Scorpion sting in Zimbabwe

Nils J Bergman

Objective. To describe the epidemiological and clinical features of scorpion stings in a district with potentially lethal scorpions.

Design. Case series of consecutive scorpion sting victims.

Setting. Manama Hospital and all seven rural health centres in Gwanda South District, Zimbabwe (population 62 500).

Participants. All known cases of scorpion sting reporting to health centres in the district; all severe cases in which the scorpions had been identified, and who were admitted and examined by the author between September 1991 and September 1993.

Main outcome measures. Description of clinical features of severe *Parabathus transvaalicus* scorpionism.

Results. Two hundred and forty-four cases, of which 184 were *P. transvaalicus* Purcell, 1899. Seventeen patients with severe *P. transvaalicus* scorpionism showed sensory and motor nerve stimulation, with generalised hyperaesthesia, weakness, ptosis, dysphagia, muscle tremors and abnormal reflexes. There was cardiac involvement, and respiration was compromised secondary to muscular weakness. Parasympathetic nervous system stimulation was seen in the absence of sympathetic stimulation, with profuse sialorrhoea, sweating and urinary retention.

Conclusions. The clinical features of *P. transvaalicus* scorpionism are described for the first time. These resemble those of *P. granulatus* scorpionism which, however, has significant sympathetic nervous system stimulation, the distinguishing features being visual disturbances, anxiety, restlessness and raised blood pressure. Scorpion antivenom should be given for both. General recommendations on management of scorpion stings are given.

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A review of the available medical literature on southern African scorpionism (defined as systemic symptoms and signs following scorpion envenomation) involving identified scorpions reveals that the majority of severe cases have been caused by the buthid species *Parabuthus granulatus*.[1-4] Except for a single case report, no series of *P. transvaalicus* stings have been published[5] (Fig. 1). A single fatal case involving *P. capensis* could not be confirmed.[4,6] It has been reported that *Opistophthalmus* sting (a scorpionid, species not specified) is able to produce scorpionism with features that differ from those associated with the *Parabuthus* spp.[1] In 1978, Newlands reviewed the clinical features of southern African scorpionism and listed the scorpion species thought to be medically important, but points out that the clinical features of southern African scorpionism have not been accurately documented.[7]

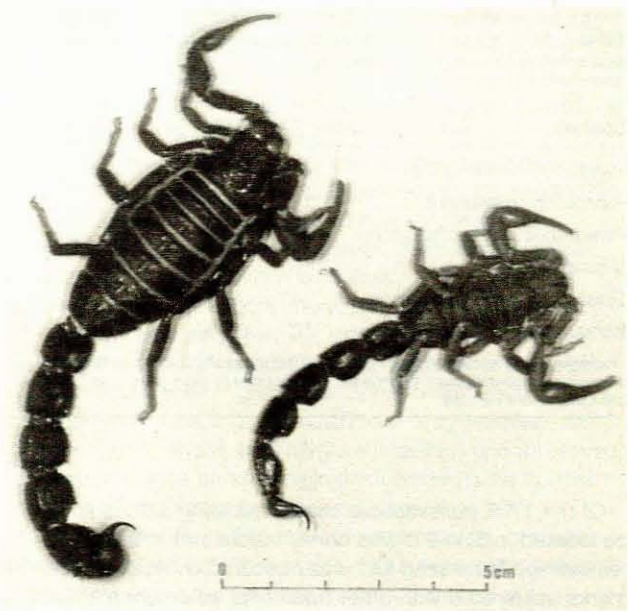

Fig. 1. *P. transvaalicus* (l.) and *P. granulatus* (r.) (photograph by Woody Cotterill, Natural History Museum, Bulawayo).

This paper describes a case series of severe *P. transvaalicus* scorpionism in Zimbabwe, and compares it with a recent case series of *P. granulatus* scorpionism from South Africa.[4] In the light of these case series, the management of scorpion stings in southern Africa is reviewed.

