Chapter 98
Approach to Snake Bite in the ICU

98.1 Introduction

Snake bites are a significant public health concern, particularly in tropical and subtropical regions, leading to substantial morbidity and mortality worldwide. The incidence of snake bites varies globally, with higher rates in rural and agricultural communities where humans and venomous snakes frequently interact. Certain regions have specific risk factors; for example, kraits often bite individuals during nocturnal settings, while viper and cobra bites are more common during agricultural activities. The demographics most affected are often those engaged in farming, herding, and other outdoor occupations, with children and young adults being particularly vulnerable [1].

Effective management of snake bites in the intensive care unit (ICU) requires a systematic approach that includes rapid assessment, stabilization, identification of envenomation syndromes, appropriate use of antivenom, and comprehensive supportive care. This chapter outlines the critical steps in managing snake bite patients in the ICU, emphasizing evidence-based practices and addressing challenges unique to different settings. [Ref: Algorithm 98.1].

98.2 First Aid Measures and Barriers to Treatment

First aid measures play a crucial role in the outcome of snake bite victims. Immediate and appropriate actions can significantly reduce morbidity and mortality.

Key Recommendations

- Avoid Harmful Traditional Practices:
- Do not perform incisions, suction, or apply tourniquets to the bite site.

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- These methods are ineffective in preventing venom spread and can cause additional harm, such as ischemia, necrosis, and increased risk of infection.
- Immobilization and Reassurance:
- Immobilize the affected limb with a splint and keep it at heart level to slow venom absorption.
- Reassure the patient to reduce anxiety and prevent increased circulation.
- Rapid Transport:
- Prioritize prompt transportation to the nearest healthcare facility equipped to manage snake bites.
- Delays in receiving antivenom can worsen outcomes.

Barriers to Treatment

- Transportation Challenges:
- Rural areas may lack adequate transportation, leading to delays in reaching medical care.
- Cost of Treatment:
- The expense of antivenom and ICU care can be prohibitive, discouraging timely medical intervention.
- Cultural Beliefs:
- Traditional healers and beliefs may lead patients to seek ineffective remedies instead of medical care.

Rationale
Educating communities about effective first aid measures and addressing barriers to treatment are essential components in improving snake bite outcomes. Avoiding harmful practices and ensuring rapid access to antivenom can significantly reduce mortality and morbidity.

98.3 Identification and Syndromic Approach

Accurate identification of the snake species is often challenging and sometimes impossible. Therefore, a syndromic approach focusing on clinical manifestations is crucial in managing snake bite envenomation.

Key Points

- Focus on Clinical Symptoms:
- Base management decisions on the patient's presenting signs and symptoms rather than relying solely on snake identification.
- Envenomation Syndromes:
- Neurotoxic Syndrome: Characterized by ptosis, diplopia, dysphagia, respiratory distress, and paralysis.
- Hemotoxic Syndrome: Presents with coagulopathy, spontaneous bleeding, hematuria, and hypotension.

- Cytotoxic Syndrome: Involves severe local tissue damage, swelling, blistering, and necrosis.

Rationale
A syndromic approach allows for timely and appropriate treatment, especially in regions where multiple venomous species coexist, and snake identification is unreliable.

98.4 History and Symptoms

Key Steps

- Confirm Occurrence and Timing:
- Determine the exact time of the bite to predict symptom evolution.
- Assess for Systemic Symptoms:
- Neurotoxic Signs: Ptosis, dysphagia, respiratory distress, and muscle weakness.
- Hemotoxic Signs: Bleeding tendencies, hematuria, hypotension, and bruising.
- Examine Bite Site:
- Look for local reactions such as swelling, erythema, blistering, and fang marks.

Rationale
Early identification of symptoms guides the urgency of interventions. Differentiating between systemic and local effects is critical for triaging and prioritizing treatment.

98.5 Laboratory Tests

Key Investigations

- Complete Blood Count (CBC):
- Check for anemia, leukocytosis, and platelet counts.
- Coagulation Profile:

20-Minute Whole Blood Clotting Test (20WBCT).

The 20-Minute Whole Blood Clotting Test (20WBCT) is a simple, rapid, and practical bedside test used to assess coagulopathy in patients suspected of hemotoxic snake envenomation, particularly in resource-limited settings. It is instrumental in detecting venom-induced consumption coagulopathy, which is common with bites from certain snake species like vipers.

Purpose

- Assess Coagulation Status:
- Detects the presence of coagulopathy caused by hemotoxic venoms that disrupt normal blood clotting mechanisms.

- Guide Antivenom Administration:
- A positive test indicates the need for antivenom therapy and helps in monitoring the effectiveness of treatment.

