₆, flattened in I, II, III, aVF, V₁. (B) Normal after 6 days.

FIG. 3.—Case 28. Boy aged 12. Electrocardiogram taken 5 hours and 27 hours after scorpion sting. (A) ST depression in several leads, cloven T waves in V₁, V₂, V₃, V₄, and QT₀ 0.45 sec. (B) Normal after 27 hours.

The erythrocyte sedimentation rate (Wintrobe) was elevated in 9 of the 16 cases. The serum calcium was normal in five cases.

Electrocardiographic Findings (Table III and Figs. 2-6).—Of the 45 patients, 39 had abnormal electrocardiographic tracings. Ectopic beats were observed in 11 cases and electrical alternation in six cases. Four patients had an incomplete right bundle-branch block, and one had an abnormal Q wave in aVL. In three

FIG. 4.—Case 29. Boy aged 15. Electrocardiogram 6 hours after scorpion sting shows incomplete right bundle-branch block, electrical alternation, tall T waves, and QT₀ 0.41 sec. N/2=½ millivolt.

FIG. 5.—Case 41. Woman aged 30. Electrocardiogram 2½ hours after scorpion sting shows multifocal ectopic beats, incomplete right bundle-branch block, and QT₀ 0.45 sec.

FIG. 6.—Case 45. Girl aged 10. Electrocardiogram 4 hours after scorpion sting shows inverted T waves in II, III, aVF, V₁, V₂, V₃, V₄, and V₅, and flattened T waves in V₆, V₇. T waves are upright after 36 hours except in II, III, V₁.

patients $S_v + R_{v_5}$ or R_{v_6} was above 35 mm. Significant deviation of the RST segment was observed in 17 patients. Inverted T waves in several leads were found in 31 patients and Q-T was prolonged in 24. All the electrocardiographic abnormalities were transient, with complete restoration to normal in three to six days. They appeared as early as two to four hours after the scorpion sting, and were most pronounced during the first 24 hours. The T-wave changes were usually the last to appear and also the last to disappear. Cardiac arrhythmias were not observed after 24 hours following the scorpion sting.

Discussion

The electrocardiograms were examined for T-wave inversion in several leads, significant deviation of the RST segment, prolongation of Q-T_c, and conduction defects may occur, and the entire gamut of conduction toxic myocarditis in this condition. The E.C.G. is the most important laboratory aid in the diagnosis of myocarditis, and in those cases where clinical manifestations are absent the diagnosis may rest entirely on the findings of serial E.C.G.s (Silber, 1959). In any form of myocarditis the RST segment and the T waves are most frequently affected. The RST segment may be normal or depressed and the T waves are flat or inverted in several leads. Arrhythmias and conduction defects may occur, and the entire gamut of conduction and rhythm disturbances may be seen, including partial intraventricular and complete heart-block, A-V dissociation, atrial, nodal, and ventricular ectopic beats, or tachycardias. The changes are transient and there is complete restoration to normal (Brigden, 1956; Wood, 1956; Robin, 1961). The tracings of 34 patients satisfied these electrocardiographic criteria of myocarditis.

It is well known that electrolyte disturbances may affect the electrocardiogram. In hypocalcaemia there is prolongation of Q-T_c but no abnormality of the T wave (Wood, 1956). In hypokalaemia the amplitude of the T wave declines when the serum potassium is at 3.2–3.5 mEq/l. The U wave becomes prominent at 2.5 to 3 mEq/l., and depression of the RST segment occurs at about 2 mEq/l. (Metzger and Blum, 1950). Since severe and prolonged vomiting may produce hypokalaemia, the serum potassium was estimated in all cases in order to determine its influence on the electrocardiogram. In four patients the serum potassium level was below 3.5 mEq/l., and this, no doubt, accentuated the electrocardiographic abnormalities. However, in all these patients there was marked T inversion and ST depression out of all proportion to the changes to be expected from the level of serum potassium. In one patient the serum potassium was 6.4 mEq/l. and the electrocardiogram showed tall T waves consistent with this degree of hyperkalaemia. In 38 patients the serum potassium level had no influence on the electrocardiogram.

Electrocardiographic changes have been described in a few cases of pancreatitis by Dittler and McGavack (1938), Gottesman *et al.* (1943), and Bockus (1950). Gottesman *et al.* described ST depression in leads II and III and diphasic T waves in leads I, II, and III. However, Siler and Wilson (1950) were unable to find a consistent electrocardiographic pattern in acute pancreatitis but advanced two hypotheses regarding the mechanisms involved: (1) a low serum calcium, and (2) a disturbance of the vagal impulses via the coeliac plexus. In the present series the electrocardiographic

changes were often very marked two to six hours after the scorpion sting, when there were no clinical signs of pancreatitis. Moreover, there was no close correlation between the severity of abdominal tenderness and pain, the level of the serum amylase, and the extent of the electrocardiographic abnormalities. Some patients with electrocardiographic changes showed no clinical or biochemical evidence of pancreatitis.

The observations made in the present study indicate that myocarditis is the commonest complication of scorpion stings from *Tityus trinitatis*. Thirty-four patients (76%) had electrocardiographic evidence of myocarditis, 29 (65%) had acute pancreatitis, 6 (13%) had hyperglycaemia and glycosuria, and 16 (39%) had renal glycosuria. As in most forms of non-rheumatic myocarditis clinical evidence of the lesion was not striking. The presence of shock, pulsus alternans, or triple rhythm in a few patients indicated serious organic disease of the myocardium. The majority of the patients appeared quite well once they had recovered from the initial episode of salivation, vomiting, and epigastric pain. However, despite the good clinical condition of the patients, the electrocardiogram showed marked changes, which usually persisted for three to six days.

