The effect of a scorpion sting on the eye: A review

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ABSTRACT

Background: Scorpions are arachnids with a specialized stinger on their tail that can envenom enemies or preys through a sting. There is little data on the ocular effects of scorpion envenomation.
Objective: The aim of this paper is to discuss the ocular conditions through the means of a literature review.
Methods: A search in the PubMed, Scopus, and SCiELO databases produced 16 papers, which were summarized.
Results: Most complications, such as pupillary abnormalities, ophthalmoplegias, and ptosis, were caused by neurotoxins. Other sequalae, like branch retinal vein occlusion, retinal haemorrhages, and necrotic skin, were reported as well.
Conclusion: This paper is the first to give an overview of all reported ocular symptoms caused by scorpion stings.

Key words: Scorpions, Stings, Review, Ophthalmology

INTRODUCTION

Scorpions (Scorpiones) are a group of arachnids that are characterized by two grasping pincers and a long, segmented tail with a curved stinger at the final segment (called telson). This stinger can be used to inject venom to either deter an enemy or attack a possible prey. Scorpions live in (sub) tropical regions on all continents, with the exception of Antarctica. There are about 1,500-2,000 species, of which about one third are potentially dangerous to humans. Almost all lethal scorpions belong to the large and widespread family of *Buthidae*[1]. All scorpions are nocturnal and hide during the day, leading to incidents when accidentally encountered[2]. Human envenomation is called scorpionism; this is a potentially life-threatening condition that needs prompt medical care, especially in vulnerable patients such as children or the elderly[3]. Symptoms vary from pain or paresthesia at the sting site to life-threatening respiratory failure or cardiac arrhythmias. The estimated global incidence is 1.5 million envenomings per year, resulting in 2,600 deaths[4].

Scorpion venoms are a complex mixture of various compounds, of which neurotoxins are the most important part in human envenomation[4]. There are multiple types of neurotoxins that can have paradoxical effects, such as paralysis or myoclonic reactions. In addition, neurotransmitters (such as noradrenalin and acetylcholine) released from the nerve endings can cause autonomous dysregulation (“autonomic storm”), such as tachycardia, hypertension, hyperthermia, vasoconstriction, and tachypnea (adrenergic reactions) or vomiting, salivation, bronchospasm, bradycardia, and hypotension (cholinergic reactions)[4,5].

Treatment of scorpionism generally consists of antivenom and supportive care[1,3]. Most commonly used antivenoms (also called antiserum) are immunoglobulins (IgG) or purified fragments of immunoglobulins (F(ab’)2) made from hyperimmune plasma of large mammals, such as horses, that can reduce the adverse effects of the venom[1]. Supportive treatment consists of intravenous fluids, analgesics (such as paracetamol), and local cooling of the sting site, or, in the case of respiratory failure, mechanical ventilation[1,3].

Little is known about the ocular effects of scorpionism, and there is no thorough appraisal of the literature. The aim of this paper is to discuss the ocular conditions caused by scorpion envenomation through the means of a literature review.

MATERIALS AND METHODS

In January 2025, a search was performed in the PubMed, Scopus, and SciELO databases using the term “scorpion” in combination with multiple (partial) terms that refer to the eye in general (“eye”, “opht*”, “ocul*”, “pupil”) or common symptoms caused by scorpionism (“diplopia”, “ptosis”, “ophthalmoplegia”, “mydriasis”, or “miosis”). Inclusion criteria were all types of papers that detail ocular and/or visual symptoms caused by scorpions in human beings. There were 89 hits, of which 12 papers were deemed relevant after screening the title and abstract. All papers were successfully retrieved online. One paper was excluded afterwards, because it discussed whip scorpions (vinegaroons), which are no true scorpions[6]. All references of the papers found were cross-checked for additional sources. This resulted in six more papers, of

which five could be retrieved online. In total, 16 papers were included in the review. For this review, no ethics approval was required, since there were no human or animal participants for this article.