Procedure

1. Sample Collection:
   - Draw approximately 2 mL of fresh venous blood from the patient using standard phlebotomy techniques.
2. Use of Clean, Dry Glass Tube:
   - Place the blood into a new, clean, and dry glass test tube without any anticoagulant additives.
   - Important: Do not use plastic tubes, as they may interfere with clot formation due to their surface properties.
3. Undisturbed Clotting:
   - Leave the tube undisturbed at room temperature for 20 minutes.
   - Do not shake, stir, or move the tube during this period.
4. Assessment:
   - After 20 minutes, gently tilt the tube to check for clot formation.
   - Observe whether the blood has clotted or remains liquid.

Interpretation

- Normal Result (Negative Test):
- Clotted Blood: The blood has formed a solid clot that stays in place when the tube is tilted.
- Implication: Normal coagulation function; no significant hemotoxic envenomation affecting clotting.
- Abnormal Result (Positive Test):
- Unclotted Blood: The blood remains liquid and does not clot after 20 minutes.
- Implication: Presence of coagulopathy due to venom-induced defibrination; significant hemotoxic envenomation.

Clinical Significance

- Indicator for Antivenom Therapy:
- A positive 20WBCT is a strong indication for the administration of antivenom in patients bitten by snakes known to cause hemotoxic effects.
- Monitoring Treatment Efficacy:
- Repeating the test after antivenom administration can help assess the reversal of coagulopathy.
- Early Detection of Bleeding Risks:
- Identifies patients at risk of severe bleeding complications, allowing for timely supportive interventions.

Limitations and Considerations

- Standardization:
- Ensure strict adherence to the standardized procedure to avoid false results.
- Variations in blood volume, tube type, or timing can affect accuracy.
- Equipment:
- Use only clean, dry glass tubes; moisture or contaminants can interfere with clotting.
- Avoid using tubes previously exposed to anticoagulants.
- Temperature Factors:
- Perform the test at room temperature; extreme temperatures may alter clotting times.
- Not Comprehensive:
- The test detects gross coagulopathy but may not identify all coagulation abnormalities.
- Additional laboratory tests (e.g., PT, aPTT, fibrinogen levels) may be necessary for a comprehensive assessment.
- Patient Factors:
- Severe anemia, hypofibrinogenemia from other causes, or anticoagulant medications can influence results.

Advantages

- Simplicity and Accessibility:
- Requires minimal equipment and can be performed at the bedside.
- Ideal for use in rural or resource-poor settings where laboratory facilities are unavailable.
- Rapid Results:
- Provides timely information to guide immediate clinical decisions.

Rationale in Snake Bite Management

- Early Intervention:
- Facilitates prompt administration of antivenom and other supportive measures.
- Improved Outcomes:
- Reduces the risk of severe hemorrhagic complications and enhances patient recovery.
- Cost-Effective:
- Minimizes the need for more expensive and time-consuming laboratory tests in urgent situations.

Precautions

- Technique Accuracy:
- Ensure proper sample collection and handling to avoid contamination or activation of clotting pathways.
- Interpretation Caution:

- Be aware of potential false positives or negatives due to technical errors or patient-specific factors.
- Repeat Testing:
- If initial results are inconclusive, consider repeating the test to confirm findings.

Prothrombin Time (PT), Activated Partial Thromboplastin Time (aPTT)

- For detailed coagulation assessment.
- Renal Function Tests:
- Serum creatinine, blood urea nitrogen (BUN), electrolytes to detect acute kidney injury.
- Venom Antigen Detection Tests:
- Innovative diagnostic tools that help identify specific venom and guide antivenom selection.
- Electrolytes and Blood Gases:
- Identify metabolic disturbances.
- Imaging Studies:
- Ultrasound or MRI if compartment syndrome is suspected.

Rationale
Laboratory evaluation confirms the extent of systemic involvement, including coagulopathy and renal injury. Advanced diagnostics like venom antigen detection can enhance targeted treatment, while standardized bedside tests are crucial in resource-limited settings.

98.6 Local Wound Care and Compartment Syndrome Management

Local Wound Care

- Key Steps:
- Clean the Bite Area:
- Use antiseptics to reduce infection risk.
- Monitor for Signs of Infection:
- Redness, warmth, pus, or increased pain.
- Avoid Harmful Interventions:
- Do not apply ice, chemicals, or herbal remedies to the bite site.

Compartment Syndrome Management

- Identification:
- Signs and Symptoms:
- Severe pain out of proportion to injury, swelling, decreased distal pulses, paresthesia, and decreased motor function.
- Diagnosis:

- Use imaging modalities like ultrasound or MRI to assess muscle compartment pressures.
- Management:
- Immediate Medical Attention:
- Elevate the limb and remove any constrictive dressings or jewelry.
- Surgical Intervention:
- Fasciotomy may be required to relieve pressure and prevent tissue necrosis.

Rationale
Effective local wound care minimizes the risk of infection and tissue damage. Early identification and management of compartment syndrome are critical to prevent permanent disability.