Method

Between September 1991 and September 1993, a detailed questionnaire on scorpion stings was distributed to all seven rural clinics of Gwanda South District in Zimbabwe, as well as Manama Mission Hospital, the district hospital facility. Instructions included that the offending scorpion be collected for identification. Cases where the scorpion was positively identified and the questionnaire adequately completed were included in this study. Cases were classified as mild, moderate or severe. *Mild* indicated local pain only, *moderate* included patients with three or fewer systemic features, and *severe* those with more than three systemic features. Severe cases were admitted to hospital, and full clinical assessments were performed daily until discharge. Electrocardiography was undertaken where indicated. A subjective assessment of treatment efficacy was made in each case, and length of hospital stay was used as an objective measure of treatment efficacy.

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Results

Of the 455 questionnaires returned, 244 met the criteria for inclusion in the study, and 136 cases were seen by the author. Ten scorpion species were identified (Table I). Twenty-one cases classified as severe were hospitalised. Of these, 3 patients had been stung by *P. granulatus*, 1 by *Hadogenes granulatus* and the remaining 17 by *P. transvaalicus*.

Table I. Species of scorpion identified, with numbers of stings and relative frequency of severity

Species	No. (*N* = 244)	Mild	Moderate	Severe
Parabuthus transvaalicus	184	60%	30%	10%
Parabuthus granulatus	10	60%	10%	30%
Parabuthus mossambicensis	20	95%	5%	
Uroplectes spp.	16	95%	5%	
Opistophthalmus glabrifrons	4	25%	75%	
Ischnuridae spp.	10	100%		

Uroplectes spp. included *U. flavoviridis, U. vittatus* and *U. planimanus*, the latter producing a moderate case. *Ischnuridae* spp. included *H. granulatus, H. troglodytes* and *Opisthacanthus asper.*

Of the 17 *P. transvaalicus* cases, the sting site could not be located in 5, in 2 it was barely visible and in the remaining 11 the sting site was obscured by scarifications or marks associated with other traditional treatment methods. Patients appeared characteristically quiet for the most part, with passive facies, and excessive sweating and profuse hypersalivation. The frequency of the most common symptoms and signs are depicted in Fig. 2. Pulse and blood pressure were mildly elevated in only 3 cases. A soft apical ejection systolic murmur was noted in 3 cases, with later evidence of mild ischaemic changes on the electrocardiogram (ECG). In 2 cases, a prolonged QT interval was noted. Peak flow rates were reduced by 32% on average, when admission and discharge values were compared. There were no gastro-intestinal symptoms. Absent corneal reflexes with reduced blinking were seen in 4 cases, and resolved within 2 days. Generalised hyperaesthesia was a common early feature. Later, hyperaesthesia and hypoaesthesia could occur concomitantly, the commonest sensory loss being a glove-and-stocking hypoaesthesia which followed on earlier hyperaesthesia. A wide range of abnormal tendon reflexes was found — hyperreflexia was the most common — involving almost all the stretch reflexes. A sustained contraction phase and prolonged relaxation phase of tendon reflexes was seen in 8 cases. The reflex could be lengthened to 15 seconds in the ankle, less in the biceps, quadriceps and adductors of the knee, and least in the abdominal reflexes (only 2 - 3 seconds). Crossover reflexes were also common, mostly seen on the adductors which, when tapped, would contract; this would also cause contraction of other lower-limb muscle groups. In 2 cases this resulted in a 'paradoxical reflex'. Tapping of the knee resulted in a contraction of the quadriceps, but at the same time elicited a more powerful contraction of the ipsilateral hamstrings and adductors, resulting in flexion rather than extension of the knee. Muscle weakness was confirmed with a squeeze dynamometer. Muscle tremors and involuntary movements were commonly seen. Fasciculations of the tongue were almost always present within a few hours of the sting; this was usually the last sign to disappear (Fig. 2).

