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Incidence of fatal snake bite in Australia: A coronial based retrospective study (2000–2016)

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ABSTRACT

Introduction: It has been over 20 years since a national review of recorded deaths from snake envenoming. The present study aimed to provide an updated review of the epidemiology of deaths from snake bites in Australia.

Methods: Deaths were identified from January 2000 to December 2016 from the National Coronial Information System. Cases identified due to snakes were extracted with data on coronial findings, autopsy and police records.

Results: Thirty five deaths (2.2 per year) were ascribed or antecedent to a snake bite. Sixteen cases were attributed to snake bite/envenoming as leading directly to death, with other direct causes of death being multiple organ failure (n = 3), intracerebral haemorrhage (n = 2), cerebral hypoxia or anoxia (n = 3), cardiac arrest (n = 1), complications of snake bite (n = 3) or brain stem death (n = 1). Four cases did not have a snake bite indicated in the case history, with an initial diagnosis of either hyperthermia, stroke, gastroenteritis and a horse accident. The median age was 46.5 years (range 1.5–70 years), and 74% were males (n = 25). The time from bite to death varied from 1 h to 19 days. Fifty four percent of bites occurred at the person's residence (n = 1), with 17 being in an urban environment.

Conclusions: Death from snake bite remains rare in Australia, and has maintained a steady rate for over 20 years. Usually considered a 'rural issue', and with varying recorded causes of death, a nationally coordinated effort to further review the national picture of envenoming in Australia can inform education and resource needs within state and local contexts.

1. Introduction

It has been over 25 years since a national review of recorded deaths from snake bite has been conducted (Sutherland, 1992). Together with the distribution of animals (Cogger, 2011), national injury trends (Henley and Harrison, 2015; Bradley, 2008; Welton et al., 2017) and clinical signs and symptoms from selected hospital datasets (Meier and White, 2008; Churchman et al., 2010; Allen et al., 2012; Scop et al., 2009), the assigned cause of death and demographics from snake envenoming can inform and update snake bite management in Australia.

Australian health policies are based on national statistics and expert submissions that are pivotal to informing national health guidelines and supporting resource allocation and education. Snake bite is categorised as an unintentional injury within Australian government health frameworks, and as a rarely occurring injury, is merged with seven other injuries forming an 'other unintentional injury' group. This is one of nine unintentional injury groups collated nationally (Henley and Harrison, 2015). While snake bite in Australia is not considered a significant injury, with approximately 550 annual admissions to public hospitals (2.4 per 100,000) (Bradley, 2008; Welton et al., 2017) and an average of 2 deaths per year (0.13 per 100,000) (Welton et al., 2017), the risk of this injury can be life threatening.

Here we report all deaths from snake bite and their associated causes of death and demographics from 2000 to 2016. This information may be important in the management of other patients and

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can provide feedback for state and national injury prevention and education agendas.

2. Methods

Deaths were identified from January 2000 to December 2016 from the National Coronial Information System [NCIS] using external cause and diagnostic codes defined by the International Statistical Classification of Diseases and Related Health Problems 10th Revision, Australian Modification [ICD-10-AM] codes (NCCH, 2014) and confirmed using cause of death certificates. Data extracts were undertaken for external cause codes (levels 1–10): X20-X29, W56, W57, W59, W60; and diagnosis codes T61-63. In addition, keywords and injury mechanism searches supplemented code searches to improve capture of cases. Australian Institute of Health and Welfare [AIHW] 2006–2011 Cause of Death Unit Record Files [COD URF] were reviewed for all cases with an external cause code or principle diagnosis associated with an envenomation event. COD URF data were cross checked against the NCIS searches between 2006 and 2011 to identify correlations or gaps between the databases. Medical literature and media reports were also reviewed to broaden searches. One case was found in media and COD URF that was not represented in the NCIS database, and is not included in this research.

Details of case history, cause, underlying cause or contribution of snakebite to death internal examination, histology and clinical notes were reviewed from closed cases and included coronial findings, autopsy and police reports.

This project was approved by the University of Melbourne Human Research Ethics Committee (1441602), the NCIS (M0308) and Western Australian Coronial ethics (EC08-14).

