TABLE 474-1 MANAGEMENT OF VENOMOUS SNAKEBITE IN THE UNITED STATES AND CANADA[a] (*CONTINUED*)

- If acute adverse reaction to antivenom:
  - Stop infusion.
  - Treat with standard doses of epinephrine (IM or IV; latter route only in setting of severe hypotension), antihistamines (IV), and glucocorticoids (IV).
  - When reaction is controlled, restart antivenom as soon as possible (may further dilute in larger volume of normal saline).
- If any evidence of neurologic dysfunction (e.g., any cranial nerve abnormalities such as ptosis):
  - Trial of acetylcholinesterase inhibitors (see Table 474-2)
  - With any evidence of difficulty swallowing or breathing, proceed with endotracheal intubation and ventilatory support (may be required for days or weeks).
- Update tetanus immunization as needed.
- Prophylactic antibiotics are unnecessary unless prehospital care included incision or mouth suction.
- Admit to hospital (intensive care unit) even if there is no evidence of envenomation; monitor for at least 24 h.

[a]These recommendations are specific to the care of victims of venomous snakebites in the United States and Canada and should not be applied to bites in other regions of the world. [b]At the time of publication, a single lot of antivenom remains, with an extended expiration date of April 30, 2015.

Abbreviations: CBC, complete blood count; FDP, fibrin degradation products; PT/INR/PTT, prothrombin time/international normalized ratio/partial thromboplastin time.

Antivenom should be administered only by the IV route, and the infusion should be started slowly, with the physician at the bedside ready to intervene immediately at the first signs of an acute adverse reaction. In the absence of an adverse reaction, the rate of infusion can be increased gradually until the full starting dose has been administered (over a total period of ~1 h). Further antivenom may be necessary if the patient's acute clinical condition worsens or fails to stabilize or if venom effects that were initially controlled recur. The decision to administer further antivenom to a stabilized patient should be based on clinical evidence of persistent circulation of unbound venom components. For viperid bites, antivenom administration generally should be continued until the victim shows definite improvement (e.g., stabilized vital signs, reduced pain, restored coagulation). Neurotoxicity from elapid bites may be more difficult to reverse with antivenom. Once neurotoxicity is established and endotracheal intubation is required, further doses of antivenom are unlikely to be beneficial. In such cases, the victim must be maintained on mechanical ventilation until recovery, which may take days or weeks.

Adverse reactions to antivenom administration include immediate (nonallergic and, less commonly, allergic anaphylaxis) and delayed-type hypersensitivity reactions (serum sickness). Clinical manifestations of immediate hypersensitivity include urticaria, laryngeal edema, bronchospasm, and hypotension. Skin testing for potential hypersensitivity, although recommended by some antivenom manufacturers, is insensitive and nonspecific and should be omitted. Worldwide, the quality of antivenoms is highly variable. Rates of acute nonallergic anaphylactic reactions to some of these products exceed 50%. For this reason, some authorities have recommended pretreatment with IV antihistamines (e.g., diphenhydramine, 1 mg/kg to a maximum of 100 mg; and cimetidine, 5–10 mg/kg to a maximum of 300 mg) or even a prophylactic SC or IM dose of epinephrine (0.01 mg/kg, up to 0.3 mg). Further research is necessary, however, to determine whether any pretreatment measures are truly beneficial. Modest expansion of the patient's intravascular volume with crystalloids may blunt acute adverse blood pressure decline. Epinephrine and airway equipment should always be immediately available during antivenom infusion. An acute anaphylactic reaction may be heralded by a single hive or mild itching or may present as bronchospasm or acute cardiovascular collapse. If the patient develops an acute reaction to antivenom, the infusion should be temporarily stopped and the reaction immediately treated with IM epinephrine and IV antihistamines and glucocorticoids. Once the reaction has been controlled, if the severity of the envenomation warrants additional antivenom, the dose should be diluted further in isotonic saline and restarted as soon as possible. Rarely, in cases of recalcitrant hypotension, a concomitant IV infusion of epinephrine may be initiated and titrated to clinical effect while antivenom is administered. The patient must be monitored very closely during such therapy, preferably in an intensive care setting. Serum sickness typically develops 1–2 weeks after antivenom administration and may present as fever, chills, urticaria, myalgias, arthralgias, lymphadenopathy, and renal or neurologic dysfunction. Treatment of serum sickness consists of systemic glucocorticoids (e.g., oral prednisone, 1–2 mg/kg daily) until all symptoms have resolved, followed by a taper over 1–2 weeks. Oral antihistamines and analgesics may provide additional relief of symptoms.

Blood products are rarely necessary in the management of an envenomed patient. The venoms of many snake species can deplete coagulation factors and cause a decrease in platelet count or hematocrit. Nevertheless, these components usually rebound within hours after administration of adequate antivenom. If the need for blood products is thought to be great (e.g., a dangerously low platelet count in a hemorrhaging patient), these products should be given only after adequate antivenom administration to avoid fueling ongoing consumptive coagulopathy.

Rhabdomyolysis and hemolysis should be managed in standard fashion. Victims who develop acute renal failure should be evaluated by a nephrologist and referred for hemodialysis or peritoneal dialysis as needed. Such renal failure, which usually is due to acute tubular necrosis, is frequently reversible. If bilateral cortical necrosis occurs, however, the prognosis for renal recovery is less favorable, and long-term dialysis with possible renal transplantation may be necessary.

Acetylcholinesterase inhibitors (e.g., edrophonium and neostigmine) may promote neurologic improvement in patients bitten by snakes with postsynaptic neurotoxins. Snakebite victims with objective evidence of neurologic dysfunction should receive a test dose of acetylcholinesterase inhibitors, as outlined in **Table 474-2**. If they exhibit improvement, additional doses of long-acting neostigmine can be administered as needed. Close monitoring is required to prevent aspiration if repetitive dosing of neostigmine is used in an

TABLE 474-2 USE OF ACETYLCHOLINESTERASE INHIBITORS IN NEUROTOXIC SNAKE ENVENOMATION

1. Patients with clear, objective evidence of neurotoxicity (e.g., ptosis or inability to maintain upward gaze) should receive a test dose of edrophonium (if available) or neostigmine.
   a. Pretreat with atropine: 0.6 mg IV (children, 0.02 mg/kg with a minimum of 0.1 mg)
   b. Treat with:
      Edrophonium: 10 mg IV (children, 0.25 mg/kg)
      or
      Neostigmine: 1.5–2.0 mg IM (children, 0.025–0.08 mg/kg)
2. If objective improvement is evident after 5 min, treat with:
   a. Neostigmine: 0.5 mg IV or SC (children, 0.01 mg/kg) every 30 min as needed
   b. Atropine: 0.6 mg IV continuous infusion over 8 h (children, 0.02 mg/kg over 8 h)
3. Closely monitor the airway and perform endotracheal intubation as needed.