RESULTS

All found articles can be found in Table 1. As one would expect with a varying geographic distribution of reported species, ocular symptoms of scorpionism differ per region. Reported cases came from Africa, North America, and Southwest Asia. With the exception of one case (*Nebo hierochonticus,* a species of scorpion in the *Diplocentridae* family[7]), all reported species belong to the *Buthidae* family. Interestingly, there were no reports from Australia, Europe, or South America, even though scorpions from the *Buthidae* family do occur there (including *Buthus occitanus* and *Centruroides* spp).

Table 1: summary of all found papers discussing ocular/visual symptoms caused by a scorpion sting, split out based on region

	Author (year)	Type of paper	Country	Scorpion species	Patient details	Ophthalmological symptoms/diagnosis	Systemic involvement	Treatment	Long-term ophthalmological results/sequelae
Southwest Asia	Thacker *et al.*[26] (2002)	Case report	*India*	*Hottentotta tamulus**	Male, 17 years	Anisocoria with sluggish pupillary reactions to light and left-sided papilledema and retinal edema with perimacular haemorrhage	Acute dyspnea and multiple watershed cerebral infarctions	Intravenous fluids and dexamethasone	Bilateral disc pallor with perimacular haemorrhage and pigmentary retinal degeneration on the left
	Sengupta *et al.*[25] (2009)	Case report	*India*	Not reported	Female, 40 years	Bilateral occipital cerebral and cerebellar infarction, leading to low visual acuity (light perception in both eyes)	Venom-induced multi-organ failure; pulmonary edema, myocarditis, and acute renal failure	Supportive care; endotracheal intubation, intravenous fluids, low-dose aspirin, and enalapril	No visual improvement after six months
	Bawaskar *et al.*[17] (2017)	Case report	*India*	*Hottentotta tamulus**	Male, 55 years	Mydriasis	Profuse sweating, hypertension, poor myocardial contraction	Supportive care (intravenous fluids) and antivenom	Full recovery after three hours
	Sadeghian[12] (2003)	Case report	*Iran*	*Mesobuthus eupeus*	Female, 54 years	Bilateral ptosis, mydriasis, and loss of adduction, elevation, and depression	No	Conservative treatment; antibiotics, hydrocortisone, ibuprofen, and promethazine	Full recovery after nine days
	Hamid *et al.*[18] (2019)	Case report	*Iran*	*Mesobuthus eupeus*	Female, 45 years	Macular branch retinal vein occlusion (BRVO) with lowered visual acuity (0.4) and peri-orbital edema after scorpion sting in eyebrow two days prior	No	Intravitreal injection with bevacizumab	Resolution of macular edema, two weeks after injection
	Shiravani *et al.*[20] (2024)	Case report	*Iran*	*Hemiscorpius lepturus*	Male, 34 years	Ocular inflammation, corneal stromal melting, and anterior chamber inflammation	No	Anti-venom and topical antibtiotics and steroids	Residual central corneal stromal scar
	Annobil *et al.*[7] (1991)	Case report	*Saudi Arabia*	*Nebo hierochonticus*	Male, 3 years	Dilated pupils with reaction to light, vertical nystagmus, bilateral papilledema, and flame-shaped retinal haemorrhages were noted on the 8th day (after extubation)	Acute pulmonary edema, petechiae, tachycardia, acute renal failure, deafness, and multiple intracranial haemorrhages.	Treatment on intensive care unit, including assisted ventilation, peritoneal dialysis, and antivenom	Full recovery; retinal haemorrhages resolved after four weeks
North America	Rimsza *et al.*[8] (1980)	Retrospective study	*United States of America*	*Centruroides sculpturatus*	24 patients; 19 under 10 years	12 patients experienced visual symptoms; roving eye movements (8), nystagmus (3), and "oculogyric movements" (1)	Various. Duration of symptoms was inversely related to patients' age	Various: i.e. antivenom, diazepam, hydrocortisone, phenobarbital, epinephrine, conservative therapy. It was not specified which therapy was given patients with ophthalmological symptoms.	Not reported
	Clark *et al.*[9] (1991)	Case series	*United States of America*	*Centruroides sculpturatus*	4 patients; 3 children and 1 adult	Involuntary, slow, roving eye movements, and unsustained primary position nystagmus. Movements resembling opsoclonus in two children	Cranial nerve and/or somatic skeletal neuromuscular dysfunction	Antivenom or symptomatic treatment	Antivenom: recovery within one hour in most patients. Symptomatic treatment: recovery within 24 hours.
	Hurst *et al.*[10] (2018)	Case series	*United States of America*	*Centruroides sculpturatus*	Female, 22 years; male, 33 years; female, 52 years	Dysconjugate, roving eye movements in all patients. One patient had blurry vision and a granular sensation in both eyes	All patients had generalized symptoms as tachypnoea, tachycardia, numbness and tingling, and/or muscle twitching	Antivenom	Resolution of all symptoms between 30 minutes to two hours

