THE CEYLON MEDICAL JOURNAL

Established 1887

The Official Publication of the Sri Lanka Medical Association
Volume 58, No.3, September 2013
Quarterly ISSN 0009–0875

Snakebite: the true disease burden has yet to be determined

Venomous snakes are a significant cause of morbidity and mortality, particularly in tropical and subtropical countries in Africa, Asia, Oceania and Latin America. Most snake bites occur in the rural tropics, and result in a high medical and economic toll. The reasons include poor access to [often sub-optimal] health services, scarcity of effective and safe antivenom (AVS), survival with disability, and the economic impact of disabled young victims [1]. Despite this, snakebite has not received due attention and the main reason for this is the paucity of sound epidemiological data with which to make the case.

Difficulties in obtaining accurate data on snakebite

Snakebite mainly occurs in the poorest countries of the world that are least able to deal with the problem [2]. Data on snakebite are based mainly on hospital returns or incomplete central databases. Bites and associated mortality are underreported because many victims do not seek treatment in government health facilities, preferring traditional treatments. Studies from rural Nigeria and Kenya have reported that only 8.5% and 27% of snakebite victims, respectively, sought hospital treatment [3, 4]. In rural Bangladesh only 3% of victims went directly to a medical doctor or hospital [5].Two qualitative studies, investigating beliefs regarding snakebite and their influence on health seeking behavior in Sri Lanka found that people living in four rural communities believed that Ayurvedic treatment was effective for snakebite [6, 7]. Common misconceptions regarding hospital treatment were based mainly on misinformation regarding AVS therapy. Traditional healers were respected and perceived to be able to cure snakebite, and although many people may finally seek treatment in a hospital, they would first consult a traditional healer. Similar situations are likely to be common to many countries where health-seeking behaviour, health beliefs and access to health care are not optimal.

The incidence of snakebite varies seasonally (e.g. high during agricultural activity) and geographically. Studies from India and Bangladesh have clearly shown increased rates of bites during periods of high rainfall and flooding [5, 8]. Therefore, data obtained during seasonal surveys would not represent true annual incidence. Marked regional variations in incident snakebite deaths have been demonstrated in a recent nationwide survey conducted in India [8].This type of geographical variation in snake bites is seen even in small countries like Sri Lanka [9]. In the face of such heterogeneity, localised surveys will not reflect true national or regional values [3].

Estimates of snakebite mortality are based mainly on hospital data, because other recording systems are unavailable or unreliable in most

developing countries. However, hospital data almost certainly underestimate the problem. Health centres in regions of highest snakebite incidence are unable to keep accurate records, and death certification of snake bite is often imprecise, despite the increased precision of recent ICD indexing [4]. In India actual snakebite-related deaths maybe 30-fold higher than official hospital returns and in Africa it is estimated that less than half these deaths are reported by the health services [8, 10]. A study in Sri Lanka (which has death registration rates of >95%), comparing death registrations with hospital mortality statistics in the Monaragala district, found that hospital statistics had missed nearly two thirds of snakebite deaths in the district [11].

Due to these issues, which are largely seen in the rural tropics where the problem is most prevalent, the true incidence of snakebite envenoming, its impact, and characteristics in different regions of the world is difficult to determine. However, global and regional estimates provide some indication of the magnitude of the problem, raise awareness of snakebite as an important but neglected public health issue and assist international organisations prioritise the distribution of resources for prevention and treatment.

