

ORIGINAL RESEARCH

Management of Snakebite and Systemic Envenomation in Rural Ecuador Using the 20-minute Whole Blood Clotting Test

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Objectives.—In low-income countries, snakebites are frequently managed in rural areas in health centers with severely constrained resources. Many healthcare providers in these settings have limited access to the numerous and relatively expensive laboratory studies used to diagnose envenomation. The relatively simple and inexpensive 20-minute whole blood clotting test (WBCT) has been recommended by several international organizations for the diagnosis of certain venomous snakebites. This study proposes to confirm the utility of the WBCT as the sole laboratory diagnostic tool to determine systemic envenomation in hematotoxic snakebite management in severely resource-constrained areas of the world.

Methods.—The authors reviewed all 110 cases of snakebite during a 6-year period in a small hospital in rural Ecuador using the WBCT.

Results.—All cases presented within 24 hours of snakebite. Twenty cases revealed normal coagulation with no clinical evidence of systemic envenomation. Ninety cases had no evidence of clot formation (positive WBCT) at 20 minutes, suggesting systemic envenomation. Of these 90 cases, according to a classification scale, 54 were mild, 26 were moderate, and 10 were severe envenomations requiring transfer to tertiary care. All mild and moderate systemic envenomations were successfully treated at the rural hospital. All severe envenomations were treated initially with antivenom before transfer to tertiary care. One patient with severe envenomation died in tertiary care.

Conclusions.—The WBCT was predictive of the presence or absence of systemic envenomation from snakebite in our region. The WBCT guided the successful management of mild and moderate systemic envenomation, and spared patients with no evidence of systemic envenomation from potential side effects of antivenom.

Key words: snakebite, whole blood clotting test, international health

Introduction

Worldwide it is estimated that every year several million persons are bitten by snakes, with envenomations ranging from 421,000 to 1,841,000 and with as much as 94,000 deaths and even greater permanent disabilities resulting.¹ Snakebite primarily affects frequently marginalized rural populations such as agricultural workers, children, and indigenous peoples, for which it is included on the World

Health Organization's list of neglected tropical diseases.²

This public health problem is greatest in countries in which healthcare systems are oftentimes challenged at many levels to manage snakebite. Furthermore, snakebite's rural predominance is precisely where national healthcare systems are weakest.

In northwest Ecuador, the town of Pedro Vicente Maldonado (PVM), on the western slopes of the Andes at an altitude of 600 m, is the geographic center of a catchment area that ranges in altitude from 200 m (tropical) to 1300 m (subtropical) along the equatorial line. Hospital PVM is a small, 15-bed hospital that serves this area and generally the only hospital that regularly stocks antivenom.

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In northwest Ecuador, *Bothrops asper* (lancehead, equis) and *Lachesis muta* (bushmaster, verrugosa, pudridora) from the Crotalinae (pit viper) subfamily are likely responsible for the majority of severe venomous snakebites.³ The geographic distribution of *Bothrops* ranges from Argentina to Mexico, whereas *Lachesis* spp. are found from Central America to Bolivia and southeastern Brazil.⁴

Bothrops spp. are the most dangerous venomous snakes in Ecuador.⁵ East of the Andes, *Bothrops atrox* is most important.⁶ However, west of the Andes, *B. asper* is the major threat. *Bothrops* is considered highly dangerous for its size (>2 m in length; head size, >9 cm), quantity of venom injected through its long fangs (potentially >2 cm), population density and reproductive capacity, immobility and camouflage during daylight, willingness to bite when disturbed, and frequent association with human dwellings.⁷ *L. muta* are the longest vipers in the world (>3 m), demonstrate typically passive behavior, and hunt nocturnally. Venom from both of these pit vipers displays proteolytic, hemorrhagic, myotoxic, and clotting activity. Complications are described elsewhere, but include coagulopathies resulting in hemorrhage or thrombosis, limb loss, renal failure, shock, and ultimately death (Figure).⁸

In rural tropical and subtropical areas where these species exist, the frequently severely constrained health-care infrastructure is challenged with the task of diagnosing and managing venomous snakebite with limited resources. Conversely, tertiary-care hospitals in large urban areas generally have limited experience with venomous snakebite. The 20-minute whole blood clotting test (WBCT) has been recommended by several institutions for the early diagnosis and management of venomous snakebites in such low-resource settings.⁹

The WBCT is used as a marker to determine systemic toxicity, as incoagulable blood is a telltale sign of systemic envenomation. The test requires 3 to 5 mL of fresh blood from venipuncture placed in a new, clean, dry glass test tube. It is maintained undisturbed at room temperature for 20 minutes, at which time it is tipped to determine whether clotting has occurred. If the specimen clots, the patient is determined not to have suffered a systemic hematotoxic envenomation, and no antivenom is required. Conversely, if the specimen does not clot, the patient is assumed to have systemic hematotoxic envenomation. This study reports on the utility of the WBCT in a rural hospital in a low-income country.

Methods

We retrospectively reviewed all 110 snakebites that presented to Hospital Pedro Vicente Maldonado (HPVM) during a 6-year period from April 2005 to September 2011. This hospital has standardized electronic medical records, simplifying the identification of all snakebite cases using snakebite, intoxication, and snake accident (all in Spanish).

The standardized procedure followed for all possible snake envenomations included a confirmatory history, physical examination, and WBCT at the time of presentation to the emergency department. A positive WBCT (no clot at 20 minutes) was followed with the placement of a peripheral intravenous catheter. Severity was based on a classification scale created by the hospital that combined that of the manufacturer's antivenom prescribing information and a commonly used toxicology textbook in Ecuador, used consistently over the 6-year period (Table 1).^{10,11}



Figure. *Bothrops* spp. envenomation complications: left, necrotic leg secondary to direct necrotic effects of *B. asper* venom 1 week after envenomation; and right, gingival bleeding 4 hours after envenomation (photographs by D. Gaus).

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