North Africa	Delma[13] (2012)	Case report	*Algeria*	Not reported	female, 24 years	Patient suffered three scorpion stings within four days; severe visual deprivation (questionable light perception ODS) and oculomotor paralysis. Visual evoked potential (VEP) revealed bilateral (toxic) neuropathy. There were no signs of cerebral infarction on magnetic resonance imaging (MRI).	No	Antivenom after every scorpion sting despite only having local symptoms; toxic neuropathy was treated with high-dose intravenous steroids	Visual acuity ODS after four months remained at counting fingers at one meter (1/300); eye movements returned to normal
	Moutei *et al*.[19] (2019)	Case report	*Morocco*	Not reported	male, 41 years	Scorpion sting in palpebral region, leading to intense pruritis and palpebral pain and eventually necrosis of the peri-ocular skin caused by local arterial spasm	No	Surgical debridement of the necrotic skin	Not reported
	Bahloul *et al*.[14] (2004)	Retrospective study	*Tunisia*	*Androctonus australus* and *Buthus occitanus*	951 patients mean age 14.7 years (range 0.5 to 90 years)	Squint in 119 patients (12.5%), bilateral miosis in 43 patients (4.5%), bilateral mydriasis in 16 patients (1.7%), and anisocoria in 4 patients (0.4%)	All patients were admitted to the intensive care unit for various reasons	Antivenom was used in 509 patients (53.5%)	Miosis, mydriasis, or anisocoria were correlated with poor general outcome. No specific effect of treatment on ophthalmologic symptoms described.
Sub-Saharan Africa	Sarkies[15] (1951)	Case report	*Ghana*	Not reported	female, 34 years	Scorpion sting in right eyebrow, causing complete oculomotor nerve paralysis with permanent ptosis and abduction and partial infraduction	No	Surgical repair of the ptosis (fascia lata graft) and strabismus surgery	Diplopia on extreme eye movements and paralyzed accommodation
	Müller[5] (1993)	Retrospective study	*South Africa*	*Parabuthus granulatus* and *P. capensis*	42 patients; 19 children <13 years	Ptosis in 9 patients (21.4%) and visual disturbances in 7 patients (16.7%)	16 patient (38.0%) presented with difficulty breathing or respiratory distress of which 4 (all children) died, 2 patients (4.8%) presented with cardiac arrhythmias	Antivenom was given in 35 cases (83.3%); there was no significant response	Not reported
	Bergman[16] (1997)	Retrospective study	*Zimbabwe*	*Parabuthus transvaalicus*	17 patients; 10 <13 years	Absent corneal reflexes with reduced blinking in 4 patients (23.5%), ptosis in 10 patients (58.8%), and "visual disturbance" in 2 patients (11.8%)	In 40% of patients	Antivenom was given in 12 cases (70.6%); hospital stay was reduced from 7 to 4 days	Not reported

* The Indian red scorpion (*Hottentotta tamulus*) was originally referred to as *Buthus tumulus*[17] or *Mesobuthus tamulus*[26]

DISCUSSION

All 32 cases of involuntary ("roving" or "oculogyric") eye movements were caused by the Arizona bark scorpion (*Centruroides sculpturatus*) in North America[8-10]. In 22 cases this involved children. Various treatments were used, including hydrocortisone, diazepam, and antivenom. Recovery of ocular function was reported to be within 30 to 120 minutes in patients that received antivenom and within 24 hours in patients that received symptomatic treatment[9,10]. It was found that toxins from certain neotropical (New World) genera, including *Centruroides*, contain peptides that bind to Na^+ channels (toxins-β) and induce a repetitive firing of action potentials, causing myoclonic or spastic muscular responses[4,11]. Paleotropical (Old World) scorpion toxins (toxins-α) also bind Na^+ channels, but cause depolarization of the membrane instead, leading to paralysis[4]. This could explain ptosis and oculomotor nerve palsy as seen in Asian and African cases[5,12-16].