98.7 Classification of Envenomation

Severity Levels

- No Envenomation:
- No local or systemic signs.
- Mild Envenomation:
- Local swelling confined to the bite site.
- Moderate Envenomation:
- Swelling extending beyond the bite site, mild systemic symptoms (e.g., nausea, mild hypotension).
- Severe Envenomation:
- Rapidly progressing swelling, severe systemic toxicity:
- Neurotoxicity: Respiratory paralysis, cranial nerve deficits.
- Hemotoxicity: Spontaneous bleeding, disseminated intravascular coagulation (DIC), shock.
- Cytotoxicity: Extensive local tissue necrosis.

Rationale
This classification directs antivenom administration and supportive measures. Severity grading ensures judicious use of resources and appropriate allocation of care.

98.8 Antivenom Use and Administration Guidelines

Indications

- Presence of Systemic Signs:
- Neurotoxic symptoms, coagulopathy, or significant hemodynamic instability.
- Progressive Local Symptoms:

- Rapidly spreading swelling, severe pain, or signs of compartment syndrome.

Dosage Considerations

- Standard Dosage:
- Mild Envenomation: Five vials.
- Moderate Envenomation: Five to ten vials.
- Severe Envenomation: Ten vials or more.
- Adjustments Based on Patient Factors:
- Body Weight:
- Dosage may be adjusted in pediatric patients.
- Pregnancy:
- Antivenom is safe and should not be withheld; dosage remains the same.
- Late Administration:
- Diminishing Efficacy Window:
- Antivenom is most effective when given within the first few hours after the bite.
- Efficacy decreases with time but should still be administered if signs of envenomation are present.

Administration

- Preparation:
- Dilute antivenom in 100–500 mL of normal saline.
- Infusion:
- Infuse over one hour.
- In severe cases, consider faster infusion under close monitoring.
- Monitoring for Adverse Reactions:
- Early Reactions:
- Anaphylaxis, urticaria, and bronchospasm.
- Management of Reactions:
- Stop the infusion temporarily.
- Administer antihistamines, corticosteroids, or epinephrine as needed.
- Restart the infusion at a slower rate once symptoms are controlled.

Rationale
Antivenom is the definitive treatment for neutralizing venom effects. Proper dosage and careful administration reduce the risk of adverse reactions while ensuring effective treatment.

98.9 Supportive Management

Multisystem Effects and Critical Complications

- Neurotoxic Envenomation:
- Interventions:
- Administer neostigmine and atropine to reverse neurotoxic effects.

Atropine 0.6 mg followed by neostigmine 1.5 mg to be given IV stat followed by neostigmine 0.5 mg with atropine every 30 minutes for five doses. Dose to be tapered at 1 hour, 2 hours, 6 hours, and 12 hours. The response is measured by recovery of ptosis. Positive response is defined as 50% or more recovery of ptosis in 1 hour. If there is no response after third dose, atropine neostigmine should be stopped.

- Provide ventilatory support in cases of respiratory paralysis.
- ICU Monitoring:
- Continuous respiratory and neurological monitoring.
- Hemotoxic Envenomation:
- Interventions:
- Transfuse blood products for bleeding or coagulopathy.
- Monitor for signs of DIC and treat accordingly.
- ICU Monitoring:
- Regular coagulation profile assessments.
- Acute Kidney Injury:
- Interventions:
- Maintain adequate hydration.
- Use diuretics cautiously.
- Initiate renal replacement therapy (dialysis) if indicated.
- ICU Monitoring:
- Monitor urine output, electrolytes, and renal function tests.
- Cardiovascular Support:
- Interventions:
- Manage hypotension with fluids and vasopressors as needed.
- ICU Monitoring:
- Continuous hemodynamic monitoring.

Rationale

Venom effects can lead to critical complications affecting multiple organ systems. Comprehensive supportive management addresses these complications, improving patient outcomes beyond what antivenom can achieve alone.

98.10 Rehabilitation and Long-Term Care

Key Components

- Physical Therapy:
- Restore function and mobility in affected limbs.
- Exercises to prevent contractures and muscle wasting.
- Psychological Support:
- Counseling to address trauma, anxiety, or depression resulting from the snake bite experience.
- Prosthetics and Assistive Devices:

- For patients with permanent disabilities or amputations.
- Follow-Up Care:
- Regular medical evaluations to monitor recovery and address ongoing complications.

Rationale
Rehabilitation services are essential for improving quality of life in snake bite victims who suffer long-term disabilities. Psychological support aids in coping with the emotional impact of the incident.