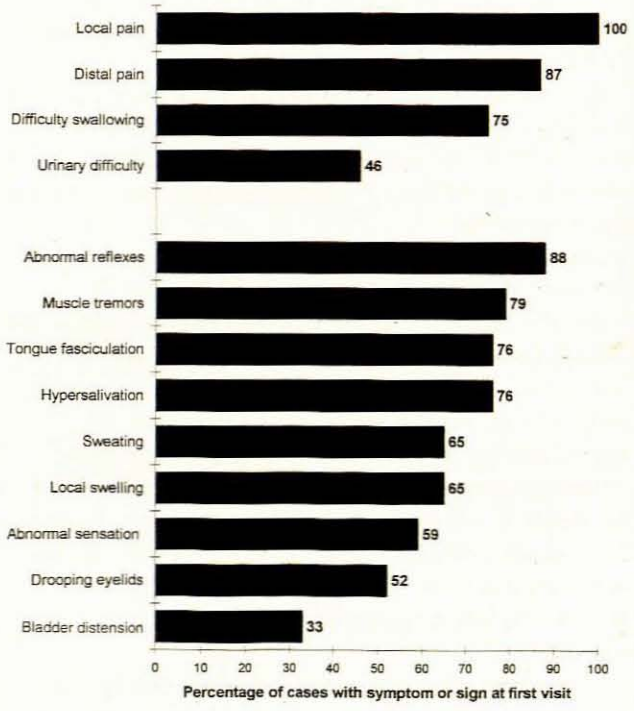

Fig. 2. Symptoms and signs of severe *P. transvaalicus* scorpionism.

It should be noted that the clinical syndrome was heterogeneous. Although the majority (10) of patients presented with both motor and sensory signs, 5 had predominantly motor symptoms and intact sensation and 2 had predominantly sensory symptoms.

Unavailability of antivenom for part of the study period permitted an unintentional comparative trial of the relative efficacy of the antivenom versus controls. The 12 patients treated with antivenom recovered within 4 days, while 5 patients who did not receive antivenom took on average 7 days to recover. The use of antivenom therefore resulted in a significant reduction of length of hospital stay, thereby showing the antivenom to be cost-effective.

The three *P. granulatus* patients seen had clinical features that resembled those of *P. transvaalicus* patients, although the sensory symptoms were more pronounced. These patients also had less hypersalivation and sweating. Table II compares the 17 patients in this series with those in an earlier series of *P. granulatus* cases.

Table II. Comparison of clinical features differentiating severe *P. granulatus* and *P. transvaalicus* scorpionism

Adults (over 13 years)	*P. gr.* (*N* = 23) %	*P. tv.* (*N* = 10) %	*P. gr.*	*P. tv.*	*P*	Note
Swallowing difficulty	70	90			NS	
Hypersalivation	30	80		+	≤ 0.01	Chol
Urine retention (Sg)	22	40		+	NS	
Visual disturbance	26	2	++		≤ 0.001	?Adr
Ptosis	26	60		+	≤ 0.1	
Excessive sweating	26	70		+	≤ 0.05	Chol
Anxiety/restlessness	26	0	++		≤ 0.01	Adr
Raised blood pressure	48	30	+		NS	
Tachycardia	22	20			NS	
Respiratory depression	26	0	++		≤ 0.01	

Children (under 13 years)	*P. gr.* (*N* = 19) %	*P. tv.* (*N* = 7) %	*P. gr.*	*P. tv.*	*P*	Note
Swallowing difficulty	26	86		+	≤ 0.001	
Hypersalivation	63	71			NS	
Urine retention (Sg)	11	71		++	≤ 0.01	Chol
Visual disturbance	5	0			NS	
Ptosis	16	57		+	≤ 0.1	
Excessive sweating	5	86		++	≤ 0.01	Chol
Anxiety/restlessness	68	0	++		≤ 0.001	Adr
Raised blood pressure	32	0	++		≤ 0.01	Adr
Tachycardia	42	57			NS	
Respiratory depression	53	0	++		≤ 0.001	

P. gr. = *P. granulatus* (data from Müller[4]); *P. tv.* = *P. transvaalicus* (author's data).
P = significance calculated by standardised normal deviant; Sg = sign, objectively verified; distinguishing features are marked '+', those with particular clinical usefulness are marked '++'; NS = not significant; Adr = adrenergic; Chol = cholinergic.