Pupillary abnormalities, such as a sluggish reaction to light, mydriasis, miosis, and anisocoria, were the most common symptoms. Abnormal pupils could indicate early signs of systemic (neurologic) involvement, but this was not always the case[12]. In the case reported by Bawaskar *et al*.[17], a 55-year-old man suffered from hypertension and poor myocardial contraction, accompanied by bilateral mydriasis[17]. Symptoms waned after three hours with supportive care and antivenom. In one large, retrospective study of 951 Tunisian patients that were admitted to the intensive care unit after a scorpion sting ocular involvement was reported, including pupillary abnormalities as bilateral miosis (4.5%), bilateral mydriasis (1.7%), and anisocoria (0.4%). Squint was most commonly seen (12.5%). All pupillary abnormalities were correlated with poor general outcome[14]. More than half of the patients

were treated with antivenom. However, no specific effect of treatment on ophthalmologic symptoms was described.

Ocular effects were mostly attributed to be part of systemic envenomation. In three cases of peri-ocular scorpion stings, however, severe and unique local effects were reported[15,18,19]. Branch Retinal Vein Occlusion (BRVO) was seen two days after a patient was stung in her eyebrow[18]. This was theorized to be an expression of localized intravascular coagulation. One patient developed necrosis of the peri-ocular skin after a sting in the palpebral region, possibly caused by a local arterial spasm, eventually needing surgical debridement[19]. In one case, a palpebral sting led to an infectious keratitis[20]. Another case of a sting in the eyebrow lead to permanent oculomotor paralysis with ptosis and partial ophthalmoplegia, which required surgical intervention[15]. There were no reported cases of direct ocular exposure with venom from the African "spitting scorpion" (*Parabuthus transvaalicus*), which can spray venom through the air to deter its enemies.

One patient suffered three scorpion stings within four days, for which she received (unspecified) antivenom every time even though there were no signs of systemic involvement[13]. On the fifth day, she suffered from severe visual deprivation, attributed to a bilateral optic neuropathy. Coincidentally, there are multiple similar case reports of bilateral optic neuropathy, six days after a snakebite for which antivenom (IgG or Fab) was given[21-24]. In one of these cases, the offending snake was later found to be non-venomous, making the antivenom a suspected cause[24]. One could theorize that this case of optic neuropathy could also be a side effect of the (scorpion) antivenom instead of the envenomation itself.

Severe cerebral visual loss, caused by bilateral occipital cerebral infarction due to hypotension, was seen in one patient[25]. Another patient also had multiple (watershed) cerebral infarcts, but in combination with retinal haemorrhages[26]. Since blood pressure and coagulation tests were normal, both were attributed to severe vasospasms, causing reduced blood flow through the arterial carotid system and retinal vessels. Finally, one patient had retinal and intracranial haemorrhages[7]. This patient was stung by a *Nebo hierochonticus*, the only non-buthid species in this review, and also suffered from hypotension as a consequence. *Nebo hierochonticus* venom also has a specific haemolytic effect and is known to cause haemorrhages[27]. Partial thromboplastin time was prolonged in this patient. This would make the mechanism of injury in this patient different from all other described cases.

CONCLUSION

This paper gives a structured overview of ocular symptoms recorded in literature. Scorpion envenomation can cause a wide array of ocular symptoms, depending on species, systemic involvement, location of the sting, and possibly antivenom treatment. However, available data is scarce and is mostly based on case reports and retrospective studies.

Reported treatment varies widely, and therefore one can say very little on the specific treatment of ocular pathology in scorpionism. Little data suggests that patients with neurologic ocular symptoms (such as mydriasis and involuntary eye movements) recover faster after treatment with antivenom[9,10,17]. The level of evidence is low, however. Since there is little data, ocular treatment should be empirical and on an individual case-by-case basis.

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