Toxicon 138 (2017) 173–183

Contents lists available at ScienceDirect

Toxicon

journal homepage: www.elsevier.com/locate/toxicon

Review

Dangerous arachnids—Fake news or reality?

Tobias J. Hauke [a], Volker Herzig [b, *]

[a] Department of Pharmacy – Center of Drug Research, Ludwig-Maximilians-Universität München, 81377 Munich, Germany
[b] Institute for Molecular Bioscience, The University of Queensland, St. Lucia, QLD 4072, Australia

ARTICLE INFO

Article history:
Received 22 June 2017
Received in revised form
28 July 2017
Accepted 27 August 2017
Available online 1 September 2017

Keywords:
Arachnid
Spider
Scorpion
Pet
Venom
Toxin
Lethal
Envenomation
Bite
Sting

ABSTRACT

The public perception of spiders and scorpions is skewed towards the potential harm they can inflict in humans, despite recent scientific evidence that arachnid venom components might be useful as bio-insecticides or even human therapeutics. Nevertheless, arachnids are becoming more popular as pets in Europe, America and Asia, raising the question for regulatory agencies in these regions as to whether they need to take measurements to protect their citizens. In order to decide upon the necessary regulatory steps, they first need to determine which arachnids are actually dangerous to humans. This review therefore provides an overview of the current literature on verified bites and stings from spiders and scorpions with the aim of assessing their potential danger for human health. As a guideline, we also provide a list of those arachnid genera that we consider as potentially dangerous, which includes 10 spider and 11 scorpion genera. The arachnid genera classified as dangerous comprise less than a quarter of all extant scorpion species and only 0.5% of all spiders species, with the actual number most likely being much lower than that, as not all species in those genera might turn out to pose an actual threat for humans. In conclusion, we found that only a small percentage of scorpions and a minute percentage of all spiders can be considered as potentially dangerous to humans. While in some countries of origin the high incidence of envenomations by dangerous arachnids can result in a serious problem to the health system, we assessed the risk that the same species pose when kept as pets under controlled maintenance conditions as significantly lower.

Contents

* Corresponding author.
E-mail address: v.herzig@uq.edu.au (V. Herzig).

http://dx.doi.org/10.1016/j.toxicon.2017.08.024
0041-0101/

1. Introduction

The general public usually perceives spiders and scorpions as aggressive, dangerous and lethal (Stuber and Nentwig, 2016), a view that is constantly reinforced by Hollywood movies. However, in recent years, other media outlets also published reports about the positive potential of arachnid venom peptides that are being developed as bioinsecticides (Windley et al., 2012; King and Hardy, 2013) or as potential therapeutics for human disorders such as pain, atrial fibrillation, erectile dysfunction, irritable bowel syndrome, stroke, and bacterial, fungal or protozoan infections (Saez et al., 2010; Smith et al., 2013; Osteen et al., 2016; Chassagnon et al., 2017). Furthermore, with a growing worldwide pet trade, keeping exotic "pet" spiders or scorpions is becoming an increasingly popular hobby in Europe, America and Asia. Thus, a question that arises for regulatory authorities in various countries is whether they need to take action to protect their citizens from potentially dangerous arachnids. However, authorities first need to determine which species are potentially dangerous to human health. Unfortunately, based on our experience with German authorities (Hauke et al., 2015), this information is often obtained from older scientific literature or textbooks or even from non-scientific sources (e.g. Internet). Hence, this review provides an update on the scientific literature on venomous arachnids focussing on those species that could potentially harm humans and it could therefore serve as a guideline for regulatory agencies.

Although arachnids comprise other venomous orders such as Pseudoscorpions (von Reumont et al., 2014) and recently also certain Acari were suggested to be considered as venomous animals (Cabezas-Cruz and Valdes, 2014) we focussed this review on spiders (order Araneae) and scorpions (Scorpiones) as they are the primary arachnids kept as exotic pets. In order to determine which arachnids might be dangerous, we mainly investigated more recent scientific literature. In older literature, the taxonomic identification is often missing, unclear, some species could have been misidentified or single species could later be split up into several new species. This makes it difficult in retrospect to determine the actual species responsible for any reported adverse effects. We therefore preferably used (if available) articles studying verified (definite, confirmed) rather than presumed bites and stings based on the criteria defined by Isbister and White (2004). Ideally, correct taxonomic identification should be carried out by an expert taxonomist. The reason why proper identification is essential is exemplified in the case of bites by spiders of the genus *Loxosceles*, which were blamed for necrotic effects in geographical areas where they don't even exist (Vetter, 2005). Furthermore, a recent study examining 134 medical case studies found that only 22% fulfilled the criteria for a verified spider bite, questioning the scientific value of many studies in this field (Stuber and Nentwig, 2016). Finally, studies examining large numbers of bites and stings were preferred to single case reports, as they allow for statistical analysis and an estimation of the incidence of various envenomation symptoms. Good examples of these larger studies include the prospective study of 750 definite bites by Australian spiders (Isbister and Gray, 2002) and the Brazilian clinico-epidemiological studies on 422 bites by *Phoneutria* spiders (Bucaretchi et al., 2000) and 1327 stings by *Tityus* scorpions (Bucaretchi et al., 2014). Overall, recent clinical studies provide a clear picture that only a very small percentage of arachnid bites or stings cause serious adverse or even lethal effects (Welton et al., 2017). However, the high incidence of accidental envenomations by certain arachnids still causes a massive problem for the health system in some countries (Chippaux and Goyffon, 2008). In addition to clinical studies, recent technical advances in the fields of biochemistry and molecular biology have rapidly increased our knowledge about the composition of arachnid venoms, leading to a clearer understanding of the mode of action of toxins and other venom components (Kuhn-Nentwig et al., 2011; Quintero-Hernandez et al., 2013). These studies have provided a better understanding at the molecular level of the activity of venoms, enabling a judgement whether a proposed clinical symptom might be explained by any of the components contained in the venom.

Based on evidence in the scientific literature, the public perception of venomous arachnids is biased towards their negative effects. With the present review, we aim for a more objective evidence-based assessment of the danger that arachnids pose for human health. We therefore first provide an overview of all arachnids that are considered medically important, before discussing those species with questionable potential to cause human harm. We then assess the potential danger of arachnids for human health before proposing a list of arachnid genera that we consider as potentially dangerous to humans.

2. Potentially dangerous arachnids

Herein we consider "potentially dangerous" arachnids as those whose bites or stings were demonstrated (i.e. in primary literature) to cause severe (i.e. systemic and/or long-lasting) envenomation symptoms or even death. Although all scorpions (about 2300 described species) and about 99% of all spiders (~47,000 described species) need to be considered "venomous" (all known spiders with the exception of those in the family Uloboridae possess venom glands (Foelix, 2011)), only few them pose a threat to humans. Their venom has evolved primarily to immobilize potential prey