Discussion

This is the first case series to describe the clinical features of *P. transvaalicus* scorpionism. *Parabuthus* venoms have not yet been analysed, but their toxins are likely to fit the general pattern of buthid venoms. These contain neurotoxins which are 30 - 70 amino acid single-chain peptides,[8] which act on the sodium and potassium channels of excitable tissue,[9] resulting in increased excitability. Nerves show prolongation of the neuronal action potential, or spontaneous and repetitive firing.[10] In skeletal muscle the result is a potentiation and prolongation of the muscle twitch,[11] in isolated cardiomyocytes there is sustained contraction and increased tone.[12]

The presenting clinical picture in severe buthid scorpionism, as described in the world literature, is usually dominated by the stimulation of the nervous system, particularly the peripheral autonomic nervous system.[13] A wide variety of symptoms and signs results, including severe local and generalised pain, vomiting, sweating, hypersalivation, priapism, agitation, hypotension and hypertension and cardiac failure; this has been termed 'autonomic storm'.[14] Massive release of neurotransmitters is thought to be responsible for the clinical features of heart failure and pulmonary oedema commonly seen.[13,14] Studies have shown diffuse hypokinesia of the heart, decrease in the left ventricular ejection fraction despite normal left ventricular volume,[15] and increase in pulmonary capillary wedge pressure and decreased stroke volume index, attributed to left ventricular dysfunction.[16] Recovery is generally seen after 1 or 2 days.

A distinguishing feature of *P. transvaalicus* scorpionism is the markedly protracted clinical course. Clinically, a striking feature is passive facies and immobility. Excessive sweating and profuse salivation, coupled with difficulty in swallowing, may lead to dehydration. The motor and sensory systems appear to be affected to a greater degree than with scorpionism described elsewhere; for example, paraesthesia has been demonstrated but is rare in *Leiurus quinquestriatus* scorpionism.[17] The severe case following sting by *H. granulatus* was, in all likelihood, due to the traditional treatment, in which the tail of a *P. transvaalicus* is ground with other substances and rubbed into scarifications.

P. granulatus scorpionism has been described by Müller.[4] *P. transvaalicus* scorpionism is clinically very similar, but appears to produce slightly more motor and fewer sensory symptoms. There are, however, significant differences between the two *Parabuthus* species' autonomic nervous system effects, with *P. granulatus* scorpionism showing predominantly adrenergic stimulation. *P. transvaalicus*, on the other hand, shows cholinergic stimulation and an almost complete absence of adrenergic stimulation (Table II). The presence of restlessness and anxiety seems to be particularly specific to *P. granulatus* scorpionism, probably due to circulating catecholamines.[18] The hypersalivation in *P. granulatus* scorpionism is less copious than that of *P. transvaalicus* scorpionism. Objective urine retention and subjective urinary discomfort are commonly seen in children following *P. transvaalicus* scorpionism; very similar pictures are produced by synthetic cholinergic agonists.[19]

Of the 244 patients in the study, none died. Five deaths occurred in the study period, all at home. Home visits were made after each death. *P. granulatus* was positively identified in 1 case, and identified by family and clinic staff in another. In the remainder, *P. transvaalicus* was identified by family or circumstantially implicated. Information on 11 other scorpion-related deaths prior to the study period was collected. Approximate epidemiological parameters could thus be calculated. It should be noted that the case fatality rates are calculated from unconfirmed identifications, and in the case of *P. granulatus* on the basis of rather few cases, and therefore cannot be regarded as accurate.

The case fatality rate associated with *P. transvaalicus* stings was 0.3%, with children under 10 and adults above 50 years equally at risk. Adult deaths from *P. transvaalicus* envenomation occurred between 12 hours and 6 days after the sting. A possible cause of death in some children was a combination of pharyngeal and laryngeal constriction with intercostal and diaphragmatic weakness. In adults and other children a sudden cardiac arrest appeared the most likely cause.

The case fatality rate associated with *P. granulatus* stings was approximately 3%. *P. granulatus* deaths were all in children, and symptoms were generally more acute, with agitation and evidence of respiratory distress. The mortality rate of scorpionism (both species) in the district was 2.8 per 100 000 per year. This is among the highest in the world.