98.11 Preventive Strategies and Education

Public Health Initiatives

- Education Programs:
- Community education on snake bite prevention, first aid measures, and the importance of seeking medical care.
- Risk Reduction Strategies:
- Encourage the use of protective clothing and footwear during high-risk activities.
- Promote safe storage of food to prevent attracting snakes.
- Healthcare Infrastructure:
- Equip rural health centers with essential supplies, such as antivenom.
- Train healthcare workers in snake bite management.
- Collaboration with Traditional Healers:
- Engage local healers to encourage timely referral to medical facilities.

Rationale
Preventive strategies and education can significantly reduce the incidence of snake bites and improve early management, leading to better outcomes.

98.12 Monitoring and Reevaluation

Key Steps

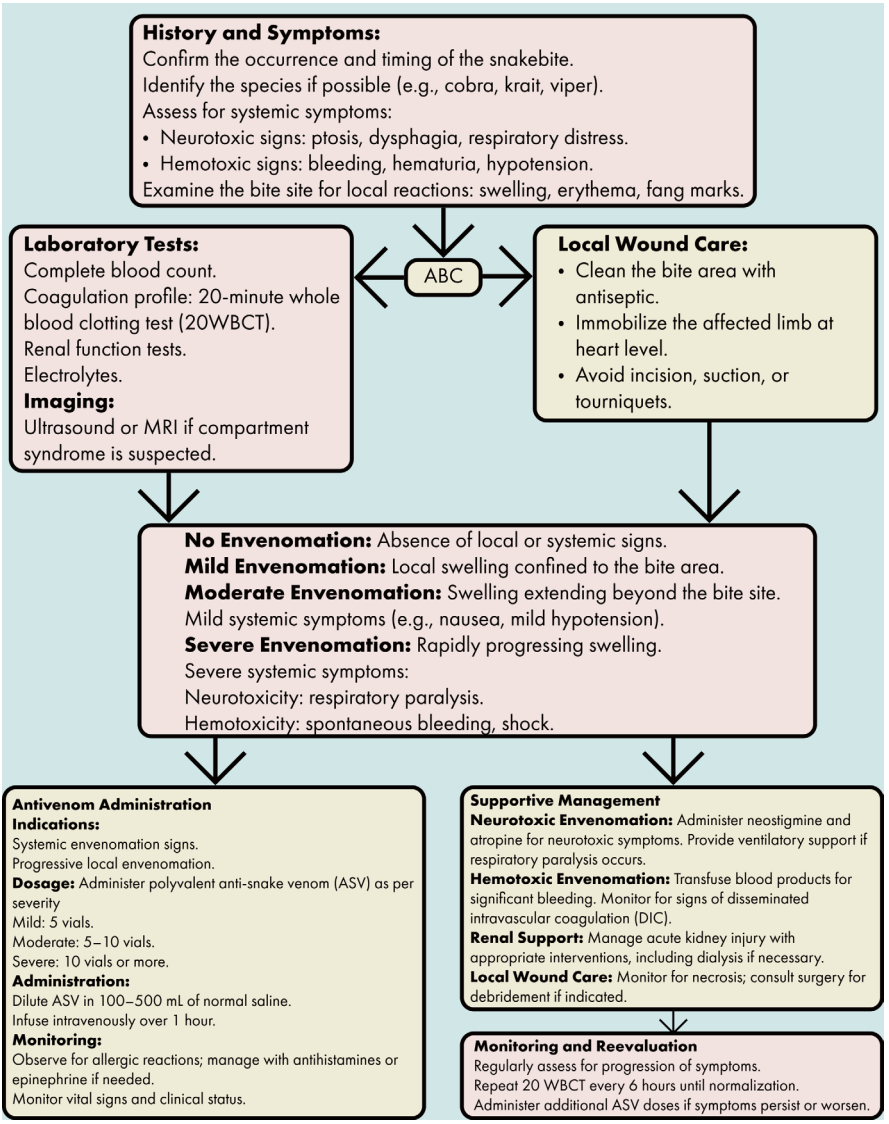
- Regular Reassessment:
- Monitor vital signs, neurological status, and local wound progression.
- Laboratory Monitoring:
- Repeat 20WBCT every 6 hours until normalization.
- Monitor renal function, electrolytes, and coagulation profiles.
- Antivenom Doses:
- Administer additional antivenom if symptoms persist or worsen.
- Documentation:
- Maintain detailed records of clinical findings, interventions, and patient responses.

Rationale
Continuous monitoring ensures timely adjustments to the treatment plan. Regular reevaluation allows for early detection of complications and effectiveness of interventions.

98.13 Conclusion

Managing snake bites in the ICU demands a comprehensive, multidisciplinary approach that includes prompt first aid, accurate assessment, appropriate antivenom administration, and extensive supportive care. Addressing barriers to treatment and incorporating preventive strategies are essential for improving outcomes. By adhering to evidence-based protocols and emphasizing both acute management and long-term rehabilitation, healthcare providers can significantly reduce the morbidity and mortality associated with snake bites.

Algorithm 98.1: Approach to snake bite in the ICU



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