The global burden

Past global estimates, variously suggest that worldwide, venomous snakes cause "5.4 million bites, about 2.5 million envenomings and over 125,000 deaths annually" [10], "more than 3 million bites per year resulting in more than 150,000 deaths" [12], or "several million bites and envenomings annually with tens of thousands of deaths" [13]. Since the reviews by Swaroopand Grab in 1954 [14] and Chippaux in 1998 [10], no comprehensive global assessment has been made of snakebite epidemiology. Swaroop and Grab's review was limited to snakebite deaths based on hospital admissions [14]. Chippaux [10] and White [12] do not give any details of the methodology used to calculate their estimates. The most recent estimates [15] employed an extensive literature analysis and modeling based on regional estimates [16] of snakebite envenoming and deaths.The study estimated that each year there were 1.2 to 5.5million bites, 420,000 to 1.8 million envenomings, and 20,000 to 94,000 deaths globally. The burden was highest in South Asia, Southeast Asia and sub-Saharan Africa. However, the inadequacy of available data and the consequent need to rely upon extrapolation means that this estimate too is imperfect. This contention is supported by two recent studies: a review of snakebite burden in Sub Saharan Africa which estimated 314,000 envenomings and 7,300 deaths annually (comparable to the global burden estimate), though household surveys indicated that incidence and mortality were likely to be 3-5 times higher [17]; and a study from India that estimates 45,900 snakebite deaths in 2005, which is three times the global burden estimate [8]. Furthermore, all global assessments have been limited to the number of snakebites, envenomings and deaths. There have been no attempts to estimate either long-term disability among survivors or the socio-economic burden of snakebite, due mainly to lack of reliable data.

To address the problem of paucity of good-quality data, robust epidemiological studies on snakebite from different regions of the world are required. Population based incidence data on snakebite are especially important from countries in the worst affected regions. Other methods that would further help to determine the burden of snakebite more accuratelyinclude optimising reporting and recordkeeping on morbidity and mortality due to snakebite in health facilities, and making venomous bites notifiable and fully implementing the use of the International Statistical Classification of Diseases and Related Health Problems 10th Revision version for 2007 in official death certification (e.g. T 63.0 snake venom) [15].

Disability in survivors: the 'hidden' burden

Most epidemiological studies estimate or report the numbers of snakebites and/or deaths. There are very few studies on the long-term consequences of snakebite envenoming, both physical and psychological, on survivors.

Local tissue necrosis is common after some snakebites, and chronic ulceration, gangrene and 'compartment syndrome' needing surgical intervention is well known. Recently, it has been estimated that as many as 6,000 to 14,500 amputations may occur annually due to snakebite in sub-Saharan Africa [17]. These numbers, however, need corroboration by more robust epidemiological studies. Delayed abnormalities of nerve conduction have been described following snakebite: a subclinical demyelinating polyneuropathy in victims of elapid (but not viper) bites who had neurotoxicity more than 12 months previously [18]; and electrophysiological abnormalities lasting 2 weeks to 6 months after krait bite causing neurotoxicity [19]. The clinical significance of these findings is still unclear, but abnormalities occurring both in the upper and lower limbs indicate a systemic rather than a local phenomenon. There have been reports that suggest the development of chronic kidney disease in victims of Russell's viper bites who had acute kidney injury at the time of envenoming at least 12 months [20] and a mean 45 months [21] previously. Major limitations of these studies are the presence of co-morbidities such as diabetes and hypertension, and the failure to rule out pre-existing renal disease. Significant delayed psychological morbidity, which included depressive illness and post traumatic stress disorder, has been recently reported among victims of snakebite in Sri Lanka who had systemic envenoming 12 to 48 months previously [22]. Nearly a quarter of the people studied had also claimed that the snakebite led to a negative change in their employment and 10% had stopped working altogether; however, the economic and social impact of this finding has not been explored.

Further detailed investigation of the long-term consequences of snakebite envenoming is important because some survivors will have physical or psychological disabilities. As most victims are young and productive [1] the economic impact of these disabilities is likely to be substantial.

Conclusions

The global burden of disease due to snakebite is large, and this is reflected by the World Health Organisation recently listing snakebite under Neglected Tropical Diseases [23]. South Asia, Southeast Asia and sub-Saharan Africa are mainly affected. Inadequacy of good quality epidemiological data – partly related to inherent methodological difficulties, are a major obstacle to assess the magnitude of the problem and plan distribution of health care resources to deal with it. While more good quality population-based incidence and mortality data are required, the impact of chronic disability also needs investigation and future assessments of snakebite burden should include chronic disability, and the related social and economic costs.

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