Management

From the above discussion, the following general approach to the management of scorpionism in southern Africa is suggested. In most of southern Africa, scorpionism is not a major medical problem, as the vast majority of scorpion stings do not cause systemic effects (Table I). In areas where potentially lethal scorpions occur (Fig. 3), prevention of stings should be part of integrated primary health care. It should be emphasised in health education of communities at risk that they should always kill and bring any offending animal to the health facility. In a well-informed community, the offending species can be established in the majority of cases with the help of an arachnologist. (In South Africa, contact Dr A Dippenaar, tel. (012) 319-7143, fax (012) 323-5275.) Consideration of the differential diagnosis is important in suspected cases, particularly in children. Spider bite (*Latrodectus*), snake bite, organophosphate poisoning, drug overdose and tetanus should be considered.[4]

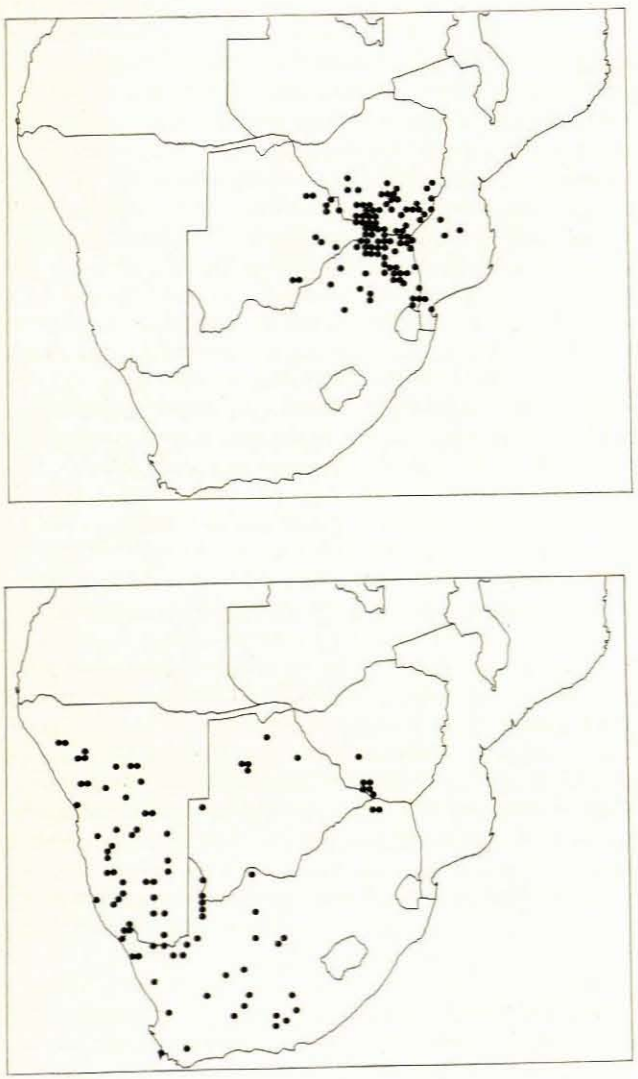

Fig. 3. Distribution maps of *P. transvaalicus* (above) and *P. granulatus* (below) (courtesy of Moira Fitzpatrick, Natural History Museum, Bulawayo).

In adults the onset of scorpionism after a sting may on occasion be delayed up to 8 hours, but in children systemic effects generally manifest within an hour of a sting. Eight hours of observation are prudent if the scorpion is identified or suspected to be potentially lethal.

The management of most stings is therefore directed primarily at the pain, which can be severe. Local anaesthesia may relieve pain completely.[4,7] Lignocaine or bupivacaine without adrenaline, diluted with an equal volume of water for injection, is infiltrated at the site of the sting. Local hyperaesthesia may be relieved by application of cotton wool secured with a bandage. Paracetamol or aspirin can be given; the effect of these is poor, however. Opiates are contraindicated.[20]

A common finding following *P. transvaalicus* sting is pain radiating from the site of the sting, extending over areas too large to be treated with local anaesthetic. Local anaesthetic at the site of the sting does not relieve such distal pain. In these patients, I have found intracutaneous sterile water injection (ISWI) to be an effective treatment modality. This has recently been described in *The Lancet*, and is used for ureteric colic, whiplash injuries and back pain in labour.[21] Sterile water for injection is given intradermally (as for Mantoux) at the points of maximal pain (tender points). As many as ten weals may be needed, and pain relief can be expected within 1 - 5 minutes. Occasionally this is complete and permanent. Pain may return after 4 - 12 hours, and repeated papulae are still effective. ISWI is best combined with local anaesthesia, the latter at the site of the sting and ISWI at sites of distal pain. There may be residual pain, which can come and go for many months; this can be treated with ISWI.