Great emphasis is usually placed on the neurological manifestations following scorpion stings (Waterman, 1938; Bennett, 1958; Brown, 1959; Manson-Bahr, 1961), and toxic myocarditis is not mentioned in the literature as a complication, even though cardiac irregularities have long been recognized in this condition. In South Africa Grasset *et al.* (1946) have found neuromotor symptoms after the intravenous injection of toxin from the three main genera of scorpions found in that country. The toxin of *Tityus trinitatis* has not been isolated, but it is generally believed to be a neurotoxin. Death is usually attributed to the effect of the neurotoxin on the cardiac and respiratory centres in the medulla (Waterman, 1938). The patients who were seriously ill in the present series were all in a state of shock due to vasomotor collapse and myocarditis. Signs of bulbar palsy were conspicuous by their absence. Hydrocortisone was given intravenously in all cases and there were no deaths. Antivenene to *Tityus bahiensis* and *Tityus serrulatus* and small doses of chlorpromazine or antihistamines were also given as a routine measure. It would be reasonable to postulate that death following stings with *Tityus trinitatis* is usually due to a toxic effect on the myocardium rather than on the brain.

Summary

This paper deals with the clinical and electrocardiographic study of 45 patients who had been stung by the common scorpion of Trinidad, *Tityus trinitatis* (family—Buthidae).

The patients were examined soon after admission, and serial 12-lead electrocardiograms were done on admission and at approximately 24, 48, and 72 hours after the scorpion sting. If the E.C.G. was still abnormal at the end of 72 hours it was repeated at the end of the week. The fasting blood sugar, urinary sugar, serum amylase, serum electrolytes, and blood urea estimations were done within 24 hours of admission.

The common clinical findings were pain at the site of the sting, excessive salivation, vomiting, epigastric pain, abdominal tenderness, disturbance of heart rate and rhythm, glycosuria, pyrexia, and profuse sweating. Nine

patients were shocked, and three had muscular twitchings and carpopedal spasms.

Thirty-four patients had electrocardiographic evidence of myocarditis—that is, inversion of the T waves in several leads, significant deviation of the RST segment, prolongation of Q-T_c and conduction defects with complete restoration to normal in three to six days.

Toxic myocarditis has not been previously described after scorpion stings. Death is usually ascribed to a toxic effect on the medullary centres. Myocarditis is the commonest complication following stings by *Tityus trinitatis*, and it would be reasonable to postulate that it is a frequent cause of death in this condition.

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NUCLEAR SEX OF EMBRYONIC TUMOURS

BY

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Many workers have reported chromatin-positive teratomata from males, mainly those of the testis (review by Lennox, 1961). As the sex-chromatin pattern of an individual may be used to infer his sex chromosomes, this suggests the presence of two X chromosomes in the teratomatous cells of normal (XY) males.

In a recent series I have found sex-chromatin discrepancies in 8 out of 50 teratomata (three from males and five from females) and in 4 out of 49 other embryonic tumours studied (one from a female and three from males).

Material, Methods, and Results

Fifty teratomata (24 from boys, 26 from girls) and 49 other embryonic tumours (21 from boys, 28 from girls) were examined. This material forms part of the collection of the Department of Morbid Anatomy, Hospital for Sick Children, Great Ormond Street.

Most of the material was fixed routinely in formol-saline, paraffin-embedded, sectioned, and stained in haematoxylin-eosin and haematoxylin-Van Gieson. Some of the material was fixed in Bouin's fixative. When available, spare sections were stained with the Feulgen method, counterstaining with light green or with orcein, and additional sections were cut when possible and necessary.

The incidence of sex-chromatin-positive cells for each tumour was determined by counting several random groups of 100 nuclei each. All pyknotic or folded nuclei were rejected. Only masses attached to the nuclear membrane were scored as positive. Neuroglial cell nuclei were not included in the counts, since in both males and females these frequently contain single or double sex-chromatin-like masses. In large areas of some malignant tumours identification of sex chromatin was impossible. When the main tumour mass was unreadable small metastases were sometimes suitable for examination. The results are listed in the Table.

Analysis of Sex-chromatin Discrepancies in 12 Out of 99 Embryonic Neoplasms Studied

Case No.	Sex	Average Sex-chromatin Incidence Percent of Tumour		Type of Tumour
		One Mass	Two Masses	
1	F	4	—	Malignant cranial teratoma
2	F	2	—	“ ovarian “
3	F	48	33	Histologically benign ovarian teratoma
4	F	47	27	“ “ retroperitoneal teratoma
5	F	60	14	Malignant retroperitoneal teratoma
6	M	31	—	Histologically benign cervical teratoma
7	M	57	—	Partly well-differentiated cranial teratoma with metastases
8	M	27	—	Histologically benign high abdominal teratoma
9	F	7	—	Embryonic sarcoma
10	M	51	Few	Nephroblastoma
11	M	30	“	“
12	M	28	“	“

Discussion

Hunter and Lennox (1954) suggested that teratomata might be derived from the fusion of two gametes, “or, at least, of haploid cells,” giving only tumours with an XX sex-chromosome complement in females, but with XX, XY, or YY complements in males. Tavares (1955) suggests that division of haploid cells followed by chromosome reduplication gives rise to either XX or YY tumours in males. This assumes that YY cells are viable in teratomata.

The main objection to these suggestions is that they do not easily account either for sex-chromatin discrepancies in extragerminal teratomata or for the mosaic teratomata which were described by Maltzeff and Sacco (1958) and Myers (1959) after the formulation of these hypotheses. Furthermore, we must reckon with the possibility that sex-chromatin discrepancies in teratomata and other tumours may be the expression of other abnormal sex-chromosome complements such as XO, XXY, XY/XXY, XX/XXX, XO/XXX, etc.