3. Results

Males represented 71% (n = 25) of cases and the patients age ranged from 1.5 to 70 years of age (median 46.5) and time from bite to death varied from 1 h to 19 days. Fifty four percent of bites occurred in or around the person's residence (19/35), with 17 occurring within an urban environment considered a Major city or Inner regional area. Seventy four percent (25/34) reached hospitals, with 42% (5/12) transferred to a major city for management. Three patients were found deceased at the scene. Sixty five percent (n = 22) of the fatal bites occurred between the months of October to January, and February to May. Sixty percent of bites occurred after 4pm, with the remainder occurring during daylight between 11 a.m. and 4 p.m. (n = 10). The foot or ankle was bitten in 33% (6/18) of cases, with 47% (9/19) on the hand or finger and in four cases, bite sites could not be identified. Fifteen reports identified seven people were bitten while trying to pick up or kill the snakes.

From January 2000 to December 2016, 35 causes of death (2.2 per year) were ascribed to or antecedent to a bite from a snake (Table 1). Sixteen cases were attributed to snake bite/envenoming as leading directly to death, with examples of other direct causes of death including multiple organ failure (n = 3), intra/cerebral haemorrhage (n = 2), and cerebral hypoxia or anoxia (n = 3), cardiac arrest (n = 1), complications of snake bite (n = 3) or brain stem death (n = 1). Four of the 15 cases did not have a snake bite indicated in the case history with an initial diagnosis of hyperthermia, stroke, gastroenteritis and a horse accident. Of the 32 closed coronial cases, 62% of cases (20/32) stated patients had venom detected either ante or post mortem.

Brown snakes caused 66% (n = 23) of snake bite deaths within the study period. The signs and symptoms of death from Brown snake bites varied, with collapse or unconsciousness (n = 10) and cardiac arrest (n = 7) being the most common presentations, consistent with previous reports. (NCCH, 2014). Of the 14 incidents with case and autopsy reports, seven described evidence of coagulopathy. Three patients were bleeding from the site of the bite, with two demonstrating spontaneous systemic bleeding with bleeding from endotracheal, indwelling catheter and wound sites, as well as mucous membranes. One coronial report described the resolution of coagulopathy after administration of intravenous polyvalent antivenom identified from hospital records. Internal examinations of eight brown snake envenoming deaths identified varied presentations of subarachnoid haemorrhage (n = 2), epicardial petechial haemorrhages (n = 4), sub plural haemorrhages (n = 3) and haemorrhagic/congested lungs (n = 5) (Table 2).

4. Discussion

This is the first review of national Australian data available to researchers, government and policy makers, which indicates that the incidence of death from snake bite that has not varied greatly from previous reports spanning the period 1981 to 1991 (Sutherland, 1992).

Snake bite is management is dependent on knowledge of the regional distribution of snake species, a history of suspected snake bite, the presence of key signs and symptoms and associated biochemical and haematological abnormalities. The snake venom detection kit can be used to support the diagnosis of snake bite (Isbister, 2006; Snake Venom Detection Kit), but the use of this test was limited. The signs and symptoms may be generalised (Healthdirect; Snakebite and Spider bite, 2014) or may demonstrate characteristic coagulopathic, neurotoxic or myotoxic effects or renal impairment (Isbister, 2006). Variations in clinical histories, presenting signs and symptoms, the potential for the variation of the amount of venom injected by the animal (Healthdirect; Snakebite and Spider bite, 2014), the variations of a person's underlying medical conditions and clinical management differences (Improving management, 2013) have been described. It is then not surprising that coronial allocation of causes of death caused by, or antecedent to snake envenoming varied with differences of the time of progression to death. Nevertheless, overall causes of death indicate cardiotoxic and coagulopathic effects are key significant issues. In all cases where a snake was not directly indicated in the clinical history, a delay in diagnosis and treatment was described, identifying the need of snake bite to be reinforced as a diagnosis of exclusion. As more cases are collated over time, ongoing review may identify if there are specific risk factors that predispose people to be more susceptible, with a correlation of envenoming leading to sudden death requiring further review.

Brown snakes (*Pseudonaja* sp) caused the majority of deaths in Australia. This significance may be linked to its widespread distribution and range of habitats. Bites from brown snakes are associated with significant haemorrhage and coagulopathy, as well as multisystem organ impairment and pathophysiological changes (Allen et al., 2012; Isbister, 2006).

The larger representation of males demonstrated is not unusual, and parallels national injury trends of a higher injury rates occurring in males and persons 25 years and above (Bradley, 2008; Welton et al., 2017). Unsurprisingly, incidents occurred in warmer seasons, when ectothermic snakes are most active and injuries were sustained on limbs, further reinforcing the need to encourage people to not pick up snakes and where possible to wear protective clothing if gardening or working on a farm. More surprising was the finding that nearly half of the cases occurred within an urban environment (Welton et al., 2017). Snake bite in Australia is typically regarded as a ‘rural issue’, with more delay to receipt of specialised care assumed to increase the risk of severity and death.