Many patients will have had traditional treatment of some kind or another after a sting, which often entails small cuts (scarifications) at the site of the sting, but also elsewhere. Routine administration of ATT is therefore advised. Skin infections are occasionally seen and should be treated appropriately, but prophylactic antibiotics have no role in the primary treatment of scorpion sting. Antihistamines are very commonly given; these have no beneficial effect and should be discouraged.[22] Rubbing the site of the sting with various herbs and chemicals is a well-established practice in rural Africa. This speeds up the rate of absorption of the venom, significantly exacerbating the clinical picture, and should therefore be actively discouraged.

Many *P. transvaalicus* stings result in minor envenomation only (Table I), but this is also seen in stings from other species, notably *O. glabrifrons*.[23] After pain relief, the main objective is observation in order to pick up any progression to severe scorpionism, which needs prompt intervention. Repeated and frequent respiratory and neurological examinations are necessary. Progression of neurological signs is unlikely after 12 - 24 hours, after which further hospitalisation is unnecessary. The indiscriminate use of antivenom is discouraged.[7]

Severe scorpionism should be treated with two ampoules (10 ml) of SAIMR scorpion antivenom, which is monovalent against *P. transvaalicus*.[24] In severe scorpionism resulting from *P. granulatus*, there is some doubt as to the efficacy,[4] nevertheless, until further studies clarify the issue, the present antivenom should be given. It should be given

intravenously and not intramuscularly,[4] and may be repeated after 4 hours if necessary. It may be given as a bolus, or preferably as an infusion over 30 minutes, when it can be stopped at the first sign of tachycardia or other reaction.[25] The response may be slow and undramatic, unlike that seen for snake and spider antivenom. The use of test doses is not recommended.[25] Standard precautions for anaphylaxis must be taken. In this author's experience, allergic reactions are uncommon and usually mild. Patients should be admitted for observations. Strict bedrest has been recommended,[26] an unnecessary admonition as these patients are often unable to move, and require careful nursing. Stridor is an ominous sign, for which intubation should be considered. Generalised hyperaesthesia may be relieved by covering with a cradle, sheet or blanket. This also responds to intravenous administration of calcium gluconate, 10 - 20 ml added to a 200 ml vacolitre, and infused over 1 - 2 hours. As long as the drip is going patients usually note a moderately beneficial effect.[4] Unfortunately, the effect is brief and does not reduce hospital stay, and there is a limit to the amount that can be administered safely.[4] The intensity of the hyperaesthesia appears to be slightly diminished after each administration.

The restlessness and confusion seen in *P. granulatus* scorpionism must be recognised as a specific effect of the scorpion venom, and is an ominous sign.[4] Barbiturates are contraindicated.[20] Sedation should never be given unless there are facilities for immediate ventilatory support and, if possible, it is best avoided. Pulmonary oedema may be an indication for ventilation. In other parts of the world where raised blood pressure is seen with pulmonary oedema and encephalopathy, hydralazine, prazosin and sublingual nifedipine are used.[14,27] Though no trial or research on the subject has been undertaken in southern Africa, these could be lifesaving where hypertension forms part of the clinical picture of life-threatening *P. granulatus* scorpionism.

In *P. transvaalicus* scorpionism, hypertension and pulmonary oedema do not occur. Hypersalivation may be excessive and, coupled with the difficulty in swallowing, may present a real danger of aspiration. Atropine is useful in such a situation, in doses 'sufficient to reduce salivation';[25] its use should therefore be seriously considered in cases where *P. transvaalicus* scorpionism is confirmed or suspected. In *P. granulatus* scorpionism atropine is generally contraindicated. Rehydration is often necessary in patients who present late, and urinary obstruction should be treated promptly.

In conclusion, only two southern African species, *P. granulatus* and *P. transvaalicus* can currently be termed 'potentially lethal'. Three, *P. mossambicensis, O. glabrifrons,* and *Uroplectes planimanus* can cause systemic envenomation and could be termed 'dangerous'. There are numerous scorpion species in southern Africa whose medical importance is unknown. It is the author's hope that this paper may stimulate further research